COVID-19 Testing Basics

Testing for COVID-19, caused by the SARS-CoV-2 virus, is rapidly evolving. As pharmacists work on the front line of the COVID-19 response, it is important to understand the differences between the types of COVID-19 tests available, what they detect, and how they can be used for different testing activities.

Quick Links for COVID-19 Testing

FDA

- Coronavirus Testing Basics
- FAQs on Testing for SARS-CoV-2
- COVID-19 Tests with Emergency Use Authorizations (EUA)

CDC

- Overview of Testing for SARS-CoV-2 (COVID-19)
- Interim Guidance for Rapid Antigen Testing for SARS-CoV-2
- Interim Guidelines for COVID-19 Antibody Testing

What is the difference between diagnostic, screening, and surveillance testing activities?

Diagnostic Testing: Intended to identify current infection. It is performed when a person has signs or symptoms consistent with COVID-19 or when a person is asymptomatic but has recent known or suspected exposure to COVID-19.

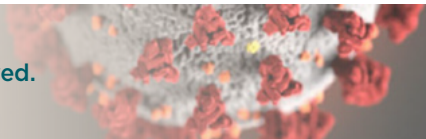
> *Example: Testing individuals who attended an event where another attendee was later confirmed to have COVID-19.*

Screening Testing: Intended to identify asymptomatic persons without known or suspected exposure to COVID-19. It is performed to identify a person who might be contagious so that measures can be taken to prevent further transmission.

> *Example: Testing all individuals before returning to the workplace.*

Surveillance Testing: Intended to monitor for community or population-level infection. It is performed on deidentified specimens rather than for a named individual. Therefore, results are not returned to an individual. Rather, the results are used to inform ongoing public health activities. Serology, or antibody testing, can also be used for surveillance across a community or population because these tests can detect individuals who were infected with COVID-19 in the past.

> *Example: Testing plan developed by a state health department to randomly sample 1% of individuals in a city to on a rolling basis to determine local trends.*



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COVID-19 Testing Basics (continued)

An Overview of the Types of COVID-19 Tests*

	Diagnostic Test		Antibody Test
	Molecular Test	Antigen Test	
What It Does	Diagnoses active infection		Indicates past infection
Also Known As	RT-PCR	Rapid diagnostic test (molecular tests can also be rapid)	Serology test
What It Detects	Detects viral genetic material	Detect viral surface proteins	Detects antibodies against the virus
How the Specimen Is Collected	Nasal or throat swab Saliva	Nasal or throat swab	Fingerstick or blood draw
How Long Until Results Are Available	Same day or up to a week Rapid molecular tests can produce results at the point of care within about 15 minutes	1 hour or less	Same day or 1–3 days

**Adapted from FDA's Coronavirus Testing Basics*

How do each of the test assays work to detect SARS-CoV-2?

Molecular Tests: Detect the presence of a virus by locking onto sequences of genetic material of interest—in this case, portions of SARS-CoV-2 RNA—then amplifying a portion until there's enough for detection. Because SARS-CoV-2 is an RNA virus, molecular assays that require DNA for the amplification and detection to occur (e.g., polymerase chain reaction) are predicated on the reverse transcription (RT) of RNA into complementary DNA. A polymerase chain reaction (PCR) test can render a positive result if it finds viral fragments, even if whole viable virus is not present.

Antigen Tests: Detect the nucleocapsid protein (N protein) of SARS-CoV-2 from upper respiratory samples. The N protein is a protein on the surface of the virus that plays an important role in infection by packaging viral RNA and aiding in the release of additional viral particles from infected cells. For more information, the American Society of Microbiology provides an in-depth look at the differences in How the SARS-CV-2 EUA Antigen Tests Work.

Serologic Tests: The Johns Hopkins Center for Health Security explains serology-based tests as "blood-based tests that can be used to identify whether people have been exposed to a particular pathogen." Serology-based tests analyze the serum component of whole blood, which includes antibodies against specific antigens that are recognized by the immune system as foreign.

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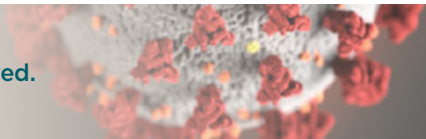

Comparing Diagnostic Tests

	Molecular Tests	Rapid Molecular Tests	Antigen Tests
Advantages	Positive and negative results are typically accurate (highly specific and sensitive)	Positive and negative results are typically accurate (highly specific and sensitive) Available at point of care Results available quickly	Available at point of care Results available quickly Positive results are typically accurate (highly specific) Generally low cost
Disadvantages	Often requires a laboratory to process the specimen Takes longer to generate results	Generally more expensive than antigen tests	Negative results may not be accurate (less sensitive) May need to confirm a negative result with a molecular test

How do antibody tests determine whether a person was infected by COVID-19 in the past?

Antibody, or serology-based, tests are designed to detect the different antibody types a person has made in response to the antigens on the surface of the pathogen. The antibodies of note in serology-based COVID-19 tests include:

- Immunoglobulin M (IgM) are antibodies made in first response to a new antigen. When present without IgG, IgM reflects early and acute infection.
- Immunoglobulin G (IgG) are antibodies made to protect against antigens the body has already been exposed to, serving as the body's "memory," and may signify prior exposure and possible immunity. If an infection persists long enough, IgG antibodies may be detectable during the latter stage of the active infection. IgG antibodies typically persist after the infection resolves, at which point they are a key element of convalescent serum.

How can I identify fraudulent tests for COVID-19?

COVID-19 Fraudulent Medical Devices and Scams can be found in APhA's COVID-19 Resources: Know the Facts library. This resource includes examples, red flags to look for, and tips to protect pharmacists and patients from fraud and scams during the COVID-19 pandemic.

What should pharmacists know about test performance?

The sensitivity and specificity of a COVID-19 test help to describe test performance and inform a level of confidence around whether the results of the test are accurate or not. The performance of the test is described by the sensitivity and specificity. The sensitivity is the ability of a test to detect the condition it was meant to test for (true positive rate). The specificity is the ability of the test to indicate the absence of the condition it was meant to test for (true negative rate). In practice, pharmacists should be mindful of the possibility of false negatives and false positives when testing for COVID-19. The patient's history and symptoms are important factors to consider along with the results of the test.

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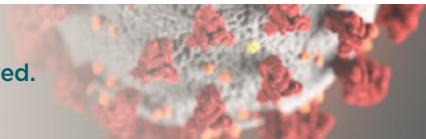

COVID-19 Testing Basics (continued)

Sensitivity and Specificity

Sensitivity	Specificity
True positive rate	True negative rate
Example for Diagnostic Testing	
The proportion of people with COVID-19 who test positive	The proportion of healthy people who test negative
A test that is 100% sensitive means everyone with COVID-19 was identified correctly (no false negatives).	A test that is 100% specific means that everyone healthy was identified correctly (no false positives).

Where can I find information about molecular diagnostic test performance?

The Food and Drug Administration (FDA) recently published comparative performance data for COVID-19 molecular diagnostic tests. This SARS-CoV-2 Reference Panel Comparative Data shows the Limit of Detection (LoD) of more than 55 authorized molecular diagnostic COVID-19 tests against a standardized sample panel provided by the FDA. In the data published, a lower LoD represents a test's ability to detect a smaller amount of viral material in a given sample, signaling a more sensitive test. The data give laboratories, health care providers, and patients a new resource on the relative performance of available tests to better inform which tests they choose to use. The FDA will continue to update the table as it receives additional results.

What should I know about antigen test performance?

Antigen tests are very specific, so positive results are considered very accurate; however, these tests are limited by their sensitivity, which means that sometimes a test may come back negative even when COVID-19 is present. Despite the possibility of false negatives, these tests are increasingly being used for screening and surveillance testing because they produce rapid results at the point of care and are FDA approved for patient care settings, including pharmacies. It is important to note that negative tests results should be considered "presumptive negatives," and health care providers should consider them in the context of clinical observations, patient history, and epidemiological information.

Where can I find information about antibody test performance?

The FDA is monitoring EUA authorized serology test performance. The performance of the test is described by their sensitivity and specificity.

Disclaimer: *Information related to the COVID-19 pandemic is changing rapidly and continuously. The material and information contained in this publication is believed to be current as of the date included on this document. The American Pharmacists Association assumes no responsibility for the accuracy, timeliness, errors or omission contained herein. Links to any sources do not constitute any endorsement of, validity, or warranty of the information contained on any site. The user of these materials should not under any circumstances solely rely on, or act based on this publication. Pharmacy professionals retain the responsibility for using their own professional judgment and practicing in accordance with all rules, regulations, and laws governing the pharmacy practice within their jurisdiction.*

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