50 Methods for Decision Support in Diabetes Care

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In this project a data-driven approach for the decision support in diabetes care using artificial neural networks based on data collected by the patient during normal blood glucose self-monitoring was investigated. The focus was on insulin dependent diabetes mellitus (IDDM).

Diabetes is a major chronic disease that affects a growing number of people in the western industrialized countries. Recently, it has been shown that maintaining the blood glucose level as close to normal as possible has a dramatic effect in reducing the risk of long-term complications. As a major share of diabetes related health care costs is directed to the care of complications, improved blood glucose control would not only lead to improved quality of life for the patients and but potentially to substantial health care cost savings. Because of the complexity of the treatment required to maintain such benefical blood glucose levels, information technology offers a number of possibilities in supporting diabetes care.

As a part of the research a categorization of different approaches in decision support based on their applicability was proposed. The most potential areas of decision support where information technology could be applied were identified as first, the development of patient specific models for prediction of the blood glucose response for any given treatment and second, the analysis of collected self-monitoring data for therapy assessment. Neural network methods were futher developed on both these areas.

To build a model of an individual patient's glucose metabolism based on the measurement data for blood glucose level prediction a two-level approach was developed. Missing blood glucose values were estimated using gaussian mixture models and Expectation-Maximization (EM) algorithm. Multiply completed data sets were then used to train a committee of feed-forward neural networks. The prediction performance was evaluated using cross-validation. Evaluation results of the approach using a preliminary model and self-monitoring blood glucose data are promising.

As an application of retrospective data analysis, the Self-Organizing Map (SOM) was used for the clustering of daily therapy responses to find groups with similar blood glucose profiles, constituting a novel approach in diabetes data analysis. The SOM was found to be a particularly suitable method for forming the clustering as it is reliable, it can deal with missing values and produces ordered results. The method was again demonstrated on real patient data. In the tests, the formed groups showed clear and clinically interesting differences in all patients. Further, it seems that factors affecting the BG response, such as day-of-the-week and exercise, can be linked to the formed groups. The method could be applied to facilitate therapy analysis and discussion between patient and physician.

References

[1] Mäkipää, M. Neurocomputing methods in diabetes decision support. Master's Thesis, Helsinki University of Technology, Finland. December 1996.