AI model may help epilepsy patients become seizure-free

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A study led by Monash University and believed to be a world first has demonstrated that an Artificial Intelligence (AI) model can potentially predict the best personalized, anti-seizure medication for patients with

newly diagnosed epilepsy.

The predictive model, once fully developed, would spare these patients the uncertainty of not knowing when their lives would be returned to normal by taking anti-seizure medications, and possibly the harmful side-effects associated with some drugs.

Professor Patrick Kwan, a neurologist and researcher from the Monash Central Clinical School's Department of Neuroscience is leading an international collaboration that is "training" the deep-learning prediction model (deep learning is a type of machine learning).

Their study is published in the influential *JAMA Neurology*.

Epilepsy affects 70 million people worldwide. Currently, choosing anti-seizure drugs for a patient is a process of trial and error with clinicians unable to predict which drug a particular patient will respond to, Professor Kwan said.

"If the patient doesn't respond to the first treatment, quite a few will respond to the second or third one, meaning that they might have become seizure-free sooner if the 'right' drug was chosen at the outset," he said. "But if they get the wrong medication they still have seizures and may also get side-effects from it—they're not getting the benefit and are getting harm from the drug."

These side-effects can range from allergies to psychiatric problems or in the case of women of child-bearing age, birth defects in their babies. Some patients have drug-resistant epilepsy, meaning that if predicted early, they could be moved more quickly to other treatment options including surgery, a device or diet, without wasting years using medications that did not work.

The model used clinical information about 1,798 patients from five health care centers in Australia, Malaysia, China and the UK. It is being designed by the Monash Medical AI led by Associate Professor Zongyuan Ge and trained using the Monash MASSIVE computing cluster.

"We are seeing how the latest deep learning model is bridging itself from the computer-aided diagnosis now to the treatment domain, which is truly exciting,"' Associate Professor Ge said.

The model's accuracy in predicting the best medication was "modest," Professor Kwan said. (It scored 0.65 on a statistical performance measurement known as the AUROC, where 1.0 is most accurate.) "Nonetheless that was more than what we expected—we were happy with that performance because only very basic clinical factors collected in routine clinical care were used to train this base model."

It is being improved both technically and by using more complex information. The enhanced model will be tested in the national multi-center randomized controlled PERSONAL trial (Personalized Selection of Medication for Newly Diagnosed Adult Epilepsy) to aid treatment selection in epilepsy.

Dr. Zhibin Chen, Monash neuroscientist and biostatistician, played a pivotal role in the study.

"This is believed to be a world-first model," Dr. Chen said. "It assures the predictability of choosing the optimal treatment for patients with newly diagnosed epilepsy. It will open the gate for personalizing the management of epilepsy."

Dr. Haris Hakeem, Ph.D. student and Epilepsy Fellow at The Alfred, was first author while Ph.D. students Wei Feng and Jiun Choong played

crucial roles in developing the model, Professor Kwan said.

It is hoped that this research will eventually improve the management and treatment of epilepsy. It is designed to predict responses to treatment, not actual seizures.

At the moment the model is for adults with new onset epilepsy who are going to start their first medication. It has not been tested in children.

This model will form the basis for further models for people with more established epilepsy.

More information: Haris Hakeem et al, Development and Validation of a Deep Learning Model for Predicting Treatment Response in Patients With Newly Diagnosed Epilepsy, *JAMA Neurology* (2022). DOI: 10.1001/jamaneurol.2022.2514

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