ACEREVERS 1: Development of an Artificial Prototype Biosensor System for Identification and Treatment of Diabetic Ketoacidosis (DKA)

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Type-1 Diabetes (T1D) affects around 1.6 million (CDC). Diabetic Ketoacidosis (DKA) accounts for almost 56-74% of T1D-induced mortality. During the past decade, DKA-admission rates have increased exponentially with a third of hospitalizations resulting in multiple readmissions within the year of initial treatment. Statistics indicate many of these visits are unplanned, emergent, and critically severe. The DKA Prototype Project : ACEREVERS-1 (a latin for “acid turning”) is designed to provide immediate, responsive treatment to ketoacidotic effects caused by cellular inability to ingest glucose by utilizing electronics-based bioengineering and chemical techniques. The project created a prototype consisting of a Ketoacidotic receptor able to conduct a current in an acidic solution simulating the blood conditions during DKA. The prototype's ability to run the circuit during such a condition by activating a peristaltic pump that transfers an electrolytic solution consisting of NaHCO3 and insulin into the system containing one of a major ketone bodies, 3-hydroxybutryate, mixed with acetic-acid. By adjusting the potentiometers to specific resistances that allow ACEREVERS-1 to recognize and inhibit the circuit at neutral pH of 7.0-7.4, the pump can transfer the bicarbonate/insulin until the acidic effects are neutralized. Futuristic improvement checkpoints include adding a heat-resistant casing, cooling measures to offset overheating of the MOSFET, minimizing the circuit and sensor into a series of non-invasive microarrays simulating other pancreatic functions such as infusion of glucagon and/or somatostatin based on the blood conditions needing only a few microliter blood to diagnose and prevent DKA induced fatality or severe hypoglycemia.

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