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Q&A with neurologists: Can your phone and AI track Parkinson's progression?

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Researchers say we're on the cusp of a new era where physicians will personalize care, adjusting medications and pacemakers based on videos captured at home by patients that can be analyzed by artificial

intelligence.

Despite recent advancements in the treatment of Parkinson's disease, it remains a challenge to accurately measure the progression of symptoms in this neurological disorder. While noticeable symptoms like tremors, stiffness and slowing of movement can be observed, there have been few ways to quantify changes in symptoms outside of a clinical setting—up until now.

Researchers at UC San Francisco have developed a video-based analysis system enabled by machine learning, a type of artificial intelligence (AI), to quantify and validate motor symptom severity in patients with Parkinson's disease (PD).

Co-senior study authors Simon Little, MBBS, Ph.D., associate professor of neurology and Reza Abbasi-Asl, Ph.D., assistant professor of neurology discuss the breakthrough and what role AI plays. The research is published in the journal *npj Parkinson's Disease*.

Why design this system for PD?

Little: Parkinson's disease is the most common and severe movement disorder. It is also the fastest growing neurological disorder and is rapidly becoming more prevalent in the U.S. and around the world. We wanted to design a system using machine learning that would enable us to quantify movements objectively and allow us to tailor treatments to patients individually according to their objectively quantified movements.

Why is it important to quantify PD motor symptoms?

Little: To adjust treatment appropriately. This includes medications and

brain stimulation, tracking patients over time and having sensitive measures for clinical trials.

What is the standard approach to measuring PD motor symptoms?

Little: The standard approach to measuring PD motor symptoms is a subjective qualitative clinical examination by an expert neurologist where a patient repeats movements like finger tapping, foot tapping and hand movements. Historically, clinicians have looked at those types of movements and subjectively scored them with a score: slight, mild, moderate or severe.

There have been quite a number of different efforts to measure things more objectively, using things like wearable sensors on the body, or using other machine learning techniques. So far, those have generally remained at the research level and are only just starting to make their way into useful clinical practice.

What differentiates your system from these clinical approaches?

Little: Our system is quick, objective, quantitative and looks at multiple types of movement, not just the movements covered in the standard clinical examination. It also works on standard video equipment, such as from a smartphone or tablet. This system gives an objective number score to how much the disease is impacting the patient's movements, including changes to the speed or quality of the movements. The system can also look at a bigger library of movements.

Abbasi-Asl: Another key component of our system is its ability to provide explanations on how it can predict PD severity. This enables us

to identify the most common movement patterns in different disease severity groups.

Can you explain how smartphone or tablet videos are translated into measurable data with AI?

Abbasi-Asl: The beauty of our approach is that our AI-enabled system transforms short videos of patients during different movement tasks into digitized and computer-friendly movement data. Our system identifies the different landmarks or body parts on these videos and then uses the movement of those body parts to differentiate between different disease severity groups.

What movements can be translated with your system?

Abbasi-Asl: The AI system is trained to analyze any type of movement in the video data. In our study, we specifically focused on videos of patients walking and moving their hands, but our future work will include other movement types, such as facial expressions and speech.

How does the system capture the severity of PD symptoms?

Abbasi-Asl: Once the AI system captures the movement in video data, our machine learning analysis identifies the most important movement features, such as the speed of finger movement that is associated with a particular severity level. It basically determines whether patients with low or high severity share a particular movement pattern.

Will the system improve assessment of changes in PD motor symptoms over time?

Little: We hope that this technology could accurately measure changes in Parkinson's symptoms over time, which can help with treatment adjustments and measuring patients in clinical trials more accurately.

Abbasi-Asl: The findings from the clinical perspective also highlight some new features of movement that maybe haven't been the primary focus in the past. We can now come up with recommendations highlighting potential new movement patterns in patients that could be predictive of the severity of the disease.

By improving motor symptom diagnosis, can you more effectively personalize treatment?

Little: At the moment, when we see patients in clinic, we assess them and compare where they are today with what they were like three or six months ago. The patient also tells us how they are feeling. They may report fluctuations in symptoms, but it's difficult to know how severe those fluctuations are.

Based on that limited information, we try to assess the next best steps for patients. Should we increase the medication? Should we change a brain pacemaker setting?

So, if we can accurately quantify the patient's symptoms to know how they are doing relative to their last visit, we can know if a treatment intervention made symptoms better or worse.

By having an accurate measure of patient symptoms that is quantitative and reliable, a clinician has a lot more to work with, and they can make sure the patient is getting the best therapy, at the best time and at the right dose, to try to offset their symptoms as much as possible.

Would the information you're getting about patients increase since it would be on a continuous basis rather than just when they are in for a clinic visit?

Little: Absolutely. I think we've kind of been conducting some areas of medicine really broadly in the same way for the last 100 years. We see patients and talk to them. We do an examination in clinic and then we try and make an adjustment of some of their treatments.

But if we can track their fluctuations and their movements at home, we could have a very different style of medical practice where patients are being monitored nearly continuously. That already happens for some conditions—for example, a patient with a cardiac pacemaker is being monitored for what their heart is doing continuously rather than just every six months when they see the clinician. So, I think that's where we could and probably will get to with these kinds of digital tools.

Can the system be applied to other neurological disorders?

Little: Yes. In theory, this could be used to quantify and measure any type of movement deficit—it doesn't have to be restricted to Parkinson's disease. Many other neurological disorders have problems with movement. Our system provides a generalizable way of analyzing movements efficiently.

Our trial analyzed the movements of patients with Parkinson's disease, but it could be used for neurological disorders like strokes, multiple sclerosis and traumatic brain injuries. However, this would need to be validated in these other conditions before we can be certain how accurate it would be.

Do you have any future studies/applications planned?

Abbasi-Asl: The next step for us is to study whether our framework could handle data that is collected at home when patients are just doing their daily activity, or perhaps when using their smartphone or tablet.

This will be a move toward more naturalistic data collection. In this setting, we can look into more complex movement types from a much larger amount of data because patients can essentially do this more frequently without the need to come to the clinic for a visit.

When will the video capture system be put into clinical use?

Little: I'm hopeful that within five years this type of approach will be more common in clinical practice. I think we are at this transformational point, moving from old-fashioned, subjective views of patients to digital transformation. Having more data will enable our models to have even better accuracy.

Currently, this system has been tested and validated in the research laboratory, but the hope is that it can be taken forward through regulatory evaluation to be used clinically and be more widespread.

More information: Daniel Deng et al, Interpretable video-based tracking and quantification of parkinsonism clinical motor states, *npj Parkinson's Disease* (2024). DOI: 10.1038/s41531-024-00742-x

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