ISDS

ABSTRACT

Exploring illness prediction in type 1 diabetes mellitus pre-symptom onset

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Objective
To develop an illness prediction model that can predict illness in type 1 diabetes mellitus (T1DM) patients before onset of symptoms, using the patient's observable parameters.

Introduction
Illnesses like infections, cold, influenza and so on in type 1 diabetes mellitus (T1DM) patients, can compromise the daily patient administered diabetes treatment. This in turn may result in fluctuating blood glucose concentrations, especially hyperglycemia for prolonged periods, which over time can cause serious late complications.[1,2] The illness prediction project at Tromsø Telemedicine Laboratory aims to construct a prediction model that, through use of patient observable parameters, for example, blood glucose, insulin injections and body temperature, can significantly identify risk of developing illnesses, before onset of symptoms and before illness onset.

Such a model could potentially enable T1DM patients to fight the illnesses, and prepare for an adequate change in the T1DM-management earlier on.

Methods
By collecting the patient's monitored data concerning the health and illness of T1DM patients, the project group is working towards a classification of a patient's health into three stages: 'healthy', 'in risk of developing illness' and 'ill, with presence of symptoms'. To obtain this data, a Smartphone application was developed, intended for monitoring diabetes treatment (blood glucose concentrations, insulin injections, food intake and physical activity) and general health status (symptoms of illness) for T1DM patients. The application was based on a newer iteration of the Few Touch Application by Årsand *et al.*,[3] but modified to address T1DM patients and additionally collect symptom data. The application was tested initially by two T1DM patients with connection to the project and subsequently refined, in order to prepare the application for use in a large field study.

Results
The results of the initial user study of two T1DM patients showed that the developed application was usable for collecting diabetes and health related parameters and that the users did register symptoms. Although they did not consider the application difficult to use, the users expressed a wish for more predefined parameters to choose from, instead of manually symptom input via text. These findings, along with minor issues have been fixed and the application symptom input features is being expanded to include the following symptoms: headache, abdominal pain, sore throat, joint/muscle pain, presence of fever, degree of fever, presence of cold, feeling weak, illness, influenza and free text input for other observations.

The project group will conduct a study in Seattle in autumn 2010, two studies in Norway 2010–2011 and a study in Denmark 2011. Utilizing the refined application, the project group hopes to achieve the following from these studies:

(1) Provide T1DM patients with a system that offers assistance in the daily patient administered diabetes management, including an overview of current treatment and health situation. (2) Produce data sets for analysis, as input to the development of the illness prediction model. (3) Produce a model that can significantly predict illness in the individual T1DM patients, using available information and patient measurable parameters. (4) Implementing the prediction model in the application and conduct a field study, to assess the patient usefulness of the model.

Conclusions
Developing a model for predicting illness in T1DM patients, before onset of symptoms, may help patients avoid illness and hyperglycemias. To develop a model, user studies centered on data gathering must be conducted to determine if it is possible to uniquely classify a patient as being 'healthy', 'in risk of developing illness' or 'ill, with presence

of symptoms' at a given time. Such studies are being prepared and will be conducted in near future.

Acknowledgements

References

1 Vinik AI, Vinik E. Preventions of the complications of Diabetes. *Am J Manag Care* 2003;**9** (3 Suppl): S63–80.
2 Deshpande AD, Harris-Hayes M, Schootman M. Epidemiology of diabetes and diabetes-related complications. *Phys Ther* 2008;**88:**1254–64.
3 Årsand E, Tatara N, Østengen G, Hartvigsen G. Mobile-phone-basen self-management tools for type 2 diabetes—the few touch application. *J Diabetes Sci Technol* 2010;**4:**328–36.