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Researchers close in on new technology for objectively measuring pain

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Wunmi Sadik is the director of NJIT's BioSensor Materials for Advanced Research and Technology (BioSMART) Center. Credit: NJIT

On a scale of one to ten, how much pain do you feel?

It's a question many patients get from their doctor in the U.S. each day, often accompanied by the Visual Analogue Scale from 1-10 that was first introduced in clinics in 1921. A century later, the simple assessment is perhaps the most widely used technique for measuring pain—a chronic symptom for 21% of U.S. adults, estimated to cost up to $635 billion annually.

However, while relying on patient self-reporting is the current standard for assessing pain, it's not always a valid and reliable tool, says Wunmi Sadik, chair of NJIT's Department of Chemistry and Environmental Sciences.

"Pain triggers both cognitive analysis and emotions, making its objective measurement challenging," said Sadik. "Determining its intensity, and the underlying cause it signals, is critical not only for effective pain management, but for diagnosis and treatment as well. People addicted to opioids may exaggerate their pain. Children, the unconscious and people with disabilities may not be able to describe their symptoms at all."

As director of NJIT's BioSensor Materials for Advanced Research and Technology (BioSMART) Center, Sadik has led new research into nano-sized analytical sensors for measuring pain biomarkers in the human body—a development that could significantly improve clinical practitioners' ability to manage pain, and potentially reduce cases of addiction in patients.

"The most significant aspect of this work is that it holds the potential for a point-of-care technology that will not require highly trained staff to operate, and will allow cheap and minimally intrusive measures of biomarkers related to pain," said Sadik, whose research has been supported by the SUNY Health Network of Excellence Program.

Sadik says her lab's biosensors measure two biochemical compounds that appear in the bloodstream when pain is present—cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS)—requiring only a patient's finger-prick blood samples for analysis.

The team has also implemented artificial intelligence to offer clinicians an easy-to-grasp summary of the results, which can be processed within minutes.

"Our approach combines calibratable measures of pain-related biomarkers with patient self-assessments of perceived pain using AI methods, which can provide a view of how consistent the inflammatory markers are with the reported pain to corroborate," explained Sadik.

The technique has demonstrated promising accuracy.

In the journal *JMIR Biomedical Engineering*, the team published results of the first clinical trials testing the approach with patients experiencing various levels of pain from Manisa Merkez Efendi State Hospital in Manisa, Turkey.

"Our preliminary data from trials with 379 patients showed close to 80% consistency between the biomarker data and the patient's self-reported pain," said Sadik. "It's encouraging. … Similar to the FDA's accuracy requirements for continuous glucose monitoring systems, we expect the pain biosensor accuracy to be greater than or equal to 87% within ±20%."

Sadik's lab has now begun testing their biosensors with healthy volunteering athletes at NJIT, comparing levels of pain biomarkers with patient's self-assessment in response to increasing applied temperature using Medoc thermal simulation technology.

"This stage is important to create baseline levels of the biomarkers in healthy volunteers," said Sadik. "After establishing this, our next step is to work with our partners to fabricate these sensors for real-world application. Ultimately, we anticipate a hand-held, field-deployable device that can offer health care professionals valuable insights into patient pain."

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