

Post-meal Glucose Patterns as Early Predictors of Gestational Diabetes

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Presenter Disclosure

Employee: Abbott Diabetes Care

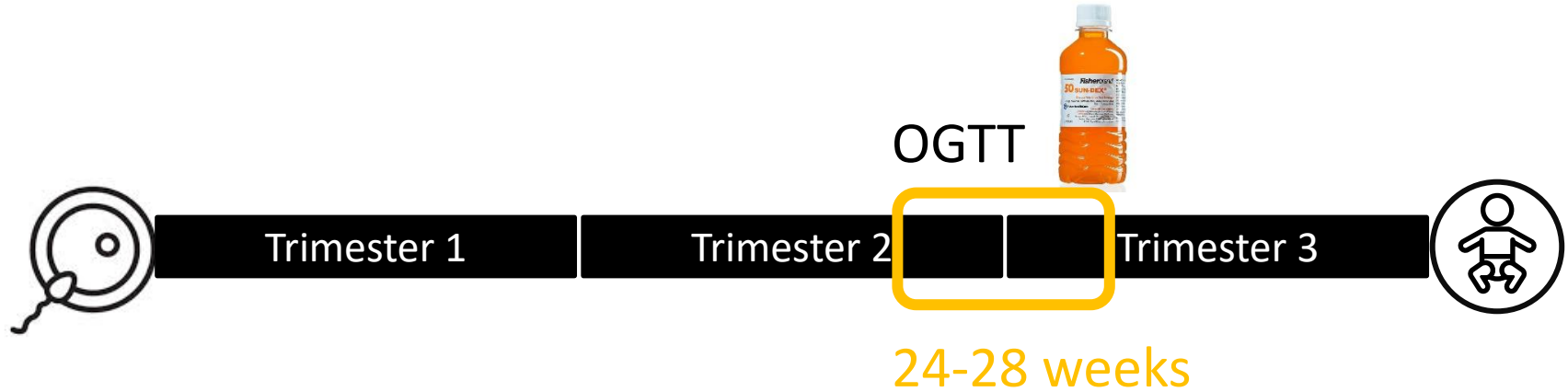
Research Support:

- Abbott Diabetes Care supported this study.
- MAGIC study was funded by Medical Research Council (MRC reference MR/T001828/1).
- The source of the part of this data is the GLAM Study, but the analyses, content, and conclusions presented herein are solely the responsibility of the authors and have not been reviewed or approved by the GLAM Study Leadership.

Overview

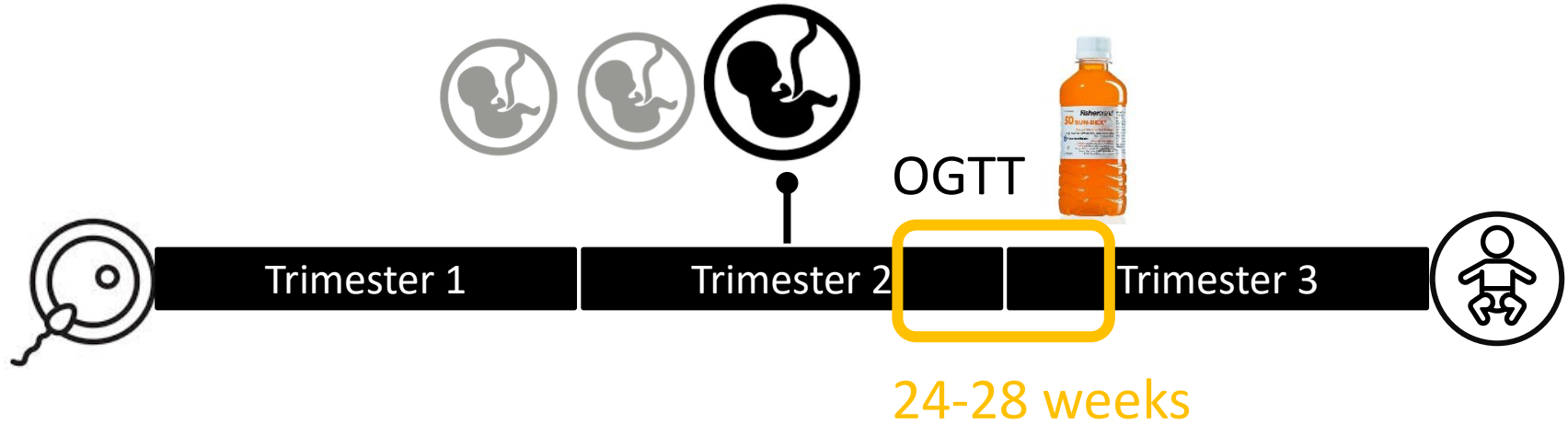
- Objective: Early Detection of gestational diabetes
- Building on findings from Observational Data of CGM in Gestational Diabetes
- Our Hypothesis: There is a strong Signal in the Meal Response
- Analysis and Results

Gestational Diabetes Standard of Care



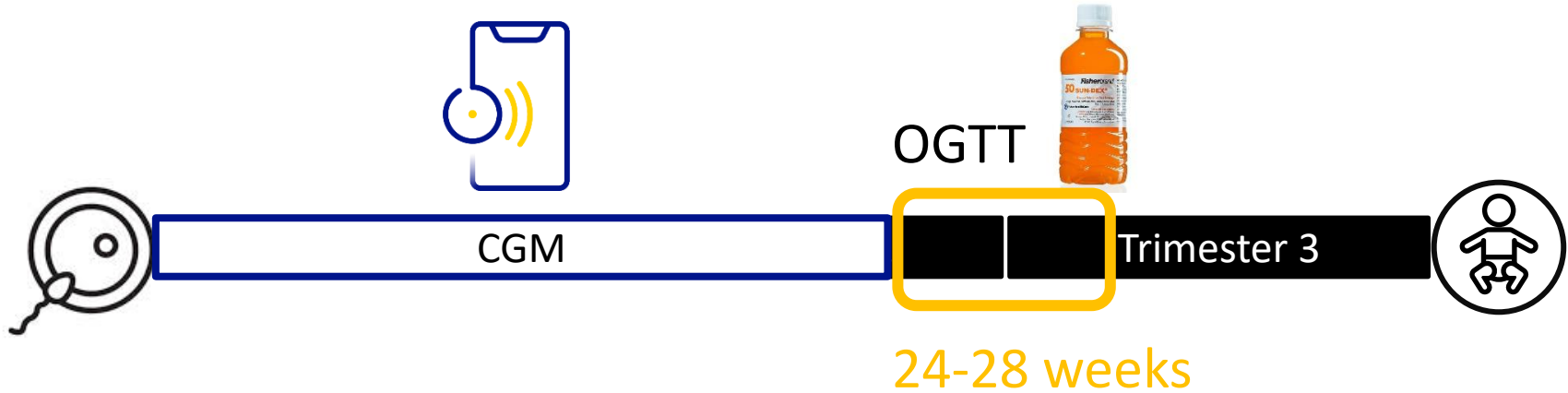
OGTT is the standard diagnostic test for gestational diabetes, conducted at 24–28 weeks of gestation ^[1]

Gestational Diabetes Standard of Care



- Maternal hyperglycemia can adversely affect pregnancy, contributing to fetal overgrowth and hypertensive disorders before OGTT testing at 24–28 weeks ^[2].
- **Earlier detection** of GDM is important.

Gestational Diabetes Standard of Care



- Studies such as **MAGIC** and **GLAM** show that continuous glucose monitoring (CGM) enables early detection of gestational diabetes mellitus (GDM) ^[3,4].
- **TA140** is emerging as an early predictor of GDM ^[3].

[3] Scott EM, Murphy HR, Myers J, Saravanan P, Poston L, Law GR. MAGIC (maternal glucose in pregnancy) understanding the glycemic profile of pregnancy, intensive CGM glucose profiling and its relationship to fetal growth: an observational study protocol. BMC Pregnancy Childbirth. 2023 Aug 3;23(1):563. doi: 10.1186/s12884-023-05824-x. PMID: 37537535; PMCID: PMC10398923.

[4] Durmwald C, Beck RW, Li Z, Norton E, Bergenstal RM, Johnson M, Dunnigan S, Banfield M, Krumwiede K, Sibayan J, Calhoun P, Carlson AL. Continuous Glucose Monitoring Profiles in Pregnancies With and Without Gestational Diabetes Mellitus. Diabetes Care. 2024 Aug 1;47(8):1333-1341. doi: 10.2337/dc23-2149. PMID: 38701400.

Are postprandial CGM patterns stronger early predictors of GDM, as diagnosed by OGTT, compared with standard CGM metrics?

Study Design: Combined Datasets



Maternal Glucose in Pregnancy

Scott EM, Murphy HR, Myers J, Saravanan P, Poston L, Law GR. MAGIC (maternal glucose in pregnancy) understanding the glycemic profile of pregnancy, intensive CGM glucose profiling and its relationship to fetal growth: an observational study protocol. BMC Pregnancy Childbirth. 2023 Aug 3;

Eligibility: Healthy at risk of GDM



CGM

Trimester 1

CGM

Trimester 2

CGM

OGTT

CGM

Trimester 3

CGM



CGM

Eligibility: Healthy no particular risk of GDM



Glucose Levels Across Maternity

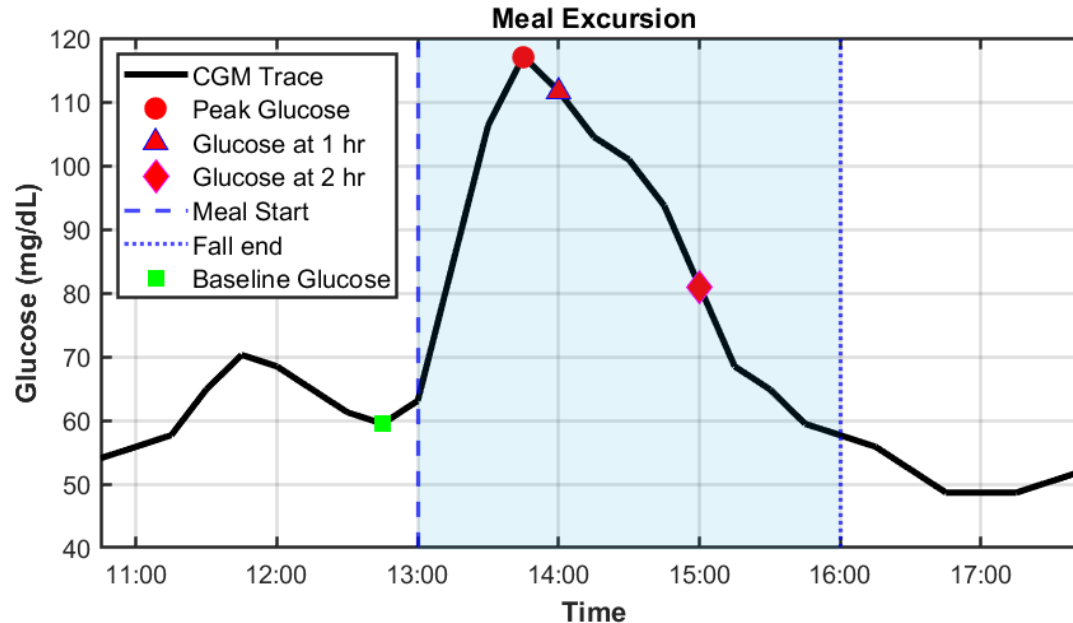
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N = 936

Data from enrollment to 24 weeks gestation (prior to OGTT) was used for analysis

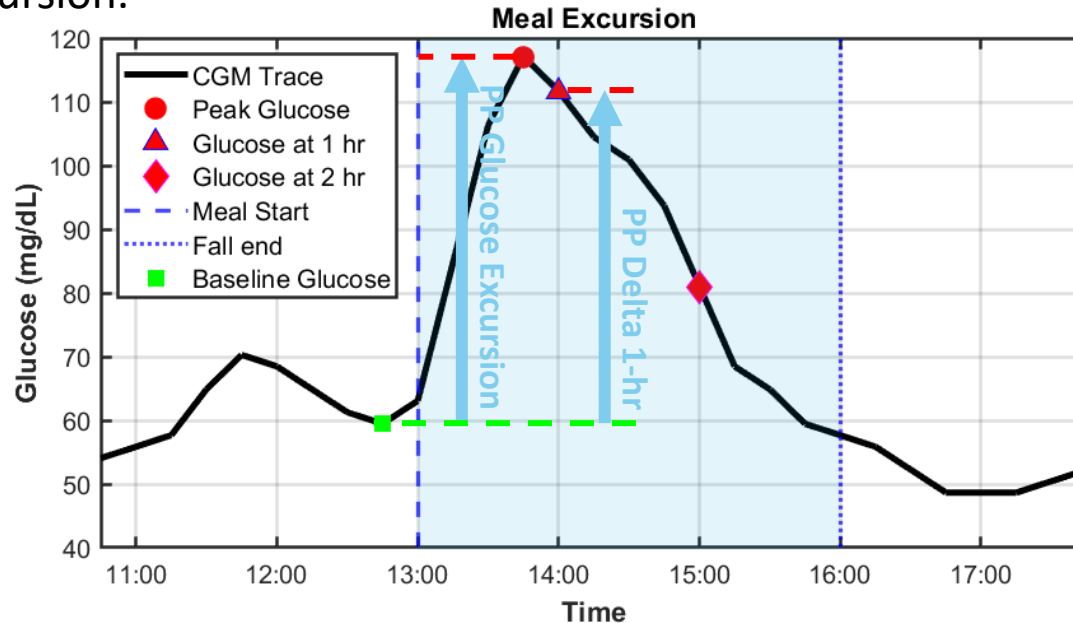
Quantifying Post-Meal Glucose Response

- We developed a meal excursion detection algorithm to identify post-meal periods from the raw CGM profile.



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- From these periods, we extracted **novel post-prandial metrics** to characterize the glucose excursion.



A Comprehensive Search for the Best CGM Metrics

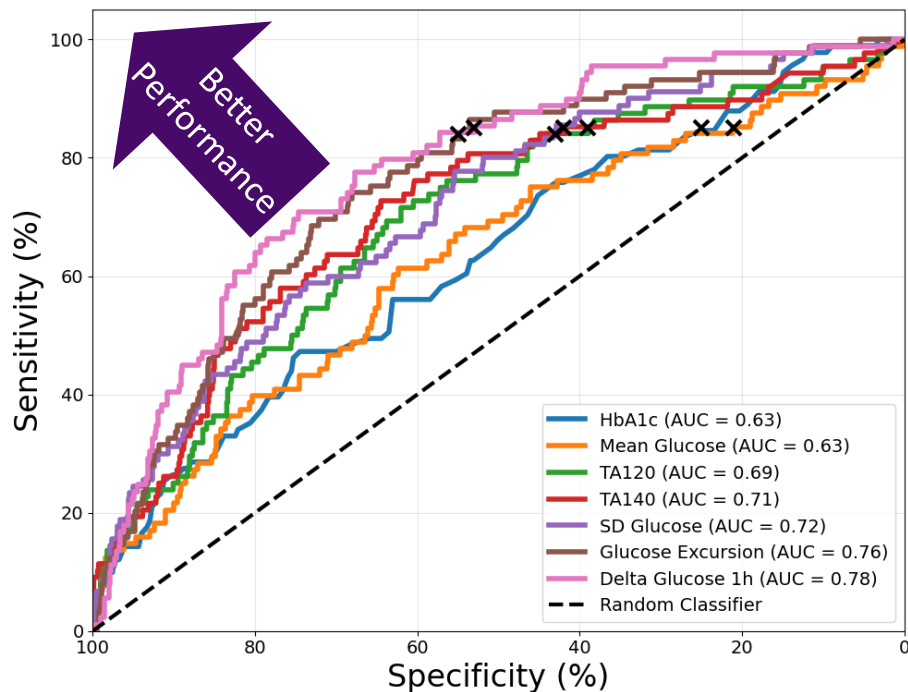
- We conducted a massive search for the most predictive CGM metrics.
- We engineered and extracted **over 170 unique metrics** from the raw CGM data.
- These markers covered all known aspects of glycemic control: overall glucose levels, variability, time-in-range, and glycemic excursions.
- We built **machine learning CGM-based models** to predict GDM.
 - Model: Logistic regression, Random Forest, SVM
 - 5-fold cross validation to evaluate performance

Table of CGM metrics

Category	Examples	#
Overall Glucose Control	Mean Glucose, Fasting Glucose, ...	4
Glycemic Variability	SD Glucose, MAGE, MODD, CONGA	4
Time in Ranges	TA140, TA120, TB63, ...	11
Hyper/Hypoglycemia Indicators	AUC140, Area Above 53, ...	4
Time of Day (TOD)	TODi_TB63, TODi_LowestMeanHr, ...	108
Post Prandial	Baseline Glucose, Peak Glucose, 1hr Glucose, ...	45

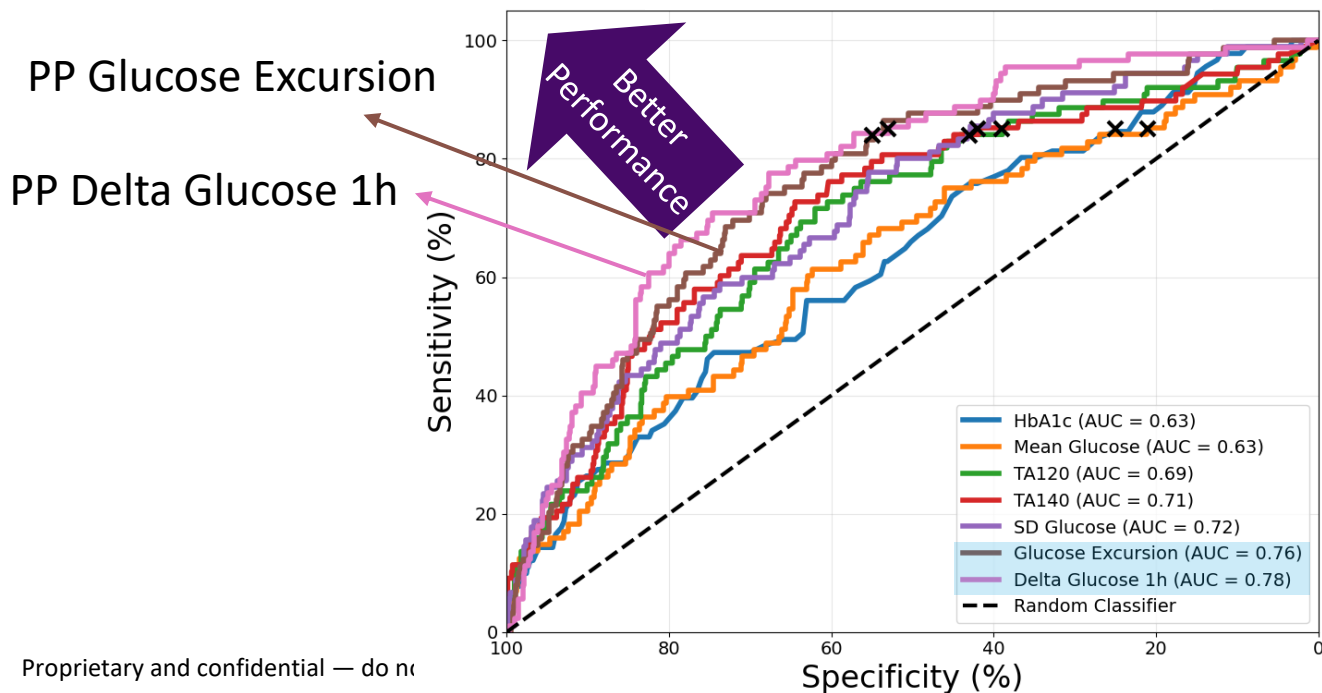
Result: Post-Meal Markers Outperform Standard CGM Metrics

Our novel post-meal metrics demonstrated superior predictive performance for GDM compared to HbA1c and standard CGM metrics.



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Result: Higher Accuracy Means Fewer False Positives

Performance at a Prespecified Sensitivity: When we set the sensitivity to a high level (85%) to ensure we identify most at-risk individuals, our new marker shows its true value.

Feature	ROC AUC	Sensitivity [%]	Specificity [%]	PPV [%]	Threshold
HbA1c [%]	0.63	85	25	13	5.0
Mean Glucose [mg/dL]	0.63	85	21	10	85.5
TA120 [%]	0.69	85	39	13	5.6
TA140 [%]	0.71	85	42	13	0.9
SD Glucose [md/dL]	0.72	84	43	13	16.8
PP Glucose Excursion [mg/dL]	0.76	84	55	16	44.6
PP Delta-1h [mg/dL]	0.78	85	53	16	24.3



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PP Delta-1h reduces the rate of false positives by 10% compared to TA140.

Result: Comb

Predicted Positives

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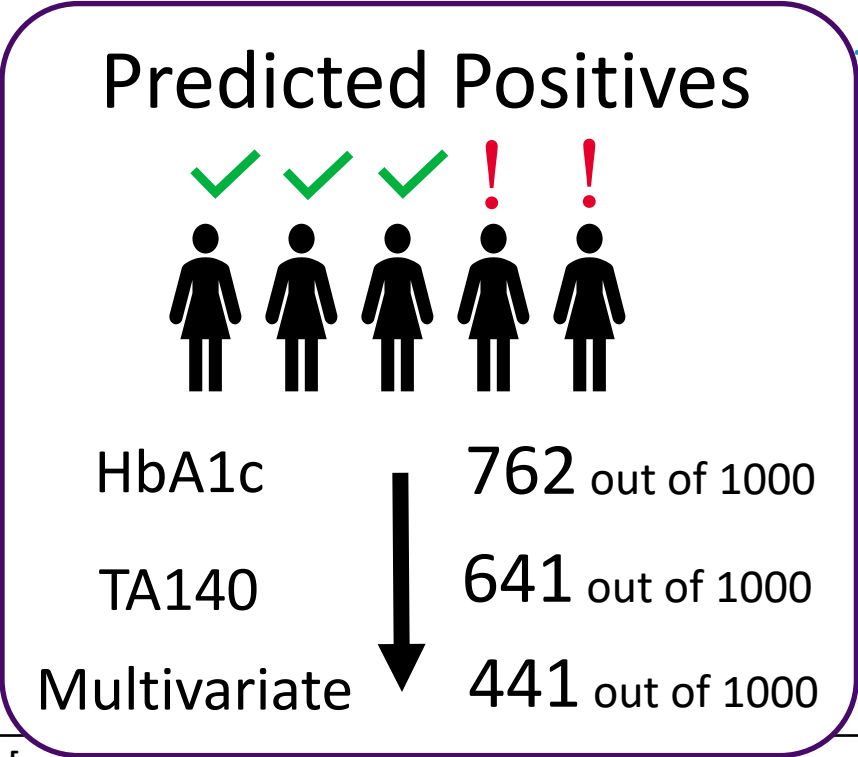
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Multivariate Model (20 CGM features)	0.83	84	60	18	-
Risk Factors (HbA1c, age, BMI, SBP)	0.67	84	38	12	-



Conclusions

Key Findings:

- Post-meal CGM analysis shows strong potential for enhancing early GDM risk assessment based on our study cohort.
- In our comprehensive feature evaluation, PP Delta-1h and PP glucose excursion emerged as highly predictive metrics.
- Combining multiple CGM metrics may further improve risk stratification.

Future direction:

- Identifying the best time window and duration of CGM sensor wear for early GDM screening.



Abbott

Study Design: Combined Datasets



Maternal Glucose in Pregnancy

Enrollment: ≤ 14 weeks gestation

Sensor: 14-day masked Libre pro

Wear window (gestation weeks):

10-12, 18-20, 26-28, 34-36, immediately postnatally

Eligibility Criteria:

healthy at risk of GDM

Diagnosis of GDM: OGTT between 24-28 week (standards differ)



Glucose Levels Across Maternity

Enrollment: < 17 weeks gestation

Sensor: 10-day masked Dexcom G6 pro

Wear window:

from enrollment until delivery based on participant's willingness for continuous wear

Eligibility Criteria:

healthy and low risk of GDM

Diagnosis of GDM: 75 gr OGTT between 24-28 weeks

N = 936

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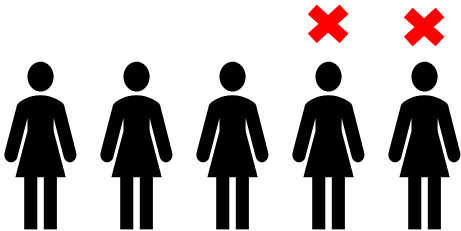
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HbA1c 663 out of 1000

TA140 526 out of 1000

Multivariate 362 out of 1000

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TA120 [%]
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	16	44.6
	16	24.3
	18	-
	12	-

Result: Combining Features Enhances Predictive Power

- We explored multivariate models, combining our best features using machine learning to see if we could improve performance even further.
- **Significant ROC-AUC Improvement:** By combining the top CGM features, we pushed the predictive performance even higher, achieving an ROC-AUC of 0.83 to 0.84.

	Model Name	Features	ROC AUC
Multivariate Model CGM Only	Logistic Regression (LR)	Top 20 CGM Features from RFE	0.83
	Random Forest (RF)	Top 20 CGM Features from RFE	0.83
	SVM	Top 20 CGM Features from RFE	0.83
Multivariate Model CGM + 4 Risk Factors	LR, RF, SVM	Top 20 Features	0.83~0.84
Risk Factors (A1c, age, BMI, SBP)	LR, RF, SVM	4 features	0.67~0.70