Lessons Learned from a Wearable-Based Digital Phenotyping Study for Prediabetes Screening in an At-Risk Population

Victoria Brügger[1], Magdalena Fuchs[2], Qiuhan Jin[1], Benjamin Wirth[3], Stefan Bilz[3], Michael Brändle[4], Tobias Kowatsch[1,2,5*], Mia Jovanova[1,2]

Institutions

[1]Digital Health Interventions, School of Medicine, University of St. Gallen, St. Gallen, Switzerland
[2]Centre for Digital Health Interventions, Department of Management, Technology and Economics, ETH Zürich, Zurich, Switzerland
[3]Department of Endocrinology, HOCH Health Ostschweiz, St. Gallen, Switzerland
[4]Department of Internal Medicine, HOCH Health Ostschweiz, St. Gallen, Switzerland
[5]Digital Health Interventions, Institute for Implementation Science in Health Care, University of Zurich, Zurich, Switzerland

Context | Digital biomarkers derived from digital devices such as wearables and smartphones have the potential to enable early screening of metabolic dysfunction, including prediabetes, through continuous monitoring of physiological and lifestyle signals. However, conducting digital phenotyping studies in real-world settings presents operational, technical, and participant-related challenges that remain underreported. Identifying practical lessons from early implementation studies is essential to inform future research and improve study feasibility and data quality.

Methods | The Glucose Observation and Wearable Use for Prevention (GLOW UP) study[1] is an observational digital phenotyping study investigating the feasibility of identifying digital biomarkers and phenotypes for prediabetes screening and metabolic health monitoring. Adults at increased risk for T2D, defined as individuals aged ≥ 45 years with a BMI ≥ recruited and monitored over a 28-day period using a smartwatch, smart ring, and a continuous glucose monitor to capture continuous physiological and behavioral signals across domains including physical activity, sleep, nutrition, and heart rate. Passive sensor data are complemented by app-based surveys assessing food intake, mood, and stress, as well as blood draws (HbA1c and FPG) at baseline and follow-up. Operational processes, data infrastructure, device performance, and participant engagement are systematically documented to derive implementation insights.

Results | Data collection began in December 2025. By mid-March 2026, 51 participants had been enrolled, of whom 17 had completed all study procedures and 2 had dropped out; the overall target enrollment is N = 200. Lessons learned will be structured into four domains based on preliminary observations: (1) participant recruitment and engagement (e.g., healthy volunteer selection bias), (2) participant experience and logistical study operations (e.g., device malfunction) (3) device performance and technical reliability (e.g., battery life of devices), and (4) data infrastructure and wearable and clinical data integration (e.g., device platform integration).

Conclusions | Digital phenotyping studies using wearable technologies are feasible in at-risk populations and can achieve high participant engagement when supported by structured operational processes and robust technical infrastructure. Preliminary observations highlight the importance of coordinated study infrastructure capable of integrating multiple device

[1]Bruegger, V., Fuchs, M., Jin, Q., Wirth, B., Bilz, S., Braendle, M., ... & Jovanova, M. (2026). GLOW UP Study: Protocol for an Observational Digital Biomarker Study for Prediabetes Screening and Digital Phenotyping. *medRxiv*, 2026-03.

platforms and continuous sensor data streams, as well as operational procedures supporting participant onboarding and device management at scale. Results are s expected to provide new insights into recruitment dynamics, specifically targeting individuals at-risk of type-2 diabetes and contextual factors influencing participant health and behaviour during the observation period.

Implications | Insights from the GLOW UP study are expected to inform the design, operational planning, and data infrastructure of future digital biomarker and phenotyping studies aimed at the early detection and prevention of metabolic diseases.

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