

A Novel New Glycemic Variability Metric

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Abstract

The pathogenesis of the long-term complications of diabetes involves multiple mechanisms including formation of advanced glycosylation end products and oxidative stress. Although chronic hyperglycemia is most strongly linked to these pathways, glycemic variability also contributes to oxidative stress. HbA1c scores routinely measure sustained hyperglycemia and correlate strongly with complication risk. However, HbA1c does not adequately reflect the upward and downward glucose fluctuations described as glycemic variability. Mean amplitude of glycemic excursion (MAGE) is most commonly used to assess glycemic variability. MAGE correlates with Urinary 8-SO-PGF2 alpha Excretion Rates (measure of oxidative stress) and serum AG=1,5-anhydroglucitol levels (measure of post prandial glucose levels). Metrics like MAGE, however, are not routinely used in practice. This research proposes a new glycemic variability metric, which may aid in evaluating the effects of treatment.

An ongoing 3-month study of 28 patients with type 1 diabetes aims to provide new metrics that can automatically quantify variability in CGMS data. Two new aspects of variability were tracked: total daily fluctuation, or "distance traveled," and number of daily fluctuations >75 mg/dl that leave the normal range. Daily CGMS data was analyzed by computer, scored for MAGE, distance traveled, and number of fluctuations. Physicians were asked to rate variability. A naive Bayes classifier was built to input the 3 variability scores and output a rating comparable to those of the physicians. The number of excessively variable days in 2 weeks indicates quality of glycemic control.

In preliminary testing, physicians rated 100 days of CGMS data twice. Physicians were consistent in 82% of their ratings, and when consistent, agreed with each other 91% of the time. The naive Bayes classifier matched consistent, agreed upon ratings 85% of the time. The 2 week trends agreed with clinician appraisals better than changes in MAGE. Comparison of pre- and post intervention serum AG=1,5-anhydroglucitol levels are under study. The new metric could potentially be added to CGMS software to facilitate assessment of overall glycemic control quality and the effects of treatment intervention.