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DECISION-AWARE INSULIN THERAPY: A 360-VARIABLE, 21-LAYER DECISION MANIFOLD FOR CAPTURING MOMENT-OF-ACTION CLINICAL REASONING

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Background and Aims

Continuous glucose monitoring (CGM) generates dense physiological datasets but captures metabolic outcomes rather than the reasoning processes underlying insulin dosing decisions. Key contextual factors—including hypoglycemia risk perception, cognitive load, environmental constraints, and behavioral strategy—remain unstructured and invisible to clinical analysis and machine-learning systems. As a result, current diabetes technologies model glucose trajectories while leaving the moment of clinical action—the decision itself—unobserved. We developed a decision-aware annotation architecture to convert contextual reasoning during insulin therapy into structured data and evaluated whether decision-layer annotation reveals behavioral patterns not detectable in physiological datasets alone.

Methods

A structured annotation framework integrated CGM measurements and insulin dosing events with 360 contextual variables organized into a 21-layer decision manifold spanning physiological state, cognitive load, environmental context, and behavioral intent. Variables were recorded through real-time annotation synchronized to the Moment-of-Action (MoA)—the precise point of insulin dosing—to capture pre-action reasoning. The framework was applied to a 60-day longitudinal dataset of CGM measurements paired with insulin dosing events

Results

Decision-aware annotation identified reproducible behavioral patterns not detectable from glucose trajectories alone, including delayed corrections following recent hypoglycemia, under-correction during elevated cognitive load, and environment-dependent dosing adjustments.

Conclusions

Capturing contextual reasoning at the moment of insulin dosing reveals behavioral signals underlying insulin therapy that remain invisible in physiological datasets alone and may support development of decision-aware datasets for diabetes care.

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