# New technology could improve diagnosis of epilepsy and lead to personalized treatment options

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Subscalp electroencephalography (EEG) systems include sensors that measure brain activity from beneath the scalp for long periods of time. Credit: Wyss Center

Today, the way a physician determines how many seizures a person with epilepsy has had is through the patient's own record of seizure activity. Despite all the technological advances in devices monitoring the human body, a patient's seizure diary, as it is often called, remains the only means to record and count epileptic seizures outside the clinic. Any insights that such a diary can provide on the effects of medication, seizure frequency or seizure triggers depend on the reliability and detail of the patient's reporting. Even accurate recognition of seizures is a problem since about half of seizures are not known to the patient.

A new generation of long-term brain monitoring technologies that continuously records brain activity in the clinic or at home is emerging and could greatly improve disease management for epilepsy patients. In an article published today in the journal *Epilepsia*, a team of scientists, engineers and clinicians from around the world describe how an innovative approach that records neural activity from beneath the scalp could provide a reliable alternative to subjective seizure diaries. These innovative devices are subscalp electroencephalography (EEG) systems that are minimally invasive and could remain underneath the scalp for long periods of time.

Maxime Baud, MD, Ph.D., epileptologist at Bern University Hospital, Wyss Center Staff Neurologist and co-author of the paper said, "Our current epilepsy treatment plans are primarily based on short-term brain activity data from EEG caps during a hospital visit. Epileptic seizures can occur months apart and come in cycles, so we need ways to, continuously and accurately, monitor brain activity in the home environment. With the Wyss Center's Epios system, we are excited to be part of the movement developing such new technologies, that can ultimately enable us to optimize and personalize treatment for each patient."

Six new technologies, commercially available or under development, are described in the paper each with a different primary value including seizure counting and recording, seizure forecasting and alerting, and neuro-stimulation. These minimally invasive techniques may help avoid some of the risks linked to directly intervening in the brain.

One of these subscalp devices is Minder, being developed by the Australian company Epi-Minder. Currently in clinical trials, the device's multichannel electrode is placed across the skull so that both brain hemispheres are covered. "Through long-term and continuous EEG measurements, Minder aims to provide accurate knowledge of brain activity and seizures to help people with epilepsy take back control of their lives," said Professor Mark Cook, MD, Ph.D., Chair of Medicine at the University of Melbourne, Director of Neurology at St Vincent's Hospital, Melbourne and co-author of the paper.

Another technology reviewed in the paper is the Wyss Center's EpiosTM system, designed to offer flexible subscalp configurations, from focal or bitemporal electrode layouts to broad head coverage and high-channel-count neural recording, through a series of thin sensing electrodes connected to a miniature implant, all inserted beneath the skin. The neural signals are wirelessly transmitted to an external (behind-the-ear) receiver, while a wearable data processor enhances brain data with heart rate, accelerometry and audio data and uploads it to the Epios Cloud, which offers secure and centralized data storage, annotation and visualization.

"In parallel to the recording devices, we are constantly optimizing our high performance analytics software with algorithms that could help clinicians draw meaningful conclusions from the vast amount of data recorded by these long-term systems," George Kouvas, MBA, Chief Technology Officer at the Wyss Center and co-author of the paper said. "We are already working towards adapting these new technologies to help patients with other brain disorders manage their daily life, such as with tinnitus and stroke," Kouvas added.

Future uses for long-term, subscalp brain monitoring include biomarker detection and efficacy monitoring of pharmaceuticals as well as well as closed-loop neuromodulation applications.

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