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.

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

TO TEST

Professor Jackie Ying, who heads the National Lab at the Agency for Science, Technology and Research (A*STAR), has a team whose work is coming 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 or two. The test looks for the genetic material of the virus in a patient's sputum collected from a nose swab.

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

"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 practitioners' 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 hindering 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 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 medical at the National University Health System, Professor Duke Fisher. Singapore then traced anyone coming in to 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 nasalpharyngeal swab.

The test takes at least two to three hours to do and results are required by use of specialised machines, if samples need to be transported, which can take time when handled.

"These tests work by first converting the coronavirus' RNA to DNA in a process 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," he said.

It is called the RT-PCR test. It is essentially a molecular photocopier. PCR was invented in 1983, 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 A*Star and PhD student Muhammad Nadaf Abdul Rahim is a new method to amplify specific DNA/SNA 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 catch a ratio 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 that her team of scientists have been working tirelessly for around six weeks to come up with a fast test that can tell if a person has Covid-19 in as little as five minutes, after A*Star's chief executive Frederick Chew (both from CapT) 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 sputum collected from a so-called "swab". (PHOTO COURTESY OF JACQUEE YING)

Another key launch from Vere- don 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 and kits being developed in China and the US, as well as in local companies such as MIKES and VeroMed Laboratories, and it is a matter of time before cases from overseas are available here.

U.S. 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 one of machines to run the test, which are already avail- able in Singapore hospitals.

Other types of tests done to find Covid-19 in patients are the serological tests. These look for immuno-globulins, which are the anti- bodies made by the immune system to fight the virus – in patients' blood.

These antibodies take a few days to show through, 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 patients here.

The two had mild symptoms, were not hospitalised and had no close contacts, 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 kit solve the problem but it is very important to rule out 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 sick, even though you are immune to 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 someone with a low viral load.

People infected with Covid-19 are believed to shed large quantities of the virus early in their illness (when viral load is low and later on so that it would be too late to use 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 nearing beginning to see unautho- rised fraudulent test kits that are be- ing marketed to test for Covid-19 in the home.

Fraudulent health claims, tests and products may keep some pa- tients 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 recov- ery, when he is shedding less or some of the virus, he said.

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