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ORIGINAL ARTICLES

# Contribution of an Intrinsic Lag of Continuous Glucose Monitoring Systems to Differences in Measured and Actual Glucose Concentrations Changing at Variable Rates *in Vitro*

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## Abstract

***Background:***

Current continuous glucose monitoring (CGM) systems measure glucose levels in the interstitial fluid to estimate blood glucose concentration. A lag time has been observed between CGM system glucose readings and blood glucose levels when glucose levels are changing. Although this lag has been attributed to the time it takes glucose to equilibrate between blood and interstitial fluid compartments, it is unclear to what extent these inaccuracies reflect an intrinsic delay of the device itself.

***Methods:***

Four Guardian® REAL-Time CGM systems (CGMSs) (Medtronic Diabetes, Minimed, CA) and eight glucose sensors were tested in glucose solutions prepared in Krebs bicarbonate buffers at 37 °C. Glucose readings obtained from CGMSs were compared with actual glucose concentrations during controlled changes in glucose concentration performed at four rates (30, 90, and 220 mg/dl/hr$^{-1}$ and an instantaneous change of 110 mg/dl) using a linear gradient maker.

***Results:***

Irrespective of the rate and direction of changes in glucose concentration, the readings obtained from CGMSs were significantly different from actual glucose levels. The faster the rise or fall in actual glucose concentration, the more pronounced the mismatch with CGMS glucose readings. Furthermore, the intrinsic lag times (8.3 to 40.1 min) were high enough to account for the lags reported in previous *in vivo* studies.

***Conclusions:***

The lag intrinsic of the CGMS may make a significant contribution to the mismatch between CGM system readings and blood glucose concentrations.

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**Abbreviations:** (CGM) continuous glucose monitoring, (CGMS) MimiMed Guardian® REAL-Time continuous glucose monitoring system, (RT) REAL-Time, (SD) standard deviation

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