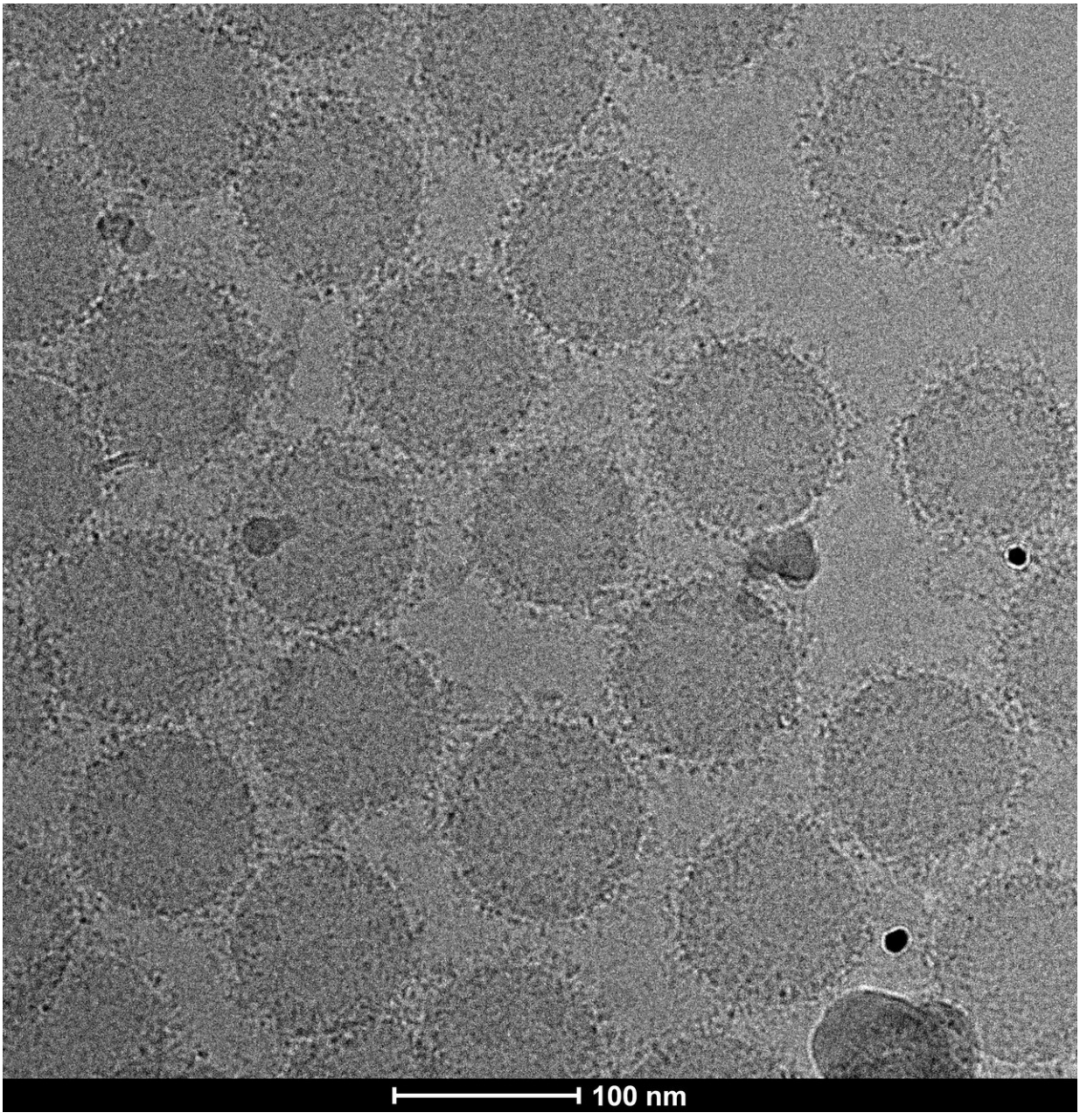
Innovative technique uses sensory nanoparticles to detect disease

June 17 2019



Transmission electron microscopy image showing the formation of biomolecular corona around the surface of nanoparticles. Credit: Morteza Mahmoudi, Brigham and Women's Hospital

Investigators from Brigham and Women's Hospital are taking advantage of a unique phenomenon of nanoparticles to develop a test for early detection of different types of diseases, including cancer.

Through previous investigations, Morteza Mahmoudi, Ph.D., now a biomedical investigator in the Department of Anesthesiology, Perioperative and Pain Medicine, and colleagues have shown that biomolecules in the blood of healthy individuals and patients form various corona profiles around nanoparticles. Like dipping a donut hole in powdered sugar, nanoparticles collect a unique coating of proteins from the blood. In a new study published in the *Royal Society of Chemistry's* peer-reviewed journal *Nanoscale Horizons*, Mahmoudi and the team present evidence that these coronas are personalized and precise, with different compositions or patterns in people with cancers. They have developed a sensor array that has been tested on blood samples, both from people diagnosed with five different types of cancer as well as purportedly healthy people who went on to have a cancer diagnosis several years later. The team's goal is to develop an early detection test that could be used in the clinic to identify those at risk of cancer and other diseases.

"For cancer and many other catastrophic diseases, the earlier you can diagnose, the more likely you can treat and extend survival and attain better quality of life," said Mahmoudi, the paper's corresponding author. Mahmoudi is the former director of the nanobio interactions laboratory at Tehran University of Medical Sciences where he began this work in

2014. "The goal here is to develop a strategy to help people get better information about their health. Today, in the clinic, we have ways to measure lipids and predict risk of cardiovascular disease, but limited ways for cancer. If everything goes well, we hope our work will lead to a screening test for the earliest signs of cancer."

To carry out their investigation, the team combined the concepts of disease-specific protein coronas with sensor array technology. Sensor arrays can identify a wide variety of interacting chemical and biological compounds all at once rather than in isolation. To test blood samples for early patterns of disease, the team developed a sensor array that consisted of three different cross-reactive liposomes—fatty molecules that caused protein coronas to form around them. The team tested samples from five patients, each with a different form of cancer: lung cancer, glioblastoma, meningioma, myeloma, and pancreatic cancer. The team found that the selected pattern of corona composition, through advanced classification techniques detected by the nanoparticle sensor array, provided a unique "fingerprint" for each type of cancer. The team also tested the tool using blood from 15 people who were subsequently diagnosed with brain, lung, and pancreatic cancer up to eight years later, finding that their approach could identify and discriminate the cancers at the very early stages.

Although promising, as with other diagnostic approaches, the team's preliminary results will need to be validated in a larger number of people to make sure the test not only works but also provides accurate diagnostic information. Mahmoudi and his colleagues are also interested in applying the technology beyond cancer to diagnose other diseases at an early stage.

"The only reason I'm in science is to do something that can help patients," said Mahmoudi. "When I see predictions about cancer, the number of new cases each year and its global burden, it excites me to

think that our multidisciplinary expertise in nanobio interfaces, sensor array, and advanced statistics may offer a way to help. There is so much potential here and we are working to tap into it."

More information: Giulio Caracciolo et al, Disease-specific protein corona sensor arrays may have disease detection capacity, *Nanoscale Horizons* (2019). DOI: 10.1039/C9NH00097F

Provided by Brigham and Women's Hospital