Seizure forecasting with wrist-worn devices possible for people with epilepsy, study shows

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Despite medications, surgery and neurostimulation devices, many people with epilepsy continue to have seizures. The unpredictable nature of

seizures is severely limiting. If seizures could be reliably forecast, people with epilepsy could alter their activities, take a fast-acting medication or turn up their neurostimulator to prevent a seizure or minimize its effects.

A new study in *Scientific Reports* by Mayo Clinic researchers and international collaborators found patterns could be identified in patients who wear a special wristwatch monitoring device for six to 12 months, allowing about 30 minutes of warning before a seizure occurred. This worked well most of the time for five of six patients studied.

"Just as a reliable weather forecast helps people plan their activities, so, too, could seizure forecasting help patients living with epilepsy adjust their plans if they knew a seizure was imminent," says Benjamin Brinkmann, Ph.D., an epilepsy scientist at Mayo Clinic and the senior author. "This study using a wrist-worn device shows that providing reliable seizure forecasts for people living with epilepsy is possible without directly measuring brain activity."

In the study, patients with drug-resistant epilepsy and an implanted neurostimulation device that monitors electrical brain activity were given two wrist-worn recording devices and a tablet computer to upload data daily to cloud storage. Patients were instructed to wear one wristband while the other charged. They switched devices at a set time each day. They used the devices while participating in their normal activities, providing unique long-term data for the study.

Information collected from the wearable device included electrical characteristics of the skin, body temperature, blood flow, heart rate and accelerometry data that tracks movement. Data were analyzed with a deep learning neural network approach to artificial intelligence, using an algorithm for time series and frequency analysis. Because the research participants already had an implanted deep brain stimulation device to

treat their epilepsy, those neurostimulation devices were used to confirm seizures, allowing the team to measure the accuracy of forecasting by the wrist-worn devices.

While the ability to forecast seizures previously has been shown using implanted brain devices, many patients don't want an invasive implant, Dr. Brinkmann notes.

"We hope this research with wearable devices paves the way toward integrating seizure forecasting into clinical practice in the future," says Dr. Brinkmann, noting that this was a preliminary study and additional patients are recording data to expand this test.

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More information: Mona Nasseri et al, Ambulatory seizure forecasting with a wrist-worn device using long-short term memory deep learning, *Scientific Reports* (2021). DOI: 10.1038/s41598-021-01449-2

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