



EXCLUSIVE

The new artificial intelligence model, called Delphi-2M, uses large-scale health data to anticipate a person's risk of developing diseases over time.

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Let's imagine a future in which our medical history can help predict the diseases that may afflict us over the next two decades, functioning almost like a "crystal ball" for health. We've never been closer to making this scenario a reality: an international team of researchers has developed an artificial intelligence (AI) model that allows for estimating an individual's long-term risk of developing over a thousand diseases. There's more: this model allows us to estimate not only the risk but also the timing of when a certain disease might appear.

It is a new generative AI model, called Delphi-2M, which uses large-scale records to predict changes in human health over time. The model was customized using algorithmic concepts similar to those used in large language models (such as those powering ChatGPT or Gemini), and trained on anonymized data from 400,000 patients collected from the UK Biobank, a long-term study that collects biological, health, and lifestyle data from more than half a million volunteers to investigate the causes of disease and improve global public health. Subsequently, the researchers also tested the model (successfully) using data from 1.9 million people in Denmark's National Patient Registry.

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The results of the research were released in a study published Wednesday in the journal Nature. The project was a collaboration between the European Molecular Biology Laboratory (EMBL), the German Cancer Research Center (DKFZ), and the University of Copenhagen (Denmark), and was funded by contributions from EMBL member states, DKFZ funds, and a grant from the Novo Nordisk Foundation.

"Our AI model is a proof of concept, and it shows that it is possible for AI to learn many of our long-term health patterns and use that information to generate meaningful predictions," said Ewan Birney, acting executive director of EMBL and corresponding author of the study, in a statement. "By modeling how diseases develop over time, we can begin to explore when certain risks arise and how best to plan early interventions. It is a major step toward more personalized and preventive approaches to healthcare."

Certainty or estimate?

Just as large language models can learn sentence structure, Delphi-2M learns the "grammar" of health data to model medical histories as sequences of events unfolding over time. These events, explains EMBL, include medical diagnoses or lifestyle factors, such as smoking, with the model learning to predict disease risk based on the order in which these events occur and the time that passes between them.

"Medical events often follow predictable patterns," says Tom Fitzgerald, a scientist at the European Bioinformatics Institute at EMBL (EMBL-EBI) and co-author of the study, in a statement. "Our AI model learns these patterns and can predict future health outcomes. It gives us a way to explore what might happen based on a person's medical history and other key factors. It's important to note that this isn't a certainty, but rather an estimate of potential risks."



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EMBL states that the model performs "particularly well" for diseases with clear and consistent progression patterns, such as certain types of cancer, heart attacks, and sepsis, a systemic infection. However, it notes that the model is "less reliable" for more variable and unpredictable conditions, such as mental health disorders or pregnancy-related complications.





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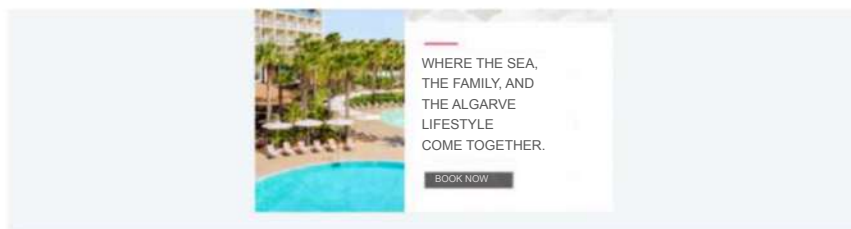


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Just like weather forecasts, this new AI model provides probabilities, not certainties. This means it does not predict exactly what will happen to a specific individual in the future, but rather offers estimates of the probability that certain diseases will occur over a given period of time.

Let's look at an example: the model can predict the probability of a person developing heart disease in the coming year, with these risks expressed as percentages over time, similar to a 70% probability of rain on a given day. As a general rule, predictions for a shorter time period are more accurate than long-term ones.

Looking at UK BioBank participants aged 60 to 65, the model predicts varying levels of heart attack risk, ranging from a probability of four in ten thousand (equivalent to 0.04%) per year for some men to approximately one in a hundred (1%) for others, depending on their medical histories and lifestyles. Women, on average, have a lower risk but a similar range of risk. Furthermore, risks generally increase as people age.



It is a major step toward more personalized and preventive approaches to healthcare

Ewan Birney

The model can also be calibrated to produce accurate population-level risk estimates, predicting how often certain diseases occur in groups of people.

In an email response to PÚBLICO, Ewan Birney highlights this AI model's ability to generate "accurate risk estimates for future diseases" in a given individual, but assures that the model can be adapted to anticipate disease risk at the collective level—such as pandemics, or the incidence of diabetes and cancer in the population. "This can already be done now; [the model] simply needs to process [the data for] all individuals in a cohort or group."



As for limitations, Ewan Birney points out that, before being used in clinical practice, the model must be tested by others and the best way to use it must be evaluated. Furthermore, it "faithfully reproduces the data" used to train it, "including any bias"—for example, since the UK Biobank data comes mainly from individuals aged 40 to 60, childhood and

adolescence are underrepresented, and the model also contains demographic biases due to data gaps, including the underrepresentation of certain ethnic groups.



Ewan Birney, interim executive director of EMBL JEFF DOWLING/EMBL

In the future, similar AI tools, trained on more representative datasets, could truly help doctors identify high-risk patients early on. “With an aging population and the rising incidence of chronic diseases, the ability to predict future healthcare needs could help healthcare systems plan better and allocate resources more efficiently. But much more testing, consultation, and robust regulatory frameworks are needed before AI models can be implemented in a clinical setting,” concludes the EMBL statement.

The next steps, according to Ewan Birney, are “many,” and involve “exploring the research possibilities with this model,” integrating other types of data (such as images and biochemical and genomic data), and ensuring access for researchers and healthcare professionals.

In the scientific article, the authors emphasize that “healthcare decision-making depends on understanding patients’ past and current health status to predict and, ultimately, alter their future course.” AI methods, they conclude, “promise to assist in this task” by improving the “understanding of personalized health risks” and informing “precision medicine approaches.”



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