

ABSTRACT

The thesis is presented in 73 pages. It contains 2 appendixes and bibliography of 39 references. 22 figures and 9 tables are given in the thesis.

Topic relevance. Diabetes mellitus is a chronic disease that requires constant care and supervision on the side of the patient to prevent possible complications and reduce risks of long-term complications. According to the International Diabetes Federation (IDF), worldwide there are more than 415 million people with diabetes. Hypoglycemia is a pressing problem for people with type 1 diabetes (that is, those whose body is unable to produce insulin). According to statistics, type 1 diabetes have an average of two attacks of symptomatic hypoglycemia each week and one attack of severe hypoglycemia once a year.

Nocturnal hypoglycemia prediction in patients is required to prevent drops in plasma glucose level below normal level at night. When glucose level drops below normal, functioning of the body is disrupted, which can lead to death. The creation of methods for predicting nocturnal hypoglycemia is an important task, as a result of the resolution of which could reduce the risks of life in patients with diabetes.

Thesis connection to scientific programs, plans, and topics. The thesis was prepared according to the scientific research plan of the Applied Mathematics Department of the National Technical University of Ukraine “Kyiv Polytechnic Institute.”

Research goal and objectives. The goal of this thesis is to develop mathematical methods for predicting nocturnal hypoglycemia at night to prevent attacks of hypoglycemia in patients with type 1 diabetes.

To accomplish this goal, the following objectives were reached:

- develop a method of selection of the key values from glucose level time series;
- analyze existing mathematical prediction methods;
- systematize existing mathematical methods for predicting nocturnal hypoglycemia in patients with diabetes first type;

- select and adapt methods based on machine learning to solve the problem of predicting nocturnal hypoglycemia;
- create software that implements the selected machine learning methods;
- conduct experimental research of created software for clinical data of patients with diabetes first type.

Object of research is mathematical methods for prediction of nocturnal hypoglycemia for patients with type 1 diabetes

Subject of research is research and development of mathematical method of predicting nocturnal episodes of hypoglycemia in patients with type 1 diabetes mellitus based on physiological and demographic data using machine learning techniques.

Methods of research. To solve the task, the following methods were used: machine learning methods (for the development of methods for solving the problem of predicting nocturnal hypoglycemia in patients with diabetes first type); methods of the theory of algorithms and programming (for implementing the developed algorithms); methods of probability theory and mathematical statistics (for carrying out experiments).

Scientific contribution consists of the following:

- for the first time used demographic data and time measurements of blood glucose values, along with blood glucose to build forecast, unlike existing methods which use only the value of blood glucose;
- developed a method of selection the key values of blood glucose readings from time series, which were gained from CGM device;
- improved methods of predicting nocturnal hypoglycemia in patients with type 1 diabetes and obtained better results than existing techniques.

Practical value of obtained results. The method by which the key values of blood glucose from CGM readings can be selected when no additional information available regarding treatment regimens and timing of meals, which reduces CGM's time series to data available from patients who use fingerstick measurements. The methods of predicting nocturnal hypoglycemia in patients with type 1 diabetes based on machine learning

techniques, which yield better results than existing techniques. The effect of demographic data on the results of prediction.

Approbation of the thesis results. Basic ideas and results of the research were presented at the 18-th International Conference SAIT 2016 (2016) and the VII Conference of Young Scientists PMK 2016 (2016).

Publications. Thesis results are published in three scientific works:

- VII Conference of Young Scientists 2016 PMK. Abstracts "Prediction night hypoglycemia in patients with type 1 diabetes using decision trees";
- VII Conference of Young Scientists 2016 PMK. Thesis "Methods of predicting night hypoglycemia in patients with type 1 diabetes mellitus using neural networks";
- 18th International Conference SAIT 2016. Abstracts "Selection of the key values of CGM readings for predicting night hypoglycemia in patients with type 1 diabetes mellitus".

Keywords: nocturnal hypoglycemia, machine learning methods, predicting, type 1 diabetes, predicting glicemia based on fingerstick measurements.

