Use of “digital twin” simulations in healthcare, example(s) from autoimmune disease

Richard Oram
University of Exeter, Exeter, United Kingdom

Type 1 diabetes (T1D) develops gradually before symptoms appear. When it is diagnosed late, people—especially children—may present with life-threatening diabetic ketoacidosis (DKA). With new therapies now able to delay progression, identifying individuals earlier has become increasingly important. Across three recent studies, we examined how best to predict, detect, and monitor early T1D.

We developed a risk prediction model combining genetic risk scores, age, family history, and diabetes-related antibodies. The model performs well across different screening settings but requires recalibration depending on who is screened. To support real-world use, we created an online tool to estimate individual risk and guide follow-up decisions. We also showed that genetic risk scores retain strong discrimination across diverse ancestries on all continents, although population-specific thresholds may improve risk stratification.

Finally, we integrated these findings into a simulation model to evaluate screening strategies that reduce DKA while balancing healthcare costs.