

## COVID-19 Testing: PCR, Antigen, and Antibody Tests Explained

There are three types of tests available for COVID-19: polymerase chain reaction (PCR), antigen, and antibody (serology) testing. PCR and antigen tests detect whether a person is currently infected, and serology detects whether a person had an infection in the past. This document is designed to explain the differences between PCR, antigen, and serology testing, and when one test might be used over another.

Topic	PCR Test	Antigen Test	Antibody (Serology) Test
<b>Why is the test used?</b>	PCR tests look for pieces of SARS-CoV-2, the virus that causes COVID-19, in the nose, throat, or other areas in the respiratory tract to determine if the person has an <b>active infection</b> .	Antigen tests look for pieces of proteins that make up the SARS-CoV-2 virus to determine if the person has an <b>active infection</b> .	Serology looks for antibodies <sup>1</sup> against SARS-CoV-2 in the blood to determine if there was a <b>past infection</b> .
<b>How is the test performed?</b>	In most cases, a nasal or throat swab is taken by a healthcare provider and tested. Sometimes the test can be run while you wait, and sometimes the swab needs to be sent to a lab for testing.	In most cases, a nasal or throat swab is taken by a healthcare provider and tested. Sometimes the test can be run while you wait, and sometimes the swab needs to be sent to a lab for testing.	In most cases, a blood sample is taken and sent to a lab for testing.
<b>What does a positive test result mean?</b>	A positive PCR test means that the person being tested has an active COVID-19 infection.	A positive antigen test means that the person being tested has an active COVID-19 infection.	A positive antibody test means that the person being tested was infected with COVID-19 in the past and that their immune system developed antibodies to try to fight it off.

<sup>1</sup> **Antibodies** are formed by the body to fight off infections. Immunoglobulin M (IgM) is the first antibody that is formed against a germ, so it appears on tests first, usually within 1-2 weeks. The body then forms immunoglobulin G (IgG), which appears on tests about 2 weeks after the illness starts. IgM usually disappears from the blood within a few months, but IgG can last for years. Some antibody tests test for IgM and IgG, and some only test for IgG.

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<b>What does a negative test result mean?</b>	A negative PCR test means that person was probably not infected at the time their sample was collected. However, it doesn't mean they won't get sick – it only means that they didn't have COVID-19 at the time of testing.	A negative antigen test means that SARS-CoV-2 viral proteins were not detected. However, a negative test does not rule out COVID-19. If there is still concern that a person has COVID-19 after a negative antigen test, then that person should be tested again with a PCR test.	A negative antibody test means that the person may not have had COVID-19 in the past. However, they could still have a current infection, and the antibody test was collected too soon to give a positive result.
<b>When is it helpful?</b>	<ul style="list-style-type: none"> <li>• It can be used to determine who has an active infection.</li> <li>• It can help identify people who are contagious to others.</li> </ul>	<ul style="list-style-type: none"> <li>• It can be used to quickly determine who has an active infection.</li> <li>• It can help identify people who are contagious to others.</li> <li>• It is a less expensive test than PCR.</li> </ul>	<ul style="list-style-type: none"> <li>• It can identify people who had an infection in the past, even if they had no symptoms of the illness.</li> <li>• In some cases, it could help determine when COVID-19 illness occurred, since we know that IgM is formed before IgG and that IgM goes away before IgG.</li> <li>• It can help determine who qualifies to donate convalescent plasma (a blood product that contains antibodies against COVID-19 and can be used as a COVID-19 treatment).</li> <li>• If lots of people take the test in a community, it can help public health leaders and researchers know what percentage of the population has already had COVID-19.</li> </ul>

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<b>When is it not as helpful?</b>	<ul style="list-style-type: none"> <li>• It does not help determine who had an infection in the past.</li> <li>• It also does not help determine if a person who was exposed to COVID-19 will develop active infection during the two weeks after exposure. In some people, the virus can only be found by PCR for a few days at the beginning of the infection, so the test might not find the virus if the swab is taken more than a few days after the illness starts.</li> <li>• In some people, the virus can be found by PCR in the nose and throat for several weeks, even longer than the time that they are actually contagious to other people.</li> </ul>	<ul style="list-style-type: none"> <li>• It does not accurately rule out those who are not infected.</li> <li>• Antigen tests are less sensitive than PCR tests, meaning there may be false negative results.</li> <li>• Negative tests should be treated as presumptive. If a healthcare provider is concerned that the person has COVID-19, even after a negative antigen test, then the test result should be confirmed with PCR testing.</li> </ul>	<ul style="list-style-type: none"> <li>• It may be negative if it is used too close to the beginning of an infection, which is why it should not be used to detect active COVID-19 infection.</li> <li>• In areas where there have not been many cases of COVID-19, many of the positive test results will actually be false positives (see Positive Predictive Value<sup>2</sup>). Some antibody tests have low sensitivity<sup>3</sup> and specificity<sup>4</sup> and thus may not produce reliable results.</li> <li>• Some antibody tests may cross-react with other coronaviruses that are not SARS-CoV2, the virus that causes COVID-19, leading to false test results.</li> </ul>

<sup>2</sup> **Positive predictive value** is a measure of how likely it is that a positive test is a true positive rather than a false positive. This is dependent on how many people in the population being tested have had the disease. When there are very few people in the population that have had the disease, then there is a higher chance that a positive test is a false positive. When there are many people in a population that have had the disease, then there is a higher chance that a positive test is a true positive.

<sup>3</sup> **Sensitivity** is sometimes called the “true positive rate.” It measures how frequently the test is positive when the person being tested actually has the disease. For example, when a test has 80% sensitivity, the test detects 80% of patients with the disease (true positives). However, 20% of patients with the disease are not detected (false negatives) by the test.

<sup>4</sup> **Specificity** is sometimes called the “true negative rate.” It measures how frequently the test is negative when the person being tested doesn’t have the disease. For example, when a test has 80% specificity, the test correctly reports 80% of patients without the disease as test negative (true negatives). However, 20% of patients without the disease are incorrectly identified as testing positive (false positives) by the test.

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	<ul style="list-style-type: none"> <li>This test requires certain kinds of swabs that may be in short supply.</li> </ul>		<ul style="list-style-type: none"> <li>We do not know yet if having antibodies to the virus that causes COVID-19 can protect someone from getting infected again or, if they do, how long this protection might last. Until scientists get more information about whether antibodies protect against reinfection with this virus, everyone should continue to take steps to protect themselves and others, including staying at least 6 feet away from other people outside of their home (social distancing), even if they have had a positive antibody test.</li> </ul>
<p><b>What public health activities will be conducted?</b></p>	<ul style="list-style-type: none"> <li>If positive, the health department will conduct a case investigation. Contact tracing will be performed to identify individuals who might have been exposed to the PCR-positive person when they could have spread COVID-19.</li> <li>If negative, no public health activities will be performed.</li> </ul>	<ul style="list-style-type: none"> <li>If positive, the health department will interview the antigen-positive person about symptoms and if they were around someone who had COVID-19. Contact tracing will be performed.</li> <li>If negative, no public health activities will be performed.</li> </ul>	<ul style="list-style-type: none"> <li>If positive, the health department will interview the antibody-positive person about symptoms and if they were around someone who had COVID-19. If the person had symptoms or was around someone with COVID-19, the health department will recommend they get a PCR test. No contact tracing will be performed.</li> <li>If negative, no public health activities will be performed.</li> </ul>