Diabetes Among Children (DAC)
Project - Exploring Opportunities with Support from Mobile Applications in a Cross Cultural Indo-Swedish Study

Jenny Lundberg[1], Soniya Billore[2] and Clara Axelsson[3]
[1]*Department of Mediatechnology, Linnaeus University, PG Vejdes väg, Växjö, Sweden*
[2]*Department of Marketing, Linnaeus University, PG Vejdes väg, Växjö, Sweden*
[3]*eHealth Institute, Linnaeus University, Bredbandet, Kalmar, Sweden*

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Abstract: In this paper we present opportunities and challenges to meet the worldwide challenge of diabetes. Diabetes has devastating long-term complications that cause very great personal suffering and social costs locally and globally. The prevalence of diabetes is increasing globally as an epidemic and affects 415 million people today, which is expected to increase to 642 million in 2040. In this paper we explore possibilities to join in Indo-Swedish R&D collaboration. We present and motivate the research purpose. Furthermore we present a research framework for mobile application development between Sweden and India. The scientific framework is elaborated and this paper ends with specific challenges and further work.

1 INTRODUCTION

According to the International Diabetes Federation (2015), 415 million in the world have got diabetes and it is estimated that by 2040, 642 million will be diagnosed with diabetes. Probably no other condition constitutes a challenge to the patient as diabetic, as glucose levels is dependent on the content of each meal, and the physical activity before and after that time, all the time, and every day. Level of emotional stress also affects sugar levels via the hypothalamic-pituitary-adrenals (HPA) cortisol-producing systems (Melin, 2015). Too little insulin is a threat in the long term, due to the risk of complications, and too much can lead to serious symptoms, mental and physical impact, in the worst cases, coma or death within minutes-hours. Patients should preferably combine information on food intake, especially the amount of carbohydrates, and previously scheduled and physical activity, and the current stress level, to calculate the optimal dose of insulin before each meal, several times per day.

Diabetes has two main types. In type 1 patients are dependent on insulin injections several times a day, to survive; in type 2 are many dependent on insulin for control, and to minimize the risk of complications (Forbes, 2016) (Thunander et al., 2012). Diabetes means risk of death in the short term, if not cared for, and the high risk of long term complications such as macrovascular (myocardial infarction, heart failure, stroke and peripheral arterial insufficiency, if not heal foot ulcers and amputations) and microvascular (retinopathy / blindness, kidney failure with dialysis or transplantation, and nerve problems).

Diabetes puts high demands on the individual when it comes to individual care, and in the case of children it puts higher demands on the family and especially the parents. Complications can occur and it is commonly known that this creates difficult health conditions and high social costs. Potentially this can be handled with support from not only medical science but also the latest developments in mobile devices and sensor technology. The measurements obtained from the close interaction of the mobile applications with the patients, here the children, and the consequent big data can be used to handle some of the issues in this area. Given that diabetes in children is a growing concern all across the world, this pilot project aims to look at the development and use of mobile applications designed specifically for them. As part of the background motivation for this study a focus group was conducted in India among paediatricians and diabetologists to inquire about the knowledge and usage of mobile applications for Diabetes. It was observed that the doctors were aware

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of such applications on a global level but these were not used commonly by the diabetic children in India. Also it was not an established practice yet for the doctors to recommend any mobile application to the parents or the children to support their lifestyle in dealing with this challenge.

2 BACKGROUND

In this background we present the situation related to diabetes from the two countries specific perspectives. This presented within the three subsections India, Sweden and motivation for the Indo-Swedish research study.

2.1 India

The presence of Diabetes among children is a growing concern in India. According to a recent report (The Times of India, 2014) there are almost 70,000 cases of children with Type I and nearly 40,000 cases with type 2 diabetes. Obesity and the fast food fad is a common factor coupled with the fact that nearly 68% of urban children do not engage in regular exercise (type 2). Praveen and Tandon (2016) discuss the incidences of type II diabetes among children in India and underline that obesity is the leading cause of the situation. It is also of concern that parents, caretakers and schools emphasise the need for a healthy lifestyle among the children so that type II incidences can be curbed and brought under control. One of the possible influencers could be the digital support systems such as mobile technologies. Forbes, 2016 reports that the mobile penetration is India has reached nearly a billion subscribers and the market has the third largest smartphone users in the world. This opens immense opportunities for using the mobile technology for health related benefits. The first diabetes app named Diabeto was launched only recently in 2015. This application connects to glucometers of 30 different types and helps to keep track of the sugar levels, insulin levels including Bolus and Basal. Further it keeps the data stored in the cloud and presents visual representations of the patient's data for further, more efficient diabetes management. There is growing awareness about this application for Diabetes management in India and there is also growing interest among health and technology entrepreneurs to develop more applications for Diabetes.

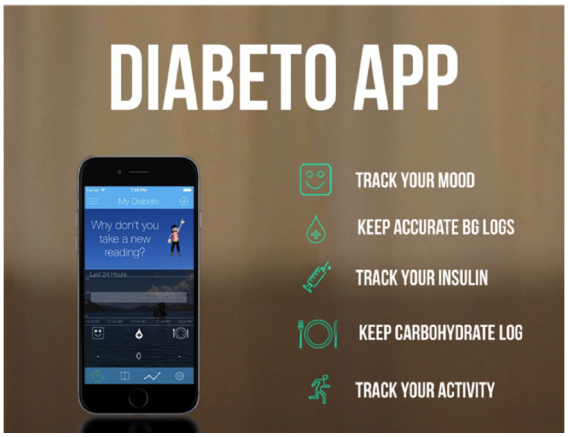

Figure 1: The Diabeto application. Photo credit: www.startupexplore.com.

Figure 2: The synchronisation of the app with the glucometer. Photo credit: http://www.medgadget.com/2015/01/diabeto-to-sync-glucometers-with-smartphones-video.html.

In the next section, the situation related to diabetes in Sweden is presented.

2.2 Sweden

Sweden has the second highest presence of diabetes among children in the world approximately 7-8000 individuals and 800 are diagnosed every year. But there are some popularly used applications such as Triabetes, a CE marked medical software (iTunes, Triabetes). Research, development & innovation related to diabetes are ongoing and mature enough with rich data material to do further analysis on. Different quality assurance systems where devices related to diabetes are included exists. CE markings (Läkemedelsverket, 2016) and other initiatives as for example Diabetesappar.se are a collection of apps related to diabetes developed in cooperation with the Swedish health care professionals and Swedish application providers to facilitate and improve everyday life for patients and healthcare. Modeling of

diabetes (Marmarelis and Mitis, 2014) are considered in essence in regular technical issue, with glucose - insulin regulations. Furthermore, there are national approaches towards open quality assured databases such as the National Diabetes Registry, NDR with a specific open registry for children, Swediabkids. In the pictures below, figure 2, an example of a diabetes kit for children in Sweden is presented. Furthermore, continuous monitoring (CGM) like for example the automatic insulin pumps are examples of additional products in use.

Figure 3: Example of children's "diabetes kit" in Sweden. Photo credit: Jenny Lundberg.

2.3 Motivation for the Indo-Swedish Study of the DAC Project

For children and adolescents diagnosed with diabetes lifelong lifestyle changes are inevitable to ensure quality of life. Dietary regulations, sound exercise and monitoring as well as medication need to be obtained regularly every day (Barndiabetesfonden, 2016). This is an immense task for the young and their family who all need to be highly motivated to succeed long term. Cafazzo et al., 2012 have shown that motivation for self-monitoring can increase with the help of specialised mobile applications.

It is believed that the experience of healthcare and researchers Sweden could be used to explore the use of similar applications for the diabetic children in India. An Indo-Swedish cross cultural study of the lifestyles of diabetes among children can provide sufficient data and enable a higher level of generalization that can be translated to create more efficient and open mobile applications for the young generation.

3 RESEARCH PURPOSE

This research will conduct the following exploratory steps to have a deeper insight of the situation regarding e-initiatives and specifically mobile applications for Diabetes among children.

1. Explore the possibilities for designing e-initiatives with a study of the child patients and the level of adjustments and adaptations needed to deal with Diabetes as a health condition
2. Explore the personal needs of the patients in order to obtain a personalized and microscopic look to their needs and wants for the e-initiative
3. Utilise information portals and big data sources to study the possibilities of building an interactive mobile based empowerment platform for virtual coordination
4. Design mobile based solutions to empower and assist the children and their parents to deal with the presence of this diagnose.
5. Connect the results of the above to health industry entrepreneurs for mobile app. creation and development. This includes connecting Swedish entrepreneurs to the ones in India so that collaborative efforts on technology and user needs can be optimally utilised for creating market specific mobile applications.

4 SCIENTIFIC FRAMEWORK

As seen from the framework, the research attempts to explore in depth the situation of the children suffering from Diabetes type I and II in the countries of Sweden and India. The research will be done for mainly 2 aspect, A: the lifestyle of the children and the requirements that the children have given their health condition. By requirements it can mean a number of parameters such as access to health and medical advice, infrastructure support in terms of access to sports and other facilities that can help keep their body healthy and active, emotional support from families and friends, and access to other children who suffer from the same health situation through a network or group either online or otherwise where they and their families could meet and support each other. The other parameter is B: systems that support diabetes management in children such as the quality of awareness regarding the condition among the families, schools and local society and the relationship between them and the local health care units. Also this will explore the technological support that children have access to as they themselves want

to know more of their health condition and how best they could manage it. For example , the use of mobile applications that can be used to bring the knowledge , awareness and management of the diabetes related health situation closer to the children suffering from it as well as making the platform user friendly.

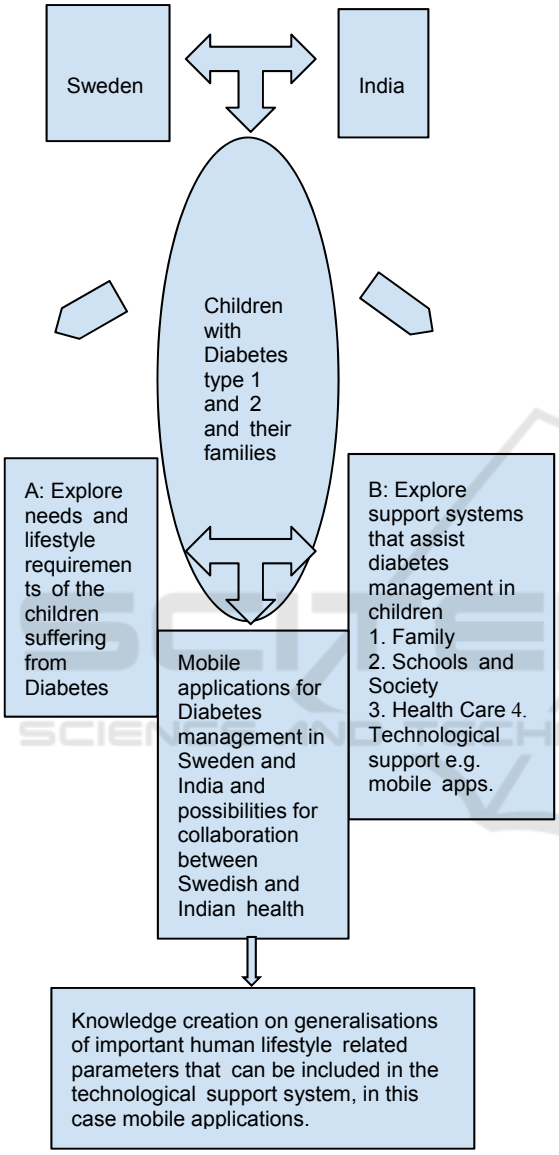

Figure 4: Research framework for mobile application development between Sweden and India.

It is known by our initial secondary research on the topic that Sweden has been using a number of mobile applications for Diabetes management but the situation is not the same for India. It will be interesting to further see how the applications in Sweden are customised to children patients if any.

By knowing the situation for parameters A and B described above we can have a list of factors that need to be tested against the presently available applications and explore the possibility of including new ones in them. Further on, the research will take the next step of bringing these observations to the world of entrepreneurship by building a link between the mobile app developers in the health industry of Sweden and India. It is believed that since Sweden and India have increasing number of diabetes affected children in very varied social and cultural settings, the knowledge created through the study will help generalise some important human and disease related elements that could be used on a wider context for Diabetes management among children on a global level.

5 SPECIFIC OPPORTUNITIES AND CHALLENGES

Novel technology with sensors / actuators, Internet of Things (IoT), micro sensors and open socio-technical systems, e.g. Internet-of-Things have unique opportunities to produce scientific data on e.g. diabetic patient's situation occurred. From here, and directly from the electronic medical record can be models based on real data and large data sets over time be developed and on contributing to a more secure basis for informed decisions in everyday life, such as about insulin doses, for patients and caregivers. The second area of this project concerns the so-called Big Data management. Much information is available today in the electronic medical record, but not available. Output data must be retrieved by experts in analysis departments, in e.g. Excel. Basic facilities required, for example. standard reports, for everyday recurring purposes. Most diabetic patients are and will be in developing countries, with type 2 diabetes, with more sophisticated technology the so-called artificial pancreas will not be an option, but there techniques that can be used with smart phones are more accessible. A combination with the automatic biological data, as pulse rate, as visualized in parallel with glucose levels and insulin doses, would provide additional information, e.g. about symptoms associated with hypoglycaemic events. Hypoglycaemia is still the biggest obstacle to achieving ideal blood glucose control, incl. fear of hypoglycaemia. Many factors influence the outcome of doses of insulin in diabetes, such as age, sex, duration of diabetes, type of insulin used (short- and

long-acting types), the patient's body composition, physical activity, why automatic data collection via a "bio-bracelet", which such as Smart Band, and practical visualization of these complex tasks, and their interactions, both can be helpful for patients and their advisers or assistants in clinical settings, and provide information to be analysed at the graduate level, can provide new information that can be converted into new clinical counselling. Analyses of data for glucose levels and insulin doses with details of HbA1c levels, over time, longitudinally, can provide both new insights into the relationship between glucose variability (i.e., frequency and amplitude of the high and low values) and the level of HbA1c (and over time relation to the development of diabetic complications), and in the patterns of glucose levels, frequency of episodes of hypoglycaemia, relationships actually taken insulin doses, etc. are not available today, and not for larger groups of real patients outside of clinical trials, and put them in the with bias (s) involved. The complex situation of diabetes care is a major global challenge (Guariguata et al., 2014) and is a good example of the area where the development and utilization of techniques to facilitate better target fulfilment can spread easily benefit both individuals and society (Sundström, 2016), (Hu et al., 2015), (Lundberg, et al., 2015), (Eriksén, 2015).

6 FUTURE WORK

Collaboration between different expert domains are of interest to battle the challenges related to diabetes. Closer collaboration between stakeholders, with care institutions and related partners for a healthy lifestyle among children are desired.

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