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Singapore scientists develop Covid-19 test method that delivers results in 36 minutes

(From left) Associate Professor Eric Yap, PhD candidate Wee Soon Keong and senior research fellow Sivalingam Paramalingam Suppiah from NTU LKCMedicine have found a way to improve the speed, handling time and cost of Covid-19 laboratory tests.

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SINGAPORE — Scientists at the Nanyang Technological University (NTU) have discovered a way to improve the speed of obtaining Covid-19 test results by up to four times.

The improved testing method for Covid-19 yields results in 36 minutes — about a quarter of the time required by existing gold-standard tests. The current testing method requires highly trained technical staff and can take a few hours before results are finalised.

NTU said on Monday (July 27) the test can be done with portable equipment and could be deployed in the community as a screening tool.

Testing is a key part of the Government's strategy to isolate and ring-fence Covid-19 cases to prevent large clusters from forming. Since July 1, individuals aged 13 and older who present with symptoms of acute respiratory infection will be tested for Covid-19 at first presentation to a doctor.

The new method, developed by scientists at NTU's Lee Kong Chian School of Medicine, has demonstrated a way to improve "the speed, handling time and cost of Covid-19 laboratory tests", the university said.

Currently, the most sensitive method of testing for the coronavirus is through a laboratory technique called polymerase chain reaction (PCR), where a machine amplifies genetic material by copying it over and over again so any trace of the coronavirus can be detected.

A big problem is purifying the ribonucleic acid (RNA) from other components in the patient sample — a process that requires chemicals that are now "in short supply worldwide", NTU said.

"The method developed by NTU LKCMedicine combines many of these steps and allows direct testing on the crude patient sample, cutting down the turnaround time from sample-to-result, and removing the need for RNA purification chemicals," the university added.

PCR tests have proven to be "a workhorse" for biological research but it has some drawbacks, said Mr Wee Soon Keong, who is the first author of the research paper that has been published in the scientific journal Genes.

"The process is fiddly and time-consuming. Our rapid Covid-19 test involves a single-tube reaction that reduces hands-on time and biosafety risk for lab personnel, as well as the likelihood for carryover contamination during the processing of samples," he added.

The same method can also be used to detect other viruses and bacteria, including dengue. The number of dengue cases this year is set to surpass the 22,170 cases in 2013 — Singapore's worst outbreak.

THE NEW METHOD

In PCR tests, the genetic material on the swab sample has to be extracted to remove substances in the sample that prevent the test from working. One example of an inhibitor is mucin, a main component of mucus.

The test designed by the NTU team uses the "direct PCR method", but removes the need for RNA purification — a time-consuming and costly step.

"Instead, they added inhibitor-resistant enzymes and reagents targeting compounds that obstruct RNA amplification, such as mucin… these enzymes and reagents, which are commercially available, have high resistance to such compounds that otherwise inhibit PCR, rendering the test inaccurate," said NTU.

The biochemical mix of crude sample and inhibitor-resistant enzymes and reagents is placed into a single tube, which is inserted into a laboratory thermocycler, a machine used to amplify genetic material in PCR. After 36 minutes, results reveal whether there is any trace of Covid-19 "with confidence".

The team also tested this method on a portable thermocycler, which can be deployed in low-resource settings and endemic areas, pointing to the possibility of having this test done in community healthcare settings by frontline healthcare workers.

Senior research fellow, Dr Sivalingam Paramalingam Suppiah, said: "By skipping the RNA extraction step with our direct-PCR method, we see cost savings on nucleic acid extraction kits, and avoid the problem of reagents in short supply when lab testing is ramped up and the demand increases globally."

Associate Professor Eric Yap, leader of the research team, said the team is now trying to deploy such methods for routine diagnostics.

"We need to determine the actual utility and benefits in a real-world setting, and to understand if there are any trade-offs. When one bottleneck is removed, other challenges may emerge — like ensuring quality control, or reducing manual errors.

“Our goal is to develop ultrafast and automated tests that yield results in minutes, and that can be performed by healthcare workers in the clinic with similar accuracy and sensitivity as in specialised laboratories,” he added.

“This will allow us to take PCR testing out of conventional laboratories nearer to the point-of-care, and into the low-resource settings that need them the most.” CNA