



Researchers at Penn State's College of Information Sciences and Technology and Houston Methodist Hospital have developed smartphone screening test to analyze stroke-like symptoms. The test, powered by a machine learning algorithm, could significantly reduce the amount of time it takes physicians to diagnose a stroke. Credit: Houston Methodist Hospital

## AI-based app can diagnose stroke in minutes

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A new tool for mobile devices can diagnose stroke as accurately as an emergency medicine specialist in just minutes, enabling patients to get brain-saving therapies in time for maximum benefit. According to researchers from Pennsylvania State University and Houston Methodist Hospital, the artificial intelligence (AI)-based tool could counterbalance physician biases, reducing both overuse of CT scans and underdiagnosis of mild and moderate stroke.

Initially, the team expects the app to be used in emergency departments, then in outpatient clinics, physician offices, care facilities and homes. “I envision a cloud-based app for people to assess their risk anywhere and at any time,” co-author Stephen Wong, of the Ting Tsung and Wei Fong Chao

Center for BRAIN and Houston Methodist Cancer Center, told *BioWorld*. The team presented a paper describing the app at the 23rd International Conference on Medical Image Computing and Computer Assisted Intervention.

"When a patient experiences symptom of a stroke, every minute counts," said James Wang, professor of information sciences and technology at Penn State. "But when it comes to diagnosing a stroke, emergency room physicians have limited options: send the patient for often expensive and time-consuming radioactivity-based scans or call a neurologist – a specialist who may not be immediately available – to perform clinical diagnostic tests."

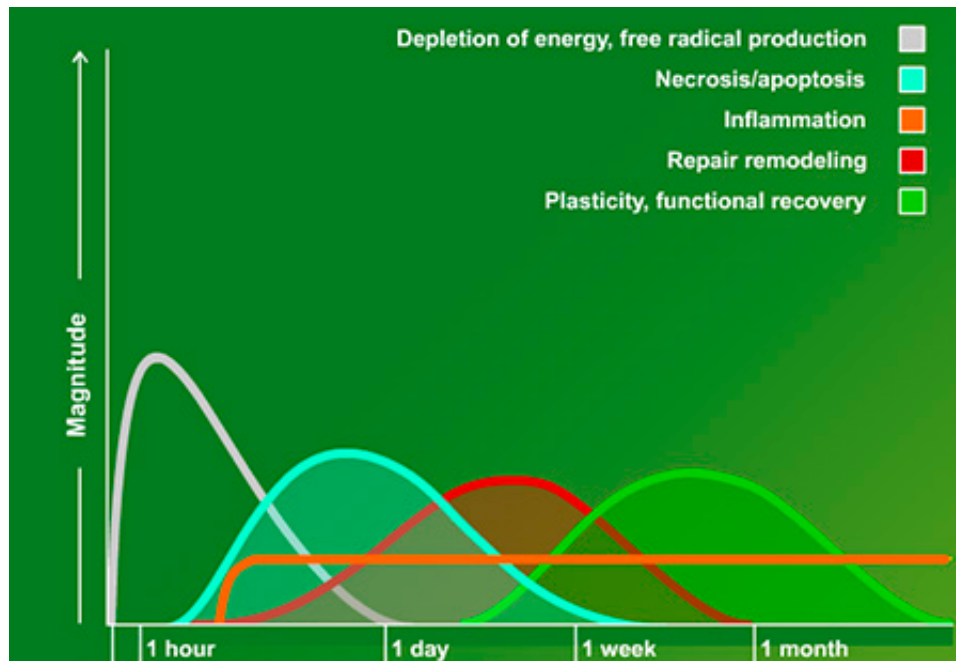
The tool is one of the first use AI to help with stroke diagnosis in emergency settings, according to Sharon Xiaolei Huang, associate professor of information sciences and technology at Penn State. It could significantly change diagnosis of mild to moderate stroke, as the symptoms may be attributed to other conditions in a busy emergency department or by a physician who does not see many transient ischemic attacks or less severe strokes.

"In severe strokes, it is obvious to our providers from the moment the patient enters the emergency department, but studies suggest that in the majority of strokes, which have mild to moderate symptoms, that a diagnosis can be delayed by hours, and by then, a patient may not be eligible for the best possible treatments," explained John Volpi, a vascular neurologist and co-director of the Eddy Scurlock Stroke Center at Houston Methodist Hospital.

Without timely, accurate diagnosis, patients miss the therapeutic window to receive recombinant tissue-type plasminogen activator or early recanalization with stent-retrieval devices that can save brain tissue and function. Misdiagnosed patients also may not receive ongoing monitoring for neurological complications or appropriate rehabilitation.

# DYNAMIC CHANGES FOLLOWING STROKE

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Today, about 50% of stroke cases are misdiagnosed, Wong noted, with about 30% of cases being overdiagnoses and 20% missed stroke cases. “We don’t have enough stroke specialists in the market,” he said. The team hopes the app will give physicians in the emergency room the tool they need to diagnose stroke quickly and accurately without needing to consult with a specialist or obtain additional training themselves.

## How it works

In a casual chat last year, Penn State’s Wang mentioned that his team was working on computer recognition of microexpressions, involuntary facial expressions made by humans, usually in connection with an emotion, that last from half a second to about four seconds. That sparked interest in Houston Methodist’s Wong, who was looking for a way to analyze nonverbal communication for conditions like stroke.

The two groups combined their skills and interests to develop a computer model that can detect abnormalities in a patient’s speech and facial muscle movements indicative of stroke. To initially train the model, the team built a dataset from 84 patients who presented to Houston Methodist’s emergency department with stroke symptoms. Each patient performed a speech test while being

recorded on an Apple Iphone. The recording captures speech issues and challenges with cognitive communication as well as facial, hand and body movement, Wong told *BioWorld*. Currently, a server analyzes the recordings using the team's algorithm.

"The app achieves 79-80% accuracy just using facial and voice alone, as compared to 72% by ER doctor who had all clinical information, physical assessment, and CT imaging result at their disposal," said Wong. The app could significantly outperform the diagnostic accuracy seen in emergency departments with less exposure to stroke.

Missing 20% of cases isn't good enough for the team, which is working to improve the accuracy with a larger dataset. They have launched a clinical trial with 500 patients and 500 controls and created a voice app on Amazon Mechanical Turks to acquire normal subject voice data and pattern via cloud sourcing. Participants will read the standard stroke assessment story, "Cookie Jar Theft," which also is used in the clinical studies. The researchers will not gather normal facial muscle movement as participants read the story, however, "due to the possible privacy issues and need for IRB approval," Wong noted.