

Turning sensors into predictors: The power of slope to anticipate hyper-and hypoglycemia

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Abstract-

Continuous glucose monitoring (CGM) is often interpreted using static thresholds, yet glycemic risk is inherently dynamic. Here, we test whether moving from purely level-based evaluation to a simple calculation enriched with the most recent glucose slope (rate of change) produces meaningful and interpretable gains in predicting near-future glycemic trajectories. We analyzed CGM recordings from 16 adults in the BIG IDEAs Lab Glycemic Variability, and wearable device dataset to (i) forecast future glucose values and (ii) classify impending hyperglycemia (180 mg dl⁻¹) and hypoglycemia (70 mg dl⁻¹). Using multiple historical window lengths and prediction horizons, we trained regression models that emphasize compact, physiologically grounded predictors—particularly current glucose and temporal-slope features. For short prediction horizons (<60 min), performance was extremely high (accuracy >99.5%, recall >97%), with predictions driven primarily by current glucose level and immediate slope. As horizons increased, performance declined gradually but remained strong, with models increasingly drawing on earlier glucose values and slope patterns consistent with diurnal structure. Across all scenarios, slope vectors consistently ranked among the most informative predictors. Overall, these results show that glycemic dynamics and risk can be predicted accurately using a small, interpretable feature set that explicitly incorporates biomarker velocity. This empirically supports the clinical relevance of glucose rate-of-change and motivates the integration of slope-based analytics into wearable decision-support for real-time monitoring.

Index Terms- glucose, hypoglycemia, hyperglycemia, prediction, forecasting, interpretability

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