

Automated Screen for Excessive Glycemic Variability Using Continuous Glucose Monitoring Data

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Objective:

There is a growing awareness that not all risks for diabetes complications are adequately assessed by hemoglobin A1c (HbA1c) alone. In particular, excessive glycemic variability, which contributes to oxidative stress linked to long-term vascular diabetic complications, is not detected by HbA1c. This study aims to provide an automated screen for excessive glycemic variability that could be routinely applied to continuous glucose monitoring (CGM) data. An automated test that routinely assesses glycemic variability could augment HbA1c as a clinical measure of overall glucose control.

Method:

Four hundred daily CGM plots, for nine patients with type 1 diabetes on insulin pump therapy, were rated by two physicians as exhibiting excessive glycemic variability or not. The 262 plots with agreed upon ratings were used as input to three machine learning (ML) algorithms: naïve Bayes, multilayer perceptron, and support vector machine. *In silico* experiments were run using each ML algorithm with either raw or smoothed CGM data and different combinations of 11 descriptive input features. Ten-fold cross validation was used to evaluate the performance of each developed classifier.

Result:

The best automated classifier matched physician ratings 93.8% of the time, with a sensitivity of 86.6%, specificity of 96.6%, and area under the receiver operating characteristic curve of 0.95. This was a multilayer perceptron using smoothed CGM data and the following features: distance traveled, roundness ratio, direction codes, mean amplitude of glycemic excursion, and standard deviation.

Conclusion:

A ML classifier, using CGM data, could potentially be used to routinely screen patients for excessive glycemic variability. Greater accuracy could be achieved by training ML algorithms on additional CGM plots rated by multiple diabetes specialists.