# EEG predicts response to medication for schizophrenia

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A commonplace electroencephalography (EEG) test may hold the key to predicting whether a person will respond to certain prescribed drugs, particularly those related to psychiatric conditions.

In a study to be published by *Clinical Neurophysiology*, and now posted online, engineering and health sciences researchers at McMaster University applied machine learning to EEG patterns and successfully predicted how patients with schizophrenia would respond to clozapine therapy.

Clozapine is recognized as an effective treatment for chronic medication-resistant schizophrenia but can produce serious side effects such as seizures, cardiac arrhythmias or bone marrow suppression. Some patients can develop blood problems that are life-threatening. Weekly to monthly blood sampling is required.

"Some people can suffer terrible side effects from clozapine," said Dr. Gary Hasey, associate professor at McMaster and director of the Transcranial Magnetic Stimulation laboratory at St. Joseph's Healthcare Mood Disorders Clinic in Hamilton. "The logistic difficulties for the patient and treatment team are also substantial. A method to reliably determine, before the onset of therapy, whether a patient will or will not respond to clozapine would greatly assist the clinician in determining whether the risks and logistic complexity of clozapine are outweighed by the potential benefits."

To conduct the study, EEGs were taken from 23 patients diagnosed with medication-resistant schizophrenia before they began taking clozapine. Twelve were men and 11 were women, all of middle age. The brainwave patterns and response to the clozapine therapy of these patients were used to "train" a computer algorithm to predict whether or not a specific patient will respond to the drug. The prediction accuracy was approximately 89 per cent. This algorithm showed similar predictive accuracy when it was further tested in a new group of 14 additional patients treated with clozapine.

This innovative work grows out of the close collaborative relationship between members of the Department of Electrical and Computer Engineering (Prof. James Reilly, Ph.D. student Ahmad Khodayari-Rostamabad), the School of Biomedical Engineering (Prof. Hubert de Bruin), and the Department of Psychiatry and Behavioural Neurosciences (Drs. Gary Hasey and Duncan MacCrimmon).

"The computational power available today supports new machine learning methodologies that can help doctors better diagnose and treat illness and disease," said Prof. Reilly. "Large amounts of data can be processed very quickly to identify patterns or predict outcomes. We're looking forward to applying the findings to other areas."

EEG records the brain's electrical activity close to the scalp. Traditionally, it has been used to monitor for epilepsy, and to diagnose coma, encephalopathies, and brain death. EEG is still often used as a first-line method to diagnose tumors, stroke and other focal brain disorders.

"EEG is an inexpensive, non-invasive technique widely available in smaller hospitals and in community laboratories," explains Dr. MacCrimmon. "Also, EEG readings take only 20 to 30 minutes of a patient's time, with no preparation required, so pose minimal

inconvenience."

Funding for the research was provided in part by The Magstim Company Ltd., a developer and manufacturer of medical and research devices for the neurological and surgical fields. The company is based in Wales, U.K.

The researchers now plan to test their findings on a larger sample group. They have successfully demonstrated the application of machine learning methods for analyzing EEG signals to predict the response to various treatments available for patients with other psychiatric conditions, specifically major depression. They have also demonstrated the effectiveness of machine learning methods as a diagnostic tool for distinguishing various forms of psychiatric illness. It may also be possible to incorporate a range of other clinical and laboratory data such as personality inventory scores, personal and demographic information and treatment history to improve performance.

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