Importance of Blood Glucose Meter and Carbohydrate Estimation Accuracy

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Abstract

Background:

The clinical significance of blood glucose meter (BGM) error in the presence of increasing carbohydrate errors in diabetes patients who use both the BGM result and the carbohydrate estimation to dose insulin is unknown.

Methods:

This Monte Carlo simulation modeled diabetes patients who calculate insulin dosages based on BGM results and carbohydrate estimations. It evaluated the likelihood of on-target insulin dosing and clinically significant insulin dose errors based on data from five BGMs with different levels of performance (expressed as bias and imprecision [coefficient of variation (%CV)]) and increasing levels of carbohydrate estimation errors. The study was performed across three separate preprandial glucose (PPG) ranges (90–150, 150–270, and 270–450 mg/dl).

Results:

When carbohydrate estimation is accurate (%CV = 0%), the likelihood for on-target insulin doses ranged 50.1–98.5%. The likelihood depended on BGM performance and PPG range. In the presence of carbohydrate estimation errors (%CV = 5–20%), the likelihood of on-target insulin dosages markedly decreased (range, 27.2–80.1%) for all BGMs, the likelihood of insulin underdosing (range, 0–12.8%) and overdosing (range, 0–32.3%) increased, and the influence of BGM error on insulin dosing accuracy was blunted. Even in the presence of carbohydrate error, the BGM with the best performance (bias 1.35% and %CV = 4.84) had the highest probability for on-target insulin dosages.

Conclusions:

Both BGM and carbohydrate estimation error contribute to insulin dosing inaccuracies. The BGM with the best performance was associated with the most on-target insulin dosages.

J Diabetes Sci Technol 2012;6(4):921-926

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Abbreviations: (%CV) coefficient of variation, (BGM) blood glucose meter, (I:C) insulin-to-carbohydrate ratio, (ISO) International Organization for Standardization, (IU) unit of insulin, (PPG) preprandial glucose, (SD) standard deviation, (SMBG) self-monitoring of blood glucose

Keywords: blood glucose monitoring, carbohydrate counting, in silico modeling, postprandial glucose, preprandial glucose

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