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Glycemia Risk Index (GRI) - A Granular Metric Beyond TIR in CGM: A Commentary

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Abstract: Time in Range (TIR) has become a cornerstone in CGM-based diabetes management. However, it does not fully capture the risks associated with glycemic variability or the severity of hypo-and hyperglycemia. The Glycemia Risk Index (GRI) has emerged as a promising complementary metric. This review explores the limitations of TIR, the rationale for GRI, and the role of composite glycemic metrics in enhancing clinical decision-making.

Keywords: Time in Range, Glycemia Risk Index, continuous glucose monitoring, glycemic variability, diabetes management

1. Introduction

Continuous glucose monitoring (CGM) has revolutionized diabetes care by providing real-time and retrospective data on glycemic patterns. Among various CGM-derived metrics, Time in Range (TIR), defined as the percentage of time a patient spends with glucose levels between 70 and 180 mg/dL, has gained widespread acceptance. The 2019 international consensus endorsed TIR as a standard target in diabetes management due to its correlation with HbA1c and complication risk [1]. However, TIR alone may not sufficiently reflect the risk associated with glycemic extremes or variability, leading to interest in additional, composite metrics like the Glycemia Risk Index (GRI).

2. Strengths and Limitations of Time in Range

TIR is intuitive, easy to interpret, and has shown a strong inverse relationship with microvascular complications [2]. It allows patients and providers to visualize progress and make timely treatment decisions. However, TIR does not differentiate between time spent slightly above or far beyond the target range, nor does it account for the duration or severity of hypoglycemia. Two patients with identical TIRs may have very different risk profiles due to differences in variability or time spent at extreme glucose levels.



Figure 1: CGM profiles from two patients with 70% TIR: one with stable glucose, another with large excursions.

3. Glycemia Risk Index: Concept and Calculation

The GRI is a composite metric that quantifies glycemic risk by weighting glucose values according to their associated health risk. Developed by Kovatchev and colleagues [3], GRI combines the Low Blood Glucose Index (LBGI) and High Blood Glucose Index (HBGI) into a single score. It is calculated using a transformation of glucose values into risk scores, reflecting both the frequency and severity of hypo-and hyperglycemia.

Unlike TIR, which is a simple percentage, GRI provides a more nuanced assessment of overall glycemic burden. Higher GRI scores are associated with increased risk of adverse events and poor glycemic control.

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4. Clinical Validation and Use of GRI

Several studies have validated the utility of GRI in capturing glycemic risk across diverse patient populations. Kovatchev et al. demonstrated that GRI could stratify patients more effectively than TIR in terms of glycemic stability and risk of complications [3]. Moreover, GRI is sensitive to changes in glucose variability, making it a useful tool in evaluating the efficacy of therapeutic interventions, especially in patients using hybrid closed-loop systems.

GRI has also been proposed for use in CGM-based quality assessments and clinical trials as a primary or secondary outcome. Its ability to distinguish between patients with similar TIR but different glucose profiles make it particularly valuable in advanced diabetes management.

5. GRI and Future Directions in CGM Metrics

The integration of GRI into CGM software platforms could enhance clinical utility by offering a more complete risk profile. Currently, most platforms focus on TIR, glucose management indicator (GMI), and coefficient of variation (CV). Including GRI could refine patient stratification and therapeutic decision-making, particularly in individuals with high glycemic variability. Additionally, composite metrics like GRI may inform algorithm design in automated insulin delivery systems and provide endpoints for evaluating digital health interventions.

6. Conclusion

While Time in Range remains a valuable and accessible metric, it does not capture the full spectrum of glycemic risk. The Glycemia Risk Index offers a complementary perspective by integrating the severity and frequency of glycemic excursions. Future directions in diabetes care may benefit from incorporating GRI alongside traditional metrics to optimize treatment strategies and improve outcomes.

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