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

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Abstract-

Objective:To show that moving from a purely level-based evaluation to a simple calculation enriched with the most recent slope (rate of change) yields meaningful, interpretable predictive gains for glycemic trajectories beyond static thresholds, based on continuous glucose monitoring (CGM) data.
Approach: We analyzed CGM data from 16 adults in the BIG IDEAs Lab Glycemic Variability and Wearable Device dataset to forecast future glucose levels and classify hyperglycemia (≥180 mg/dL) and hypoglycemia (≤70 mg/dL). Using varying historical windows and prediction horizons, we trained regression (Lasso, Linear, Random Forest) and classification (Random Forest) models. We focused on interpretable predictors, especially current glucose and temporal slope features.
Main results: For short-term predictions (<60 minutes), models achieved very high performance (accuracy >99.5%, recall >97%), driven mainly by the current glucose value and immediate slope. Performance declined gradually at longer horizons but remained strong; models leveraged earlier glucose values and slopes to capture diurnal patterns. Across all scenarios, slope vectors consistently ranked among the most informative predictors.
Significance: Glucose dynamics and glycemic risk can be predicted accurately using a compact, physiologically grounded feature set that includes slope vectors. These findings empirically support the clinical relevance of biomarker velocity and motivate integrating slope-based analytics into wearables for real-time monitoring and decision-support.

Index Terms-

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