KNOW LABS

A New Machine Learning Model and Expanded Dataset for a Non-Invasive BGM

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BACKGROUND & AIM

Continuous glucose monitoring is essential in diabetes management, but global adoption is hindered due to economic costs and discomfort. A non-invasive, cost-effective, and highly accurate continuous glucose monitor (CGM) would support the patient population and increase adoption. This study evaluates the accuracy of a multi-frequency RF sensor for non-invasive blood glucose (BG) monitoring in people with prediabetes and Type 2 diabetes using venous blood as a reference.

METHODS

- The study employed a novel RF sensor that rapidly sweeps frequencies from 500 MHz to 1500 MHz.
- Participants' forearms were scanned for up to three hours during an Oral Glucose Tolerance Test (75g).
- From 22 participants, 1,430 venous blood samples were collected using a peripheral intravenous catheter (PIVC) every five minutes and analyzed using a blood glucose monitoring test system (StatStrip, Nova Biomedical) as reference values.
- Using the RF data, a CatBoost machine learning (ML) model was trained on 80% of these values (1,143 paired values) to estimate BG as a dependent variable. This model was applied to the remaining 20%, held-out test dataset (287 paired values) and a Mean Absolute Relative Difference (MARD) was calculated.

RESULTS

The CatBoost model returned an overall MARD of 11.8% ± 1.5% on the test dataset. We observed similar accuracy in normoglycemic (12.1% ± 1.8%) and hyperglycemic ranges (11.0% ± 2.3%). Notably, 100% of estimates fell in Risk Grade A or B in a Surveillance Error Grid analysis of model accuracy.

Glucose Range (mg/dL)	n	MARD(%)	± 15%	± 20%
Hypoglycemic (<70)	1	5.5 ± nan	100.0 ± 0.0	100.0 ± 0.0
Normoglycemic (70-180)	226	12.1 ± 1.8	77.9 ± 0.5	85.4 ± 0.5
Hyperglycemic (>180)	60	11.0 ± 2.3	76.7 ± 1.1	85.0 ± 0.9
Total	287	11.8 ± 1.5	77.7 ± 0.5	85.4 ± 0.4

Table 1: MARD values and percentages falling within 15% and 20% of the reference value by glycemic status. Error values on the MARD give the 95% *t*-Confidence interval. Error bars on the ±15% and ±20% give the 95% *z*-Confidence interval for proportions.

CONCLUSION

The ML techniques applied to data collected by this RF sensor hold promise for the non-invasive measurement of BG. Ongoing studies will include expanding the participant population and continuing model refinement.

Figure 1: Surveillance Error Grid analysis comparing 287 Know Labs' RF sensor BG estimations in the test dataset to the venous blood reference.

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Disclosure of Conflicts of Interest: DK and VS are consultants for and own stock in Know Labs. JA, KC, CB, and FK are employed by and have stock options in Know Labs.

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