

Periodic Graphics

A GUIDE TO COVID-19 TESTING

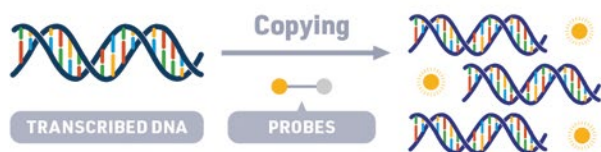
NUCLEIC ACID TESTS

Nucleic acid tests detect the virus's genetic material to confirm that a person is currently infected with the virus.

HOW DO THE TESTS WORK?



Virus RNA is extracted from a nose or throat swab. An enzyme called a reverse transcriptase converts the RNA to DNA.



In some tests, polymerase chain reaction makes millions of copies of the transcribed DNA. Short, virus-specific oligonucleotide probes with a fluorophore on one end bind to the copies. An enzyme cleaves the probe, causing fluorescence and confirming infection.

TEST BENEFITS AND LIMITATIONS



These tests give accurate results early in the infection. Patients can collect their own swab samples at home and mail them to a lab for testing.



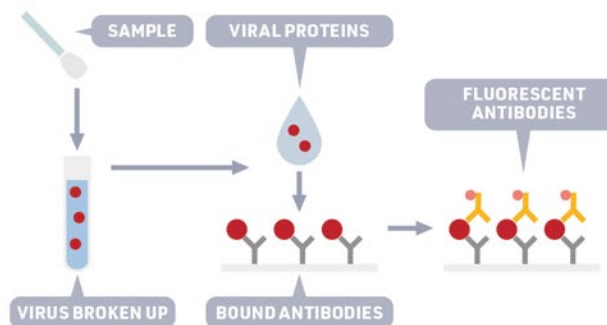
Accuracy of the test drops later in infection. It can only tell you if you have an infection now—it can't tell if you had an infection in the past.

ANTIGEN TESTS

Antigen tests look for fragments of viral proteins to confirm that a person is currently infected with the virus.

HOW DO THE TESTS WORK?

Antigen tests can be carried out in a variety of ways. Most use a sample collected on a swab, though some use blood samples.



Virus in a collected sample is chemically broken up in solution and added to a slide coated in antibodies. The antibodies bind to the viral proteins. Then, fluorescent antibodies are added, which attach to confirm a positive result.

TEST BENEFITS AND LIMITATIONS



These tests are faster and cheaper than most nucleic acid tests. Like some rapid nucleic acid tests, they can be carried out at the point of care.



They can only report whether you have an infection now. The tests are also less accurate than nucleic acid tests, particularly if the level of virus in the sample is low.

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog *Compound Interest*

More online

To see more of Brunning's work, go to compoundchem.com. To see all of C&EN's Periodic Graphics, visit cenm.ag/periodicgraphics.

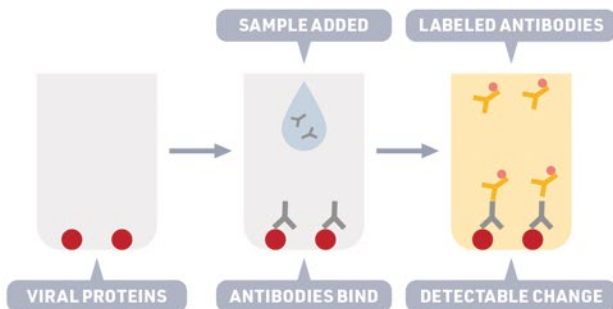
We're several months into the COVID-19 pandemic, and testing is vital to preventing the spread of the novel coronavirus. This graphic looks at how current diagnostics work and what they tell us.

ANTIBODY TESTS

Antibody tests identify if a person has antibodies to the virus. If they do, they had an infection in the past.

HOW DO THE TESTS WORK?

Many types of antibody tests are available. They all aim to detect antibodies in a person's blood, serum, or plasma sample.



Most antibody tests work by mixing a person's sample with viral proteins or protein fragments. Any antibodies the person generated will bind to these. Then a reporter molecule, such as a fluorescent antibody, is added to detect past infection.

TEST BENEFITS AND LIMITATIONS



These tests usually produce results quickly. Some of them can be carried out at home. They tell you if you've had a past infection.



The presence of antibodies to the virus doesn't guarantee immunity to reinfection. These tests vary widely in their accuracy.

COMPARING TESTS

TIME TAKEN



Nucleic acid tests **HOURS → DAYS**

Antigen tests **MINUTES → HOURS**

Antibody tests **MINUTES → HOURS**

The time needed for each test to yield results varies. For example, a nucleic acid test that uses polymerase chain reaction can take several hours to complete, whereas more recently approved CRISPR-based tests take around an hour.

FDA AUTHORIZED TESTS



Nucleic acid tests **120 TESTS**

Antigen tests **1 TEST**

Antibody tests **20 TESTS**

(Authorized tests as of June 21, 2020)

The US Food and Drug Administration has granted emergency use authorization to a number of COVID-19 tests, allowing them to be marketed and distributed. These authorizations are based on data submitted by test manufacturers.

TEST ACCURACY

Test accuracy varies for diagnostics from different manufacturers. It's commonly measured in terms of sensitivity (the correct production of positive results) and specificity (the correct production of negative results).



© C&EN 2020

Created by Andy Brunning for *Chemical & Engineering News*