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# The AI Doctor Will See You Now

Artificial intelligence comes to the doctor's office, helping identify disease, monitor heart activity, stave off seizures



An X-ray scan of the head of Kimberly Bari, who had a NeuroPace Responsive Neural Stimulator implanted in her brain to listen for and interrupt impending seizures. PHOTO: KIMBERLY BARI/UCSF



By

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Kimberly Bari had her first seizure in 2010 at age 26 and since then has had hundreds. Some rendered her unconscious, others left her confused and terrified. By 2016, her surgery- and drug-

resistant condition led her to try something fewer than 2,000 people in the world have attempted: [implanting a computer into her brain](#).

The NeuroPace Responsive Neurostimulation System “literally provides peace of mind I never imagined could exist,” she said. And, according to its makers, it would be impossible without a type of artificial intelligence known as machine learning.

Machine-learning algorithms accomplish tasks by training on a set of data, rather than being programmed by humans. NeuroPace Inc.’s engineers pattern-match patients’ neural activity to a database of two million recordings from the brains of other patients. Armed with the knowledge of what worked before, the system instructs the implant to stimulate users’ brains to interrupt a seizure at its onset.

The innovation is part of a larger phenomenon that has big implications for how we identify and treat disease: the introduction of artificial intelligence to consumer and clinical electronics. As machines learn from at times millions of humans, doctors are gaining the ability to better identify disease and even predict it before it becomes catastrophic.

As in every other area of human endeavor, the introduction of AI to medicine comes with challenges. There’s the need to educate both patients and practitioners about how to use these tools. There are [major potential privacy issues around patient data](#). Then there’s the possibility of overdiagnosis. If Google Search created a generation of hypochondriacs, imagine what happens when an overzealous AI starts sending people to the doctor every time it detects a small chance of a rare disease.

Another challenge, said [Robert Mittendorf](#), a physician and venture capitalist, is that AI isn’t always trained with the same population it serves. For example, [an MIT study](#) showed some facial-recognition software that uses machine learning is highly accurate at identifying the faces of white men, but relatively shoddy at identifying the faces of dark-skinned women, because of the data these systems were trained on.

Despite these concerns, medicine might be uniquely suited to a safe and effective rollout of AI. It’s a highly regulated industry, full of risk-averse practitioners who are nevertheless accustomed to incorporating new technology and insights.

### ‘Bloodless blood test’

The NeuroPace system requires installation by a brain surgeon, but much of this innovation is likely to reach the masses through our mobile devices. The KardiaMobile is a pocket-size electrocardiogram monitor, and the first iPhone accessory approved by the U.S. Food and Drug Administration. Now its maker, AliveCor—which also sells the KardiaBand EKG recorder for Apple Watch—is gathering the sort of data from its devices that could someday feed a machine-learning system that doctors could use to spot disease.



AliveCor’s KardiaBand is an EKG recorder for Apple Watch. PHOTO: ALIVECOR

One potential application is a “bloodless blood test,” said Paul Friedman, head of cardiovascular medicine at the Mayo Clinic, which formed a partnership with AliveCor.

This test would look at a subtle shift in the EKG that’s characteristic of a potential potassium blood-level elevation, which the AI is uniquely skilled at identifying. Currently, the condition can be diagnosed only by drawing blood. Measuring this marker in real time, from the convenience of a phone or smartwatch, could transform how people are treated after a heart attack or while on certain medications, Dr. Friedman added.

His research also has led to an algorithm that uses machine learning to predict whether someone has or will develop a [medical condition](#) known colloquially as a “weak heart pump”—which affects 2% to 9% of the population and is predictive of heart failure.

“Our body is giving off signals as to our health all the time that we’ve never been able to capture before,” Dr. Friedman said. “Now, not only can we capture them,” he added, but “we might be able to interpret those signals in ways that allow us to prevent disease.”

### From prediction to autonomy

Edwards Lifesciences’ Acumen Hypotension Prediction Index, for example, was recently approved by the FDA, and has already been used on thousands of patients in Europe. The U.S. rollout has been slow, doctors who have used it say, because it’s one of the first pieces of medical equipment to incorporate AI. The HPI uses machine learning, applied to a large body of previously gathered data, to give doctors a moment-to-moment probability that a patient’s blood pressure might drop in a life-threatening way.



Screen shot from the Acumen Hypotension Prediction Index from Edwards Lifesciences, which uses AI to produce a probability index warning doctors when a drop in a patient’s blood pressure is likely to occur. PHOTO: EDWARDS LIFESCIENCES

Monty Mythen, a physician at University College London who was part of the system’s testing in Europe, compared it to a weather app. Watching the system’s AI-powered prediction values “twitch” helps alert doctors to the possibility that something could be amiss with a patient, many minutes before conventional measures might, he said.

This kind of AI isn't telling doctors what to do—decisions are still in the hands of a human—but eventually it will.

“Decision support” technology not only will tell doctors that a catastrophe in the operating room is impending, but also will suggest a cause and even what to do about it, Dr. Mythen said. If physicians agree with the machine's assessment, they could simply press a button to administer the remedy.

### **Dr. Apple**

Tech giants in the consumer market are well aware that AI in their wearable devices could lead to new revenue. Hence Apple's attempts to use the heart-rate sensor in the Apple Watch to harvest massive quantities of anonymous data for its [heart study, in partnership with Stanford](#).

While Apple is tight-lipped about where this will lead, it's clear the company could eventually seek FDA approval for apps that rely on the heart-rate sensor to deliver medical advice.

Entering into an industry as visible and highly regulated as medical devices isn't for the faint of heart. Apple has occasionally run afoul of customers for issues ranging from [call-dropping antenna design](#) to [secret performance-limiting software](#). Would the company be prepared to handle results with potentially life-and-death impact on its users? Apple didn't respond to requests for comment. “Like automating any human labor, introducing AI means automating a portion of a highly trained professional's job,” Dr. Mittendorff said. “And that professional will want to make sure that what you're doing to automate their job adheres to the highest ethical standard before adopting it—so the stakes are high.”

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