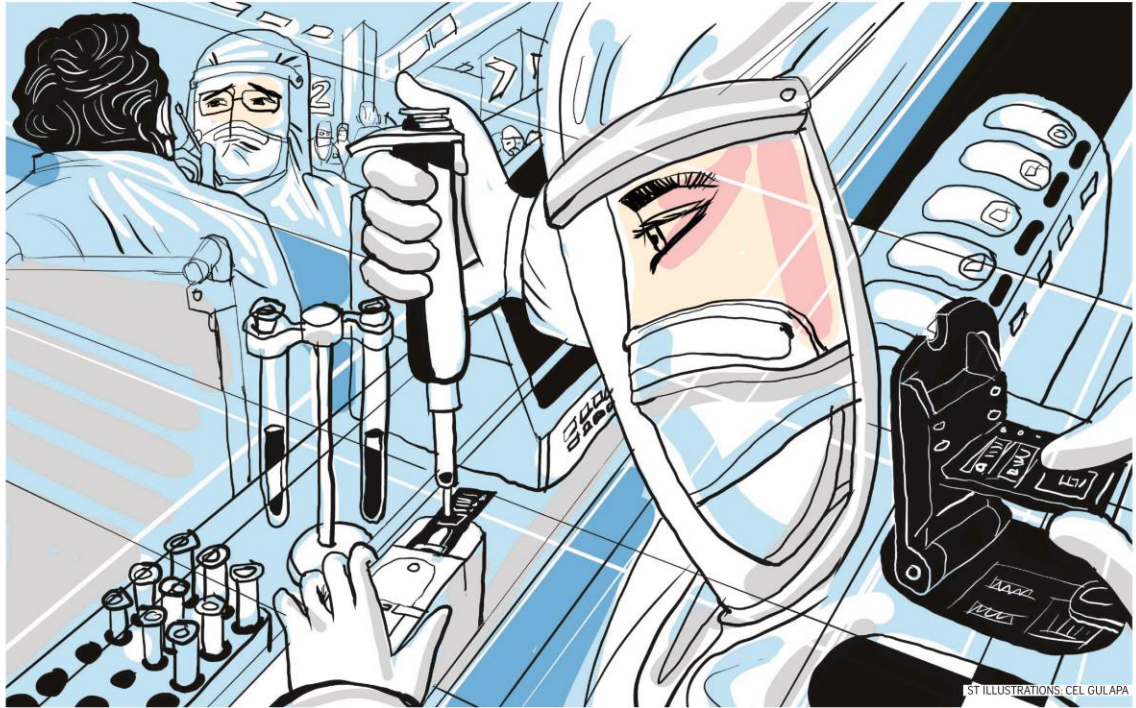


The coronavirus pandemic has put Singapore's research and development capability in the spotlight. Scientists here are racing to develop faster diagnostic and screening tests, and a potential vaccine. Senior Health Correspondent **Joyce Teo** looks at what Singapore and the world are doing to test, treat and prevent Covid-19



ILLUSTRATIONS: CEL GULAPA

Singapore scientists on the front lines of fight against Covid-19

TO TEST

Professor Jackie Ying, who heads the NanoBio Lab at the Agency for Science, Technology and Research (A*Star), and her team have come up with a rapid test that can tell if a person has Covid-19 in as little as five minutes. When approved, this would be about the fastest test out there for Covid-19.

They hope to submit the test for approval in a month's time. The test looks for the genetic material of the virus in a patient's secretions collected from a swab.

This sample is then put in a portable device that will give the result in about five to 10 minutes, using an extremely rapid amplification method that they have named Cepath.

"We have done some preliminary clinical validation at the KK Women's and Children's Hospital using real patients' samples, and found the test to be very sensitive and accurate," said Prof Ying.

Once it is approved, the technology can be used to make such kits for use in hospitals. It will also be adapted for use in general practitioner clinics, said Prof Ying.

She and her team are among the researchers here and around the world who are racing to come up with point-of-care tests that can tell you if you have Covid-19 much faster than the current standard lab test. The challenge, Prof Ying said, is to develop rapid and accurate diagnostics that can be done without the use of expensive machines.

As the pandemic grows, the spotlight is increasingly falling on testing as a way to contain the spread —

for the lack of it has potentially been hiding a large number of cases.

The World Health Organisation has emphasised the need to "test, test, test", as it allows cases to be picked up earlier and promptly isolated, before they spread it to more people.

Some countries are able to do widespread testing; others, like the United States, are experiencing a shortage of tests.

In Singapore, testing started in January at the National Centre for Infectious Diseases, where the National Public Health Laboratory is based. By the end of January, all of Singapore's public hospitals could test for Covid-19, said the group director of medicine at the National University Health System, Professor Dale Fisher. Singapore then tested anyone coming to a hospital with a respiratory illness and anyone who had been in contact with a Covid-19 patient.

"Less than 1 per cent of tests are positive, which reflects the large number being done," he said.

These are the standard lab tests that look for the genetic material of the virus in the patient's secretions, often collected with a nasopharyngeal swab.

The test takes at least two to three hours to show results and requires the use of specialised machines. If samples need to be transported, the turnaround time is even longer.

These tests work by first converting the coronavirus' RNA to DNA in a method known as reverse transcription (RT). Then, the polymerase chain reaction (PCR) technique is used to amplify the genetic material of the virus so that it can

be easily detected.

It is called the RT-PCR test. "It is essentially a molecular photocopier. PCR was invented in 1984, and even in today's machines, about 60 per cent of the time is spent waiting for the PCR machine to heat up and cool down," said Prof Ying.

The latest invention by her and PhD student Muhammad Nadjad AbdulRahim is a new method to amplify specific DNA/RNA at a single temperature.

Just like PCR, their method can "photocopy" the genetic material of the virus millions of times. The difference in their new method is that they can hit a rate of millions of copies within a minute.

One key reason is that unlike PCR, their approach does not require any heating and cooling between each controlled amplification step. This is enabled by a special enzyme developed in Prof Ying's lab.

Prof Ying said she and her team of scientists have been working tirelessly for around six weeks to come up with the fast test, after A*Star's chief executive Frederick Chew gave them the challenge of coming up with rapid tests for Covid-19. Earlier, A*Star had developed PCR test kits for use here and overseas, and has passed the baton to local firm MIRXES, which can mass produce them.

Another local biotech firm Verudus Laboratories developed a three-hour PCR test kit that is being used at checkpoints here.

Associate Professor Hsu Li Yang, the programme leader for infectious diseases at the National University of Singapore's Saw Swee Hock School of Public Health, said that there are many diagnostic tests



Professor Jackie Ying (in pink headgear), the head of A*Star's NanoBio Lab, said she and her team of scientists have been working tirelessly for around six weeks to come up with a rapid test that can tell if a person has Covid-19 in as little as five minutes, after A*Star's chief executive Frederick Chew (third from left) gave them the challenge of coming up with rapid tests for Covid-19. The test looks for the genetic material of the virus in a patient's secretions collected from a swab. PHOTO: COURTESY OF JACKIE YING

and kits being developed in China and the US, as well as those by local companies such as MIRXES and Verudus Laboratories, and it is a matter of time before the ones from overseas are available here.

US firm Cepheid has received emergency authorisation from the US Food and Drug Administration for its rapid molecular test, which can be used at the point of care for patients and gives a result in 45 minutes. It makes use of machines to run the test, which are already available in Singapore hospitals.

Other types of tests done to find Covid-19 in patients are the serological tests. These look for immunoglobulins, which are the antibodies made by the immune system

to fight the virus — in patients' blood.

These antibodies take a few days to show though, and will not appear in the early stage of the disease. Hence, a blood test will not detect Covid-19 if someone has just been infected with it.

Duke-NUS Medical School was the first in the world to develop a serological test that was put to good use last month to trace two people who were the source of infection of two clusters here.

The two had mild symptoms, were not hospitalised and had recovered, but the test found they had antibodies against the coronavirus.

As serological tests pick up such

mild cases, they can be done to ascertain the extent of community spread, as well as asymptomatic spread.

Such tests, however, take several hours to show results. Fast test kits solve the problem but it is very important to note the sensitivity of the tests, said Prof Ying.

There is little point using a very fast test kit when it cannot detect the virus in you most of the time. Or, worse, it may tell you that you are not sick, even though you are infected with Covid-19.

The latter is what is called a false negative, and it can happen, for instance, when the test kit is unable to pick up the virus in a person with a low viral load.

People infected with Covid-19 are believed to shed large quantities of the virus early in their illness (high viral load) and less later on.

Hence, it would be best if a fast test can pick up the infection from a patient at various stages of the disease, regardless of whether he has a high or low viral load, said Prof Ying.

On Saturday, the US Food and Drug Administration said it is already beginning to see unauthorised fraudulent test kits that are being marketed to test for Covid-19 in the home.

Fraudulent health claims, tests and products may keep some patients from seeking care or delay necessary medical treatment, it said. "When you run a test, you must know what you are testing for," said Prof Ying.

An RT-PCR test should be able to detect the disease in someone who is in the earlier stage of the disease, when he is shedding more of the virus, and, therefore, likely more infectious.

On the other hand, a serological test can find antibodies in someone who is at the late stage or recovered, when he is shedding less or none of the virus, she said.

"This crisis has forced Singapore to re-examine whether we have the ability to do the various things needed to fight it and we do," she said. "We can do the science and we can also develop our own tests."

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