

Glucose Prediction Algorithms from Continuous Monitoring Data: Assessment of Accuracy via Continuous Glucose Error-Grid Analysis

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Abstract

Aim:

The aim of this article was to use continuous glucose error-grid analysis (CG-EGA) to assess the accuracy of two time-series modeling methodologies recently developed to predict glucose levels ahead of time using continuous glucose monitoring (CGM) data.

Methods:

We considered subcutaneous time series of glucose concentration monitored every 3 minutes for 48 hours by the minimally invasive CGM sensor Glucoday[®] (Menarini Diagnostics, Florence, Italy) in 28 type 1 diabetic volunteers. Two prediction algorithms, based on first-order polynomial and autoregressive (AR) models, respectively, were considered with prediction horizons of 30 and 45 minutes and forgetting factors (ff) of 0.2, 0.5, and 0.8. CG-EGA was used on the predicted profiles to assess their point and dynamic accuracies using original CGM profiles as reference.

Results:

Continuous glucose error-grid analysis showed that the accuracy of both prediction algorithms is overall very good and that their performance is similar from a clinical point of view. However, the AR model seems preferable for hypoglycemia prevention. CG-EGA also suggests that, irrespective of the time-series model, the use of ff = 0.8 yields the highest accurate readings in all glucose ranges.

Conclusions:

For the first time, CG-EGA is proposed as a tool to assess clinically relevant performance of a prediction method separately at hypoglycemia, euglycemia, and hyperglycemia. In particular, we have shown that CG-EGA can be helpful in comparing different prediction algorithms, as well as in optimizing their parameters.

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Abbreviations: (BG) blood glucose, (CG-EGA) continuous glucose error-grid analysis, (CGM) continuous glucose monitoring, (ff) forgetting factor, (P-EGA) point-error grid analysis, (PH) prediction horizon, (R-EGA) rate-error grid analysis

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