Northeastern University

Accurate, Inexpensive, and Fast Coronavirus Testing—Three Potential Solutions

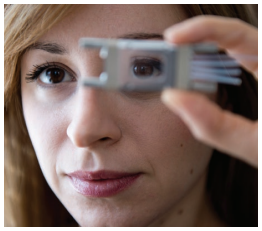
Developing a reliable stock of accurate, simple, inexpensive, and fast SARS-CoV-2 tests that can be mass produced has emerged as the key issue in getting people back to work safely and getting economies running again.

Currently, the two main approaches for large-scale SARS-CoV-2 detection are serological assays, which detect patient antibodies, and polymerase chain reaction (PCR) assays, which detect viral RNA sequences. While useful, these methods have significant limitations: Serological tests have considerable false-negative and false-positive rates and identify persons who have already been infected and have developed immunity against COVID-19. PCR-based detection of viral RNA is only 50 to 70 percent accurate and is also still detectable in the body many weeks after clearance of the infectious virus. Below, we describe three representative projects by Northeastern faculty, each of which is designed to overcome some or all of these limitations:

Professor Meni Wanunu has designed a diagnostic method that employs DNA hybridization methods to detect the presence of intact SARS-CoV-2 virus capsids, a proxy for active, infectious virus. This methodology is ultra-sensitive (with potential to detect even one virus per sample), draws from standard molecular reagents, and can detect the virus from persons or surfaces. It can be formulated into detection kits that support rapid high-throughput testing or rapid self-administered tests.

Because the test identifies active infections only, test results will support much better decision-making in terms of when to practice isolation and when to seek medical attention. The test can be modified to a number of distinct, highly practical use cases. For example, it could be self-administered via saliva swab and visually detected within about 30 minutes. For facilities equipped with PCR expertise, like an airport, prospective passengers could be evaluated for the active virus within about an hour. This technology could alternately be deployed on a population scale, by collecting and sequencing samples across a community of potentially exposed individuals and generating test results for up to millions of patients within about two days.

Professor Ming Wang's novel, non-invasive, and rapid viral detection system is designed to identify intact viruses or their protein components through saliva. The test works via a protein-protein binding assay that employs two virus-binding proteins to minimize false positive and negative results. This platform leverages the Wang Lab's 10 years of experience in salivary glucose monitoring for diabetes. This approach has many advantages: it has a high detection rate of greater than 95 percent; POC rapid detection within three minutes, including sampling time; it is an excellent method for asymptotic detection; it minimizes the chance of exposing healthcare workers to the virus; it is suitable for port-of-entry facilities, physician offices, military installations, urgent care centers, and long-term nursing facilities; the kit is reusable for detecting various influenza viruses by changing sensor strips; and it has an affordable, per-household price of $100 per kit with ten test strips, which are sharable with family members.



Professor Tali Konry's lab recently developed a microchip-based technology, ScanDrop, to evaluate cellular interactions. Her lab is proposing to adapt this innovative technology to detect the coronavirus RNA at extremely high sensitivity and accuracy. This diagnostic tool would be a one-step, easy-to-use test that offers results in less than an hour; could be detected by the naked eye (i.e., would not require laboratory analysis); and could be easily transported to any hospital or even used at home. In short, the test will be cheaper, faster, and easier to use than anything currently available.

Funding will support staffing, equipment, and lab supplies. In addition, funding partners could help bring successful technologies to market and underwrite instructional resources and training for the administration of tests.