New Metrics for Glucose Variability Using Continuous Glucose Monitoring Data

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Objective:
Glycemic variability contributes to oxidative stress, which has been linked to long-term complications of diabetes. Hemoglobin A1c (HbA1c), routinely used to measure sustained hyperglycemia, correlates with complication risk but does not adequately reflect fluctuations in blood glucose levels. Mean amplitude of glycemic variability (MAGE) correlates with serum 1,5-anhydroglucitol (AG) level, which reflects postprandial glucose excursions, but these measures are not routinely used in practice. This study aims to provide new metrics that can be routinely applied to continuous glucose monitoring (CGM) data to determine quality of glycemic control.

Method:
Nine of 28 patients with type 1 diabetes on insulin pump therapy have completed a 90-day protocol in an ongoing study. Patients provide CGM data, which is scored each day for MAGE and three new metrics: total daily fluctuation, or "distance traveled;" number of fluctuations >75 mg/dl that leave the normal range; and excessive variability, as determined by a naive Bayes classifier trained on physician ratings of daily CGM plots. Measurements are aggregated for the first and last two weeks of each patient's participation in the study and compared to initial and final serum AG levels.

Result:
Preliminary results suggest that the change in excessive variability as measured by the naïve Bayes classifier varies with the change in serum AG level and agrees with clinician appraisal better than the change in MAGE.

Conclusion:
New metrics providing an assessment of overall glycemic control quality could potentially be incorporated with CGM software to augment HbA1c for routine patient screening and to aid in evaluating the effects of treatment. Additional work to validate and refine these metrics is underway.