

A Semilogarithmic Scale for Glucose Provides a Balanced View of Hyperglycemia and Hypoglycemia

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Abstract

Objective:

It would be desirable to improve the ability of physicians and patients to identify hypoglycemic episodes when viewing displays of glucose by date, time of day, or day of the week.

Research Design and Methods:

A logarithmic scale is utilized for display of glucose versus date and time of day using a range of 40 to 400 mg/dl. Several plausible alternatives are considered for transformation of the glucose data.

Result:

Use of a semilogarithmic plot triples the percentage of the vertical axis allocated to hypoglycemia (e.g., 40–80 mg/dl) from 10% to 30.1% while compressing the hyperglycemic region. The log scale improves the symmetry of the glucose distribution. Transformations were evaluated corresponding to the Schlichtkrull M_{100} value, the high blood glucose index/low blood glucose index of Kovatchev and associates, an index of glycemic control developed by the present author, and the GRADE score of Hill and coworkers. Results are similar for all four transformations. This approach is applicable both to self-monitoring of blood glucose (SMBG) and continuous glucose monitoring (CGM). Based on preliminary results, it is proposed that the log transform could potentially facilitate analysis of glucose patterns and may facilitate rapid and consistent detection and appreciation of the severity and consistency of hypoglycemic episodes, even in the presence of complex overlapping patterns commonly observed in both SMBG and CGM glucose profiles.

Conclusion:

Display of glucose on a logarithmic scale can potentially improve the accuracy of analysis and interpretation of popular methods for graphic display of glucose values. Device manufacturers should consider including options for semilogarithmic display of glucose on SMBG meters, CGM sensors, and software for retrospective analyses of glucose data.

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Abbreviations: (CGM) continuous glucose monitoring, (CSII) continuous subcutaneous insulin infusion, (HBGI) high blood glucose index, (IGC) index of glycemic control, (LBGI) low blood glucose index, (LLTR) lower limit of the target range, (SMBG) self-monitoring of blood glucose, (ULTR) upper limit of the target range

Keywords: clinical, continuous glucose monitoring, glycemic variability, hyperglycemia, hypoglycemia, quality of glycemic control, self-monitoring of blood glucose, statistical analysis, type 1 diabetes, type 2 diabetes

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