**Summary of Analysis**

# Emerging Artificial Intelligence (AI) systems for diagnosis and prediction of Type 2 diabetes mellitus (T2DM) using electrocardiograms (ECGs)

## Description of system:

The National Health Service (United Kingdom) (NHS) has started trialling an AI system that assesses ECGs to predict individuals at risk of T2DM "up to 10 years" before the condition develops.[1] The system is based upon a deep learning model derived from an analysis of more than 1.1 million ECGs.[2] In terms of efficacy, the system accurately predicted future T2DM in non-diabetic outpatients approximately 70 percent of the time. These results were consistent across sexes, ethnic groups and body mass index categories.[3]

## Data produced:

The system produces data that identifies non-diabetic individuals who are at risk of T2DM significantly before the condition manifests and develops.

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[1] National Health Service, Imperial Health Care, "AI could predict type 2 diabetes up to 10 years in advance" 18 November 2024 (https://www.imperial.nhs.uk/about-us/news/ai-could-predict-type-2-diabetes-up-to-10-years-in-advance).

[2] Pastika L, Sau A, Sieliwonczyk E, et al An actionable, explainable, and biologically plausible AI-ECG risk estimation platform for diabetes mellitus Heart 2024;110:A232.

[3] Pastika L, Patlatzoglou K, et al Artificial Intelligence-Enabled Electrocardiography For The Prediction of Future Type 2 Diabetes Mellitus Circulation 2024; 150.

**Anticipated treatment arm:**

The data produced by this AI system may supplement early intervention strategies that direct at-risk non-diabetic patients into appropriate care pathways, including specialist pre-diabetic and diabetic support as well as general medical and primary care.[4]

**Location of adoption:**

The AI system that has been validated in the cited published studies is currently being rolled out within the NHS and its results will be assessed over the course of the next 12 months. There are also studies of analogous AI systems being used in South Korea.[5]

**Suitability in developing country contexts:**

The healthcare systems of developing countries are experiencing an ever-increasing burden of Type 2 diabetes. A 2023 *Lancet* study found that 101 million people had diabetes and the number with prediabetes was 136 million.[6] While people in developed countries are often insufficiently nourished to maintain physiological health, they frequently have access to artificial and processed sugars, particularly within carbonated beverages. In addition, developing countries tend to lack public health systems that establish awareness about chronic conditions like Type 2 diabetes.

For these reasons, AI systems that predict T2DM amongst non-diabetic populations have the potential to greatly reduce the future burden of the condition on developing country healthcare. The problem, however, is that developing countries may lack the diabetic care and general medicine infrastructure to respond to the data that these AI systems produce. At present, very few developing countries have sufficient capacity, especially outside of urban areas. In particular, there is currently a general insufficiency of pre-diabetic care pathways to meet the demand that AI systems are likely to produce.

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[4] Kulkarni AR, Patel AA, Pipal KV*, et al* Machine-learning algorithm to non-invasively detect diabetes and pre-diabetes from electrocardiogram *BMJ Innovations* 2023;**9:**32-42.

[5] Kim, Junmo et al Deep learning-based long-term risk evaluation of incident type 2 diabetes using electrocardiogram in a non-diabetic population: a retrospective, multicentre study. eClinicalMedicine, Volume 68, 102445

[6] Anjana, Ranjit Mohan Mohan, Viswanathan et al, Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). The Lancet Diabetes & Endocrinology, Volume 11, Issue 7, 474 - 489

**Potential for adaptation:**

Pre-diabetic healthcare pathways necessarily remain the optimal strategy for patients who are identified as being at risk of T2DM by these systems. But in the absence of those pathways, there is potential for targeted digital medical resources made by local doctors using local languages and references. This is because, although sufficient medical infrastructure may presently be lacking, digital networks and devices are pervasive, including into rural and otherwise isolated areas. These complementary digital medical resources would explain to the patient why they are at risk of T2DM, what can happen if the condition is left untreated and what steps the patient can take to reduce the risk of the condition's progression.

**Supporting literature:**


- Kulkarni AR, Patel AA, Pipal KV, et al Machine-learning algorithm to non-invasively detect diabetes and pre-diabetes from electrocardiogram BMJ Innovations 2023;9:32-42.
- National Health Service, Imperial Health Care, "AI could predict type 2 diabetes up to 10 years in advance" 18 November 2024 (https://www.imperial.nhs.uk/about-us/news/ai-could-predict-type-2-diabetes-up-to-10-years-in-advance).
- Pastika L, Sau A, Sieliwonczyk E, et al An actionable, explainable, and biologically plausible AI-ECG risk estimation platform for diabetes mellitus Heart 2024;110:A232.
- Pastika L, Patlatzoglou K, et al Artificial Intelligence-Enabled Electrocardiography For The Prediction of Future Type 2 Diabetes Mellitus Circulation 2024; 150.
- Kim, Junmo et al Deep learning-based long-term risk evaluation of incident type 2 diabetes using electrocardiogram in a non-diabetic population: a retrospective, multicentre study. eClinicalMedicine, Volume 68, 102445
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