The GlycoCharge: A Translational Spectrophotometric Apparatus for Noninvasive Glucose Monitoring in Type II Diabetics Using Correlated Electrolyte Concentrations

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Over 462 million individuals suffer from Type II Diabetes worldwide. However, current glucose monitors are painful, costly, and unsustainable. This project establishes a novel, non-invasive monitor that uses the spectrophotometric detection of glucose biomarkers (potassium, sodium, and phosphate) to estimate blood sugar through the finger at wavelengths of 400-800 nm. This uniquely deviates from other spectroscopic monitors that measure glucose directly, requiring inaccessible equipment emitting wavelengths exceeding 1000 nm. Our previous research encompassed 250+ experiments involving the induction of varying levels of diabetes in an invertebrate model, extraction of hemolytic fluid (blood equivalent), and the development of a novel prediction model effectively correlating potassium, sodium, and phosphate to glucose ($R^2 > 0.9$ for all three electrolytes). This translational model was integrated into the GlycoCharge, a novel prototype. It consists of three distinct LEDs to measure the absorbances of each of the electrolytes (766.5nm, 595nm, and 470nm), a potential fourth LED to measure path length (650nm) as used in Beer's Law, an Arduino microcontroller, and a photodiode to measure transmittance. To verify the prototype glucose output, 100 trials were conducted by comparing readings from a medically verified glucometer to the GlycoCharge device. Residual graphs and error charts yielded $p > 0.001$, indicating that the error associated with the GlycoCharge had no influence from outside factors and that there was a significant increase in accuracy when detecting lower glucose levels. Comparatively, a majority of current glucometers fail to measure lower extremes of glucose concentrations. The overall error for the device is 4.57%, on par with current standards.

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