

## Hypoglycemia Impairs Quality of Blood Glucose Simulation in a Clinical Decision Support System

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### Abstract

#### **Background:**

Clinical decision support systems allow for decisions based on blood glucose simulations. The DiasNet simulation tool is based on accepted principles of physiology and simulates blood glucose concentrations accurately in type 1 diabetes mellitus (T1DM) patients during periods without hypoglycemia, but deviations appear after hypoglycemia, possibly because of the long-term glucose counter-regulation to hypoglycemia. The purpose of this study was to evaluate the impact of hypoglycemia on blood glucose simulations.

#### **Method:**

Continuous glucose monitoring (CGM) data and diary data (meals, insulin, self-monitored blood glucose) were collected for 2 to 5 days from 17 T1DM patients with poor glycemic control. Hypoglycemic episodes [CGM glucose <63 mg/dl (3.5 mmol/liter) for  $\geq 20$  min] were identified in valid (well-calibrated) CGM data. For 24 hours after each hypoglycemic episode, a simulated (DiasNet) glucose profile was compared to the CGM glucose.

#### **Results:**

A total of 52 episodes of hypoglycemia were identified in valid data. All subjects had at least one hypoglycemic episode. Ten episodes of hypoglycemia from nine subjects were eligible for analysis. The CGM glucose was significantly ( $p < .05$ ) higher than simulated blood glucose for a period of 13 h, beginning 8 h after hypoglycemia onset.

#### **Conclusions:**

The present data show that hypoglycemia introduces substantial and systematic simulation errors for up to 24 h after hypoglycemia. This underlines the need for further evaluation of mechanisms behind this putative long-term glucose counter-regulation to hypoglycemia. When using blood glucose simulations in decision support systems, the results indicate that simulations for several hours following a hypoglycemic event may underestimate glucose levels by 100 mg/dl (5.6 mmol/liter) or more.

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**Abbreviations:** (CGM) continuous glucose monitoring, (SMBG) self-monitored blood glucose, (T1DM) type 1 diabetes mellitus

**Keywords:** clinical decision support systems, continuous glucose sensors, hypoglycemia, physiopathology, type 1 diabetes mellitus

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