

# Near-Infrared Device for Screening of Diabetes: ANODE02 Study

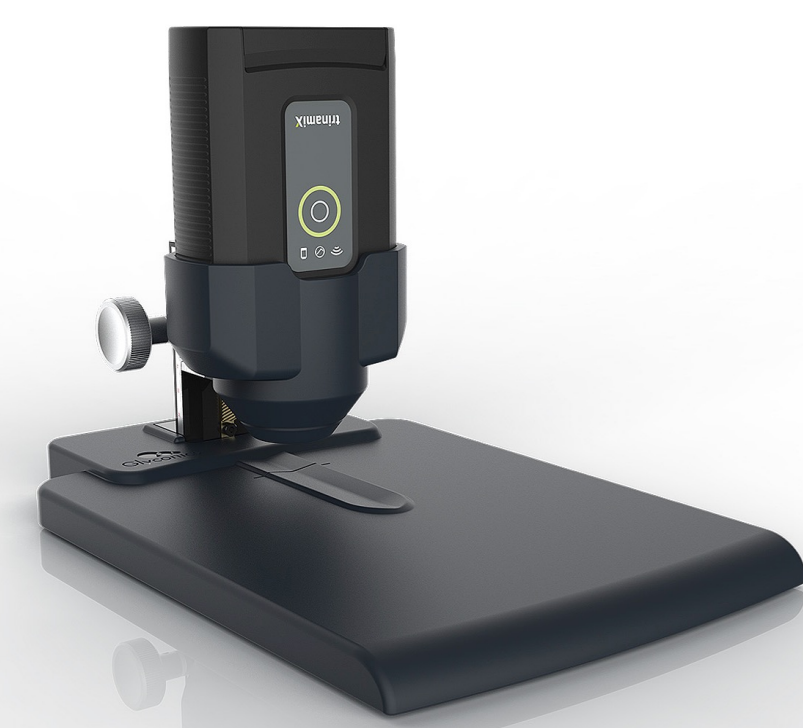
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## Background

- Undiagnosed type 2 diabetes (T2DM) can lead to treatment delays, increasing the risk of poor health outcomes, including micro- and macrovascular complications as a result of prolonged hyperglycemia.<sup>1</sup>
- Due to their positioning within communities and high patient footfall, primary care centers play a pivotal role in the identification of type 2 diabetes (T2DM), both in symptomatic and asymptomatic individuals.<sup>2</sup>
- While preventive screening programs have been established in many high-income countries,<sup>2</sup> there remains broad inter-variability in rates of diagnosis, with a higher prevalence of undiagnosed T2DM in those from minority backgrounds<sup>3</sup> or with lower socioeconomic status.<sup>4</sup>
- There is a need for affordable screening tools with high specificity, to aid in preventive community screening of T2DM and the smart allocation of limited healthcare resources for those in need of further diagnostics.<sup>5</sup>
- The Glyconics-DS System\* is an innovative miniaturized full-spectrum near-infrared (NIR) spectroscopy which assesses the absorption pattern of glycated keratin in an individual's middle fingernails to screen for T2DM.
- The ANODE02 study evaluated the safety and performance of the Glyconics-DS System in assessing glycated nail keratin in individuals with or without type T2DM, compared with a standardized glycated hemoglobin (HbA1c) assay.



## What is chemometric modelling?

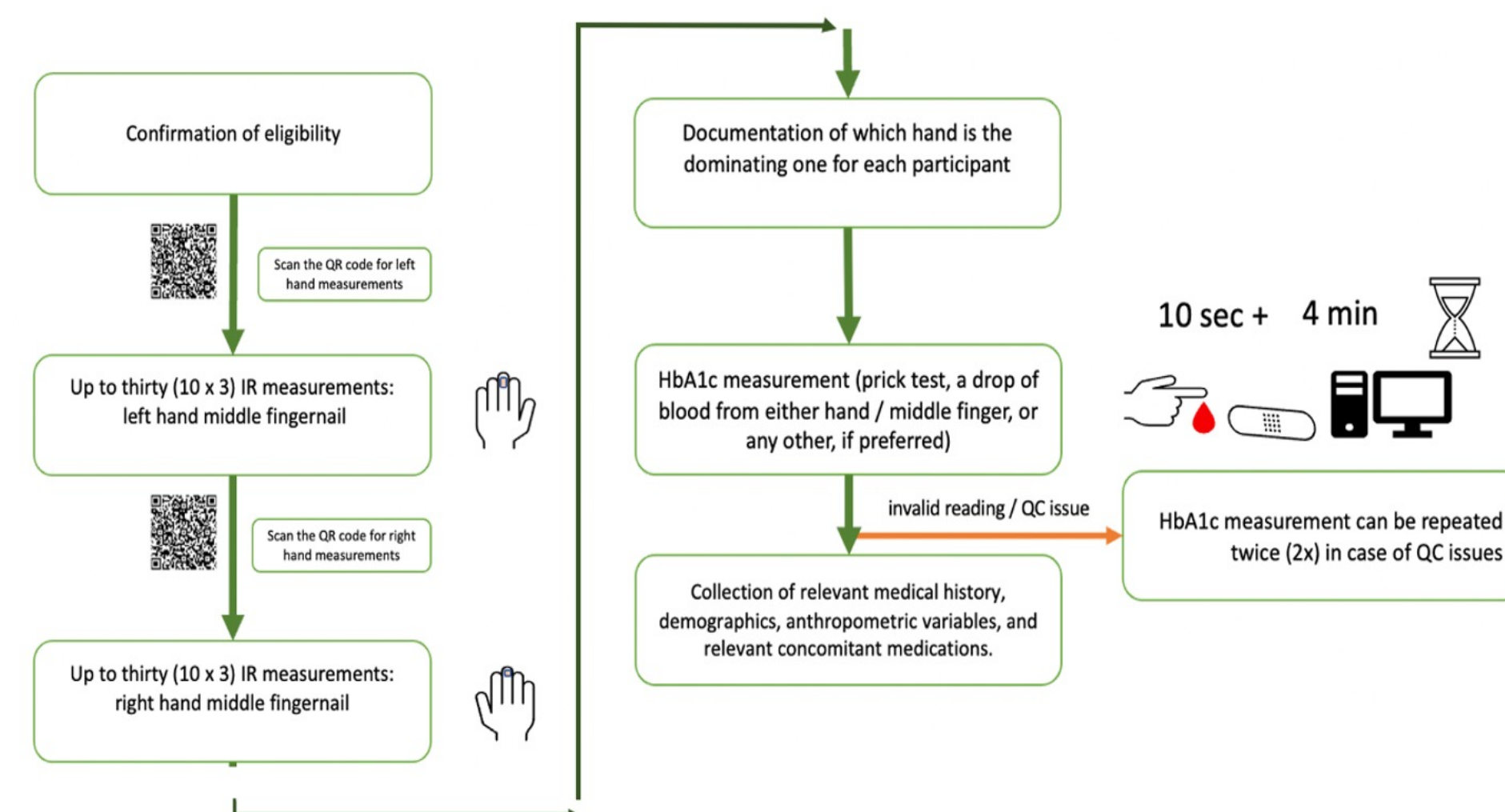
Chemometric models used for spectroscopy are based on mathematical calibration of datasets of spectra with known properties ('training sets'). Predictions based on samples calculated from new spectra are then compared against these 'trained' models.

By identifying chemical patterns associated with the glycation of the keratin in nails, the chemometric model predictive power can identify elevated and normal risks of diabetes in diverse demographics. The real-time spectral acquisition and potential prediction can offer the opportunity to improve and maintain the inertia needed for primary care.

## Methods

- ANODE02 (NCT05476016) was an open-label, single-visit, cross-sectional study, conducted at the Sant Martí primary health center in Barcelona, Spain.
- Individuals were eligible for inclusion if  $\geq 18$  years of age, either with known or unknown T2DM status, with visually assessed apparently healthy middle fingernails on both the left and right hand.
- Individuals were enrolled 1:1 based on their T2DM status (with or without known T2DM). NIR-spectroscopy (Glyconics-DS) and control point-of-care HbA1c tests (QuoTest®) were conducted, as outlined in the study flow in Figure 1.
- Up to six predictive chemometrics models using partial least squares-discriminant analysis (PLS-DA), were trained with an 80:20 ratio and tested for their potential robustness and insensitivity to baseline patient characteristics. Validation was completed using 7-fold cross-validation.

Figure 1. Study flow



## Results

- 100 individuals with (n=50) or without (n=50) were enrolled between August and November 2022. Demographics of this cohort (n=100) are presented in Table 1.
- Based on the best chemometrics model, the NIR-device demonstrated a specificity of 98.5% and 88.9% at 6.5% (48 mmol/mol) and 6.0% (42 mmol/mol) cut-off levels, respectively (Table 2). The current model was shown to have high predictive accuracy for both HbA1c cut-off levels (Figures 2A and B).
- Overall, no adverse NIR-device-related events or complaints were reported for over 6000 spectral measurements.

Table 1. Demographics and baseline characteristics

	Without T2DM (n=50)	Known T2DM (n=50)
Age (mean, SD)	50.2 (20.5)	70.5 (11.8)
Women (n, %)	35 (70.0)	23 (46.0)
Race (n, %)		
Caucasian	45 (90.0)	44 (88.0)
Mixed or Multiple ethnic groups	2 (4.0)	2 (4.0)
Black, African, Caribbean or Ethnic Black	0 (0.0)	1 (2.0)
Other	3 (6.0)	3 (6.0)
Body weight, (kg, SD)	69.1 (13.9)	77.8 (15.5)
BMI, (kg/m <sup>2</sup> , SD)	24.9 (4.4)	28.9 (4.7)
HbA1c in % (median, IQR)	5.3 (5.2-5.5)	7.2 (6.3-7.9)
Non-smoker (n, %)	17 (34.0)	16 (30.0)
Diabetic complications	-	CVD (n=3) Renal (n=11) Retinal (n=14) Neuropathic (n=4) Diabetic foot (n=2)

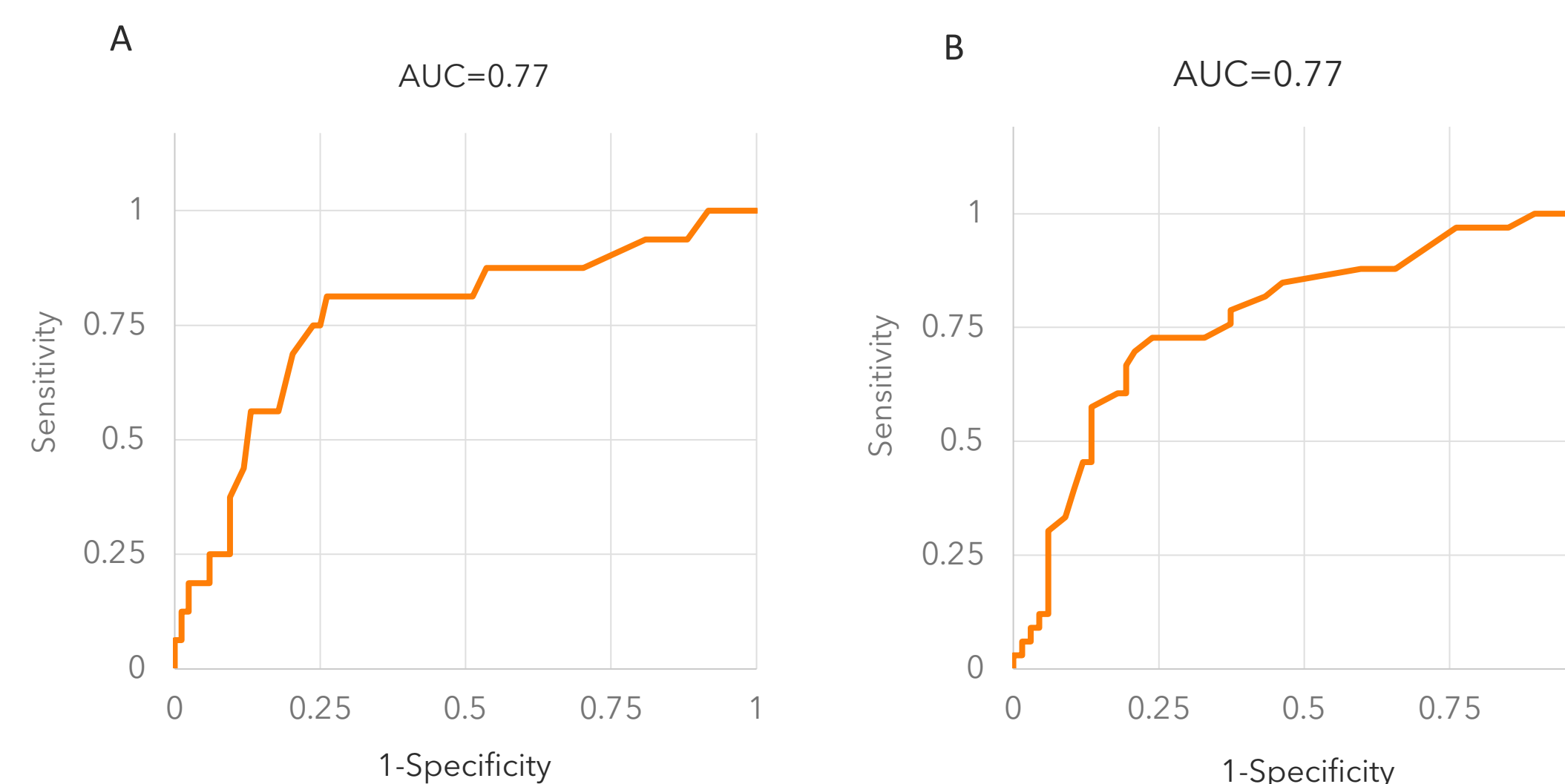
BMI, body mass index; CVD, cardiovascular disease; HbA1c, glycated hemoglobin; IQR, interquartile range; n, number of patients; SD, standard deviation.

Table 2. Sensitivity and specificity for 6.5% and 6.0% HbA1c cut-off values

HbA1c (%) cut-off value	Sensitivity (%; 95% CI)	Specificity (%; 95% CI)	Concordance (%)
6.5	2.9 (0.0-8.4)	98.5 (95.5-100.0)	65.0
6.0	23.9 (11.6-36.2)	88.9% (80.5-97.3)	59.0

CI, confidence interval; HbA1c, glycated hemoglobin.

Figure 2. ROC analysis for A) 6.5% and B) 6.0% HbA1c cut-off values



AUC, area under the curve; HbA1c, glycated hemoglobin; ROC, receiver operating characteristic curve.

## Discussion

- These preliminary results are indicative of high specificity and safe implementation of non-invasive NIR technology with potential for early detection and management of increasing T2DM risk.
- The detection of glycated keratin was not impacted by baseline characteristics such as presence of diabetic complications or e.g., smoking/assumed contamination of fingernails with tar
- The IQR of baseline HbA1c values in those with and without T2DM was broad, with some individuals presenting with levels close to or below the diagnostic threshold of 6.5% (48 mmol/mol). The presented results suggest that this model is accurate across a range of HbA1c levels and can differentiate between values close to this important threshold.
- As a reusable, portable, non-invasive device, the Glyconics-DS system has the potential to be used in primary care and community settings, in order to reduce health inequalities and improve access to timely interventions.

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\*Known as Glyconics-SX at time of study.

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**Disclosures:** FX Cos Claramunt: AstraZeneca, Abbott, Boehringer Ingelheim, Lilly, Novartis, Novo Nordisk, Sanofi Diabetes, Sanofi Pasteur, Esteve; D Lazaro-Pacheco & JE Salter: Glyconics Ltd.; PM Paldanius: Glyconics Ltd., Altimmune Corp, UPM Biomedicals, Sigrid Juselius Foundation for Paediatric Research, Novartis.

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