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Nanotechnology sensors redefine early disease detection with AI-powered diagnostics

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Dr Paramita Kar Choudhury shared her perspective at the 14th Bengaluru INDIA NANO Conference 2026



Nanotechnology is rapidly transforming healthcare diagnostics, enabling diseases to be detected earlier, faster and more accurately than ever before. From analysing a patient's breath for metabolic disorders to identifying life-threatening infections within minutes, nanoscale sensors are emerging as one of the most promising frontiers in precision medicine.

Speaking at the 14th Bengaluru INDIA NANO Conference 2026, Dr Paramita Kar Choudhury, Senior Scientist in the Embedded Devices and Intelligent Systems (EDIS) group at Tata Consultancy Services Research, highlighted how nanotechnology-enabled sensors are moving beyond laboratories to develop practical, point-of-care diagnostic solutions capable of reshaping healthcare delivery.

"Nanotechnology allows us to interact with biological systems at the molecular level, providing unprecedented sensitivity and specificity for disease detection," she said, adding that the convergence of nanomaterials, microelectronics, artificial intelligence (AI), and data analytics is opening a new era of personalised healthcare.

Breath Analysis for Prediabetes

Among the projects presented was a non-invasive diagnostic platform that employs Chemi resistive nanosensors to detect volatile organic compounds (VOCs) in human breath for prediabetes monitoring.

Unlike conventional blood-based glucose testing, breath diagnostics could offer a painless, rapid and repeatable method for identifying metabolic changes before the onset of overt diabetes. The sensor arrays identify disease-associated VOC signatures with high sensitivity, making continuous health monitoring more practical for both clinics and home-based settings.

The work aligns with a growing global trend toward wearable and non-invasive diagnostics, where breath, sweat and saliva are increasingly viewed as valuable sources of health biomarkers.

SERS Nanosensors Target Early Sepsis Detection

Another major focus of the presentation was the application of Surface Enhanced Raman Spectroscopy (SERS)-based nanosensors for early prediction of sepsis.

Sepsis remains one of the leading causes of mortality in intensive care units because diagnosis often occurs after the infection has already progressed. By amplifying molecular signals thousands to millions of times, SERS-based nanostructures enable clinicians to detect subtle biochemical changes associated with sepsis at much earlier stages.

Earlier identification could significantly improve treatment decisions, reduce mortality and lower healthcare costs by enabling timely interventions.

Lab-on-Chip Technology for Rapid UTI Diagnosis

Dr Paramita also showcased microfluidic lab-on-chip nano biosensors designed for rapid diagnosis of urinary tract infections (UTIs).

Traditional microbiological culture methods can take 24–72 hours to confirm infections. The miniaturised nanobiosensor platform integrates microfluidics with nanotechnology to rapidly analyse patient samples at the point of care, potentially reducing diagnosis times from days to minutes.

Such portable diagnostic devices are expected to play an important role in primary healthcare, emergency medicine and rural health systems where laboratory infrastructure is limited.

Dr Paramita emphasised that translating scientific innovation into deployable healthcare products remains a key objective. "These cutting-edge technologies are not just futuristic concepts, they are tangible innovations that promise to revolutionise disease detection, bringing us closer to a world where early, accurate, and personalised healthcare is accessible to everyone", she concluded.

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