# Researchers develop rapid test for detecting fentanyl

February 5 2024, by Kim Horner

UT Dallas bioengineering researchers Ivneet Banga Ph.D.'23 and Dr. Anirban Paul demonstrate how a sensor their team developed can detect fentanyl. The researchers drop liquid directly on the sensor platform, which is connected to a laptop and provides results within seconds. Credit: The University of Texas at Dallas

University of Texas at Dallas researchers have developed a first-of-its-kind, handheld electrochemical sensor that can accurately detect fentanyl in urine within seconds.

The proof-of-concept technology can detect even trace amounts of fentanyl with 98% accuracy using a small portable device without costly and time-consuming lab analysis. A study demonstrating the device was published in the Jan. 10 print edition of the *Applied Materials & Interfaces*.

The prototype, which could be used to test for fentanyl via urinalysis, is a precursor to a test to detect the drug in saliva, said Dr. Shalini Prasad, professor and department head of bioengineering in the Erik Jonsson School of Engineering and Computer Science. The technology also could be used to test substances for fentanyl by mixing a sample with water and dropping the liquid onto the sensor.

"There is an urgent demand for an easy-to-use, portable, miniaturized device that can detect fentanyl with high specificity and share results immediately to an internet-connected device," said Prasad, corresponding author of the study and a Cecil H. and Ida Green Professor in Systems Biology Science. "Our study demonstrates the feasibility of a highly accurate sensor to detect fentanyl within seconds."

Fentanyl is a synthetic opioid 50 times more potent than heroin and 100 times more potent than morphine, according to the Centers for Disease Control and Prevention. Illegally made fentanyl is commonly mixed with other drugs, and an amount as small as 2 milligrams—equal to 10 to 15 grains of table salt—can be lethal. More than 150 people die every day from overdoses related to synthetic opioids like fentanyl.

Research has determined fentanyl is detectable in urine for up to 72 hours. UT Dallas researchers are working to advance the technology to

detect fentanyl in hair. Their ultimate aim is to develop a test to detect fentanyl in saliva. A saliva test could help first responders make treatment decisions for someone who has overdosed, Prasad said.

The device contains an electrochemical sensor, which generates electrical signals based on chemical reactions. Developing a sensor to detect fentanyl posed a challenge, however, because the synthetic opioid is a nonvolatile compound, which means it does not produce an electrochemical signature.


From left: Dr. Sriram Muthukumar, Dr. Anirban Paul, Dr. Shalini Prasad and Ivneet Banga Ph.D.'23 developed a sensor that can detect even trace amounts of fentanyl with 98% accuracy. Credit: The University of Texas at Dallas

To capture fentanyl with an electrochemical sensor, researchers used a molecular cage-like structure they compared to a mousetrap. The trap consists of several substances, including gold nanoparticles. For the "cheese," researchers had to get creative.

Bioengineering researcher Dr. Anirban Paul, first author of the paper, used reverse engineering to find a solution. Paul, who moved from India to work with Prasad, decided to try using naloxone, a lifesaving medication that can reverse an opioid overdose. The researchers conducted computational tests to understand how the compounds interact so they could determine how to deploy naloxone to draw fentanyl to it like a magnet.

"Naloxone is used to decrease the power of fentanyl," Paul said. "I had the idea to use naloxone to capture fentanyl, like cheese to catch a mouse."

Researchers tested urine from a lab that was spiked with low, medium and high levels of fentanyl. The urine is dropped onto a test strip. If the drug is present, the naloxone interacts with it and generates a signal. The device detected fentanyl up to 100 parts per million in spiked urine samples.

Study author Ivneet Banga Ph.D.'23, a research project manager in bioengineering, helped plan the experiments and synthesize the materials. Last year as a doctoral student, Banga won a second-tier Baxter Young Investigator Award for a handheld breath analyzer that can detect respiratory diseases, including COVID-19, in seconds. She said she hopes the fentanyl sensor can help prevent deaths from overdoses.

Prasad and her team have developed a variety of electrochemical sensors, including technology to detect biomarkers of infections, such as

COVID-19, in sweat, as well as biomarkers for flare-ups of inflammatory bowel disease. Last year, they developed a test to measure THC, a major active component in marijuana, in saliva with 94% accuracy.

The fentanyl sensor was developed in collaboration with EnLiSense, an Allen, Texas, company that develops lifestyle-based sensors and devices. Prasad and the current study co-author Dr. Sriram Muthukumar are co-founders of EnLiSense.

**More information:** Anirban Paul et al, Naloxone-AuNPs@ZIF-8-Based Impedimetric Sensor Platform for Ultrasensitive Detection of Fentanyl and Fabrication of Fen-Track Prototype for Real-Field Analysis, *ACS Applied Materials & Interfaces* (2023). DOI: 10.1021/acsami.3c14246

Provided by University of Texas at Dallas