

Why NTNU developed a new test method

After several weeks of intensive testing for the coronavirus, St. Olavs hospital in Trondheim was running out of test equipment.

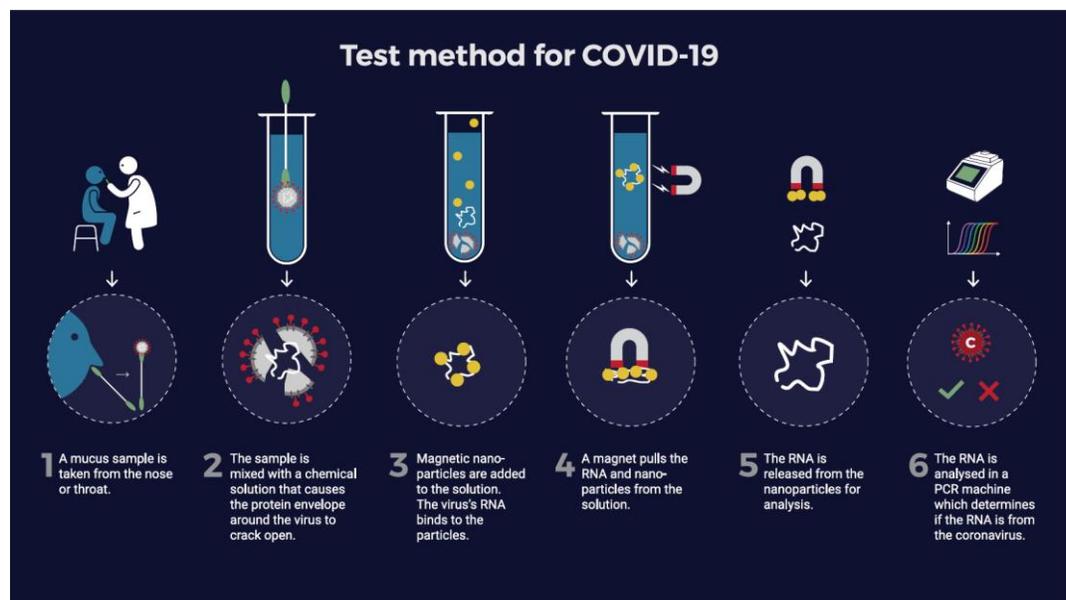
To prevent a shortage of test materials, as well as limit the country's dependence on commercial sources for test equipment, researchers from NTNU's Department of Clinical and Molecular Medicine and the Department of Chemical Engineering teamed up to develop their own test method.

The result is a new method based on known processes, that uses an in-house chemical mix and NTNU-crafted magnetic nanoparticles. Preliminary results indicate that the NTNU test is at least as sensitive as the best methods on the market.

How does the new coronavirus test work?

The coronavirus test involves several steps:

1. A sample is taken from nose and/or throat.
2. The sample is mixed with a chemical solution that causes the protein envelope around the virus to crack open so that the virus's RNA (genetic material) is released.
3. The sample is then mixed with magnetic nanoparticles to which the coronavirus RNA binds.
4. The magnetic nanoparticles, covered with RNA, are extracted from the solution with a magnet.
5. RNA is released from the nanoparticles by adding water.
6. A standard PCR analysis determines if the sample contains coronavirus RNA.



Here's how NTNU developed an effective coronavirus test

1. Researchers optimized a process to identify small amounts of the coronavirus

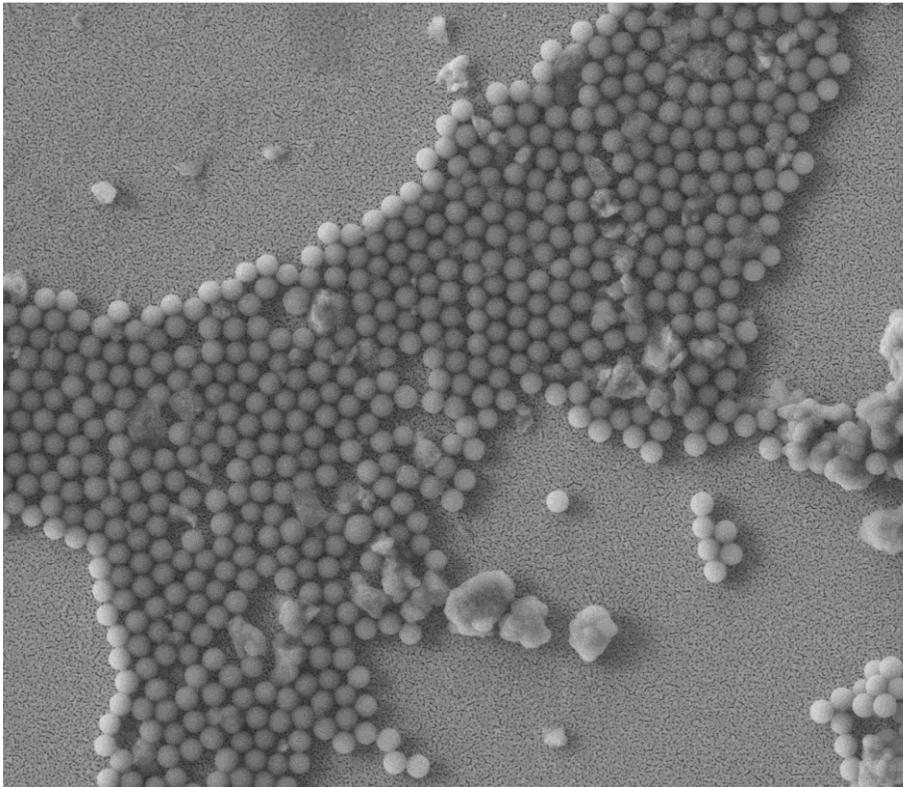
An RNA molecule is essentially the genetic material from the coronavirus. The RNA molecules of the virus are protected by a protein envelope and are closely surrounded by other molecules. That means when a sample is taken from someone infected with the virus, the first challenge is to "unpack" the virus's RNA so that it can be analysed.

NTNU has developed a specific combination of polar solvents, buffers, salts and other chemicals to achieve this without damaging the RNA molecule itself. NTNU researchers were able to optimize this combination to extract RNA from small amounts of virus.

2. Magnetic nanoparticles efficiently capture RNA from the coronavirus

Once the RNA molecules have been liberated from the virus, they must be extracted from the solution for analysis. The NTNU test uses iron oxide magnetic nanoparticles covered with a substance that strongly binds RNA. Once the magnetic nanoparticles are coated with the viral RNA, they can be removed from the solution using a magnet.

NTNU has developed and filed patent applications on an upscalable process for producing these high-quality, high-performance magnetic nanoparticles. The newly developed technology allows the NTNU lab to produce particles for roughly 10,000 tests in one production cycle. The process can then be further scaled up by running several production lines in parallel. Today, NTNU can produce at least 100,000 tests a day. It is possible to scale up this process even further.



An image of the magnetic nanoparticles used in NTNU's COVID-19 test (click for larger version of the image).

Photo: Electron microscope image taken by NTNU NanoLab, April 2020.

Interdisciplinary team

The work has been done by researchers from three different departments at NTNU in close collaboration with staff at St. Olavs Hospital. The results illustrate how new interdisciplinary teams of researchers can solve societal challenges in an efficient manner.

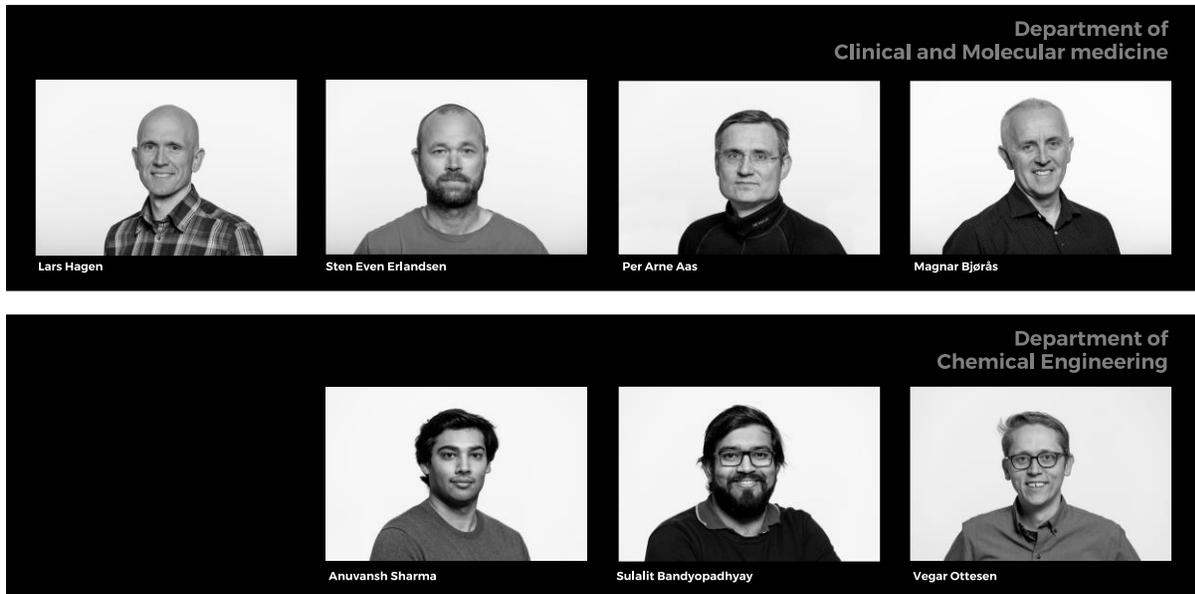


Photo: Geir Mogen / NTNU

NTNU COVID-19 test provided to the Norwegian health care system

NTNU has been commissioned by the Norwegian Directorate of Health to provide COVID-19 tests for Norway's health care system.

The university is already delivering 300,000 tests per week to Norwegian university hospitals. By further scaling up production, up to 5 million tests can be delivered per week.

The COVID-19 tests will be used to test everyone who has symptoms of COVID-19, and in some cases to test people who are asymptomatic.

The Norwegian Institute for Public Health and the Directorate of Health will continuously update the status of testing and future plans here.

The newly developed test effectively means that access to tests is no longer be a limiting factor in the ability of the Norwegian health care system to test for the coronavirus.