Review

Types of Assays for SARS-CoV-2 Testing: A Review

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ABSTRACT

Clinical laboratory testing routinely provides actionable results, which help direct patient care in the inpatient and outpatient settings. Since December 2019, a novel coronavirus (SARS-CoV-2) has been causing disease (COVID-19 [coronavirus disease 2019]) in patients, beginning in China and now extending worldwide. In this context of a novel viral pandemic, clinical laboratories have developed multiple novel assays for SARS-CoV-2 diagnosis and for managing patients afflicted with this illness. These include molecular and serologic-based tests, some with point-of-care testing capabilities. Herein, we present an overview of the types of testing available for managing patients with COVID-19, as well as for screening of potential plasma donors who have recovered from COVID-19.

Beginning in December 2019, an outbreak of "pneumonia of unknown cause" was detected in Wuhan City, Hubei Province, China. Ultimately, the 2019 novel coronavirus, or SARS-CoV-2, was identified as the causative agent and subsequently isolated and sequenced.[1] Since that time, SARS-CoV-2 has spread worldwide, causing a severe illness known as COVID-19 (coronavirus disease 2019), which led the World Health Organization (WHO) to declare it a pandemic on March 11, 2020.[2] Since the beginning of the outbreak, clinical laboratories have been developing various assays to aid in detecting SARS-CoV-2 and clinically managing patients with COVID-19.

The 3 categories of tests used to detect current or past viral infection are molecular, serologic, and antigen-detection assays (**Table 1**). In this context, a molecular assay is used to determine whether a patient is actively infected with the pathogen of interest. Reverse transcription polymerase chain reaction (RT-PCR) is a common laboratory technique used to detect respiratory viral pathogens, such as influenza and respiratory syncytial virus (RSV).[3] Currently, this is the main type of test being utilized to determine whether patients are infected with SARS-CoV-2.

RT-PCR is a sensitive technique for RNA detection, whereby RNA is reverse transcribed into complementary DNA (cDNA) and cDNA targets specific for the pathogen of interest are amplified. If SARS-CoV-2 RNA is present in a patient specimen, typically collected as a nasopharyngeal (NP) or anterior nasal swab,[4] it will be detected by this assay. Depending on the platform, these assays can be completed in less than 1 hour to several hours, once the specimen arrives in the laboratory and is loaded onto the platform.

The caveats to interpreting results from this assay type are that doing so does not inform us whether a patient previously had the infection; rather, this type of assay only detects patients actively shedding virus (current infection or carriage state) or those who have residual viral RNA present. Therefore, these assays are most useful in acute settings to detect patients with COVID-19, where the results can inform appropriate isolation protocols and ensure that appropriate personal protective equipment (PPE) protocols are utilized when treating these patients. As of the date of publication of this article, of the 102 commercial laboratories and/or test kit manufacturers approved for emergency

Abbreviations:

COVID-19, coronavirus disease 2019; WHO, World Health Organization; RT-PCR, reverse transcription polymerase chain reaction; RSV, respiratory syncytial virus; cDNA, complementary DNA; NP, nasopharyngeal; PPE, personal protective equipment; FDA, United States Food and Drug Administration; LDTs, laboratory-developed tests; OP, oropharyngeal; EUA, Emergency-Use Authorization; BAL, bronchoalveolar lavage; Ig, immunoglobulin; CDC, Centers for Disease Control and Prevention; POC, point-of-care; TAT, turnaround time; PCR, polymerase chain reaction; CLIA, Clinical Laboratory Improvement Amendments; HIV, human immunodeficiency virus; qPCR, quantitative polymerase chain reaction; ddPCR, droplet digital polymerase chain reaction; ELISA, enzyme-linked immunosorbent assay; FIA, fluorescence immunoassay analyzer.

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Table 1. Clinical Laboratory Testing Types

Test Type	Patient Specimen Type	Detection	Clinical Utility	Necessary Reagents	Development Time
Nucleic acid amplification (ie, RT-PCR, isothermal amplification)	NP swab[a]	RNA	Active infection	Oligo primers	*Fastest:* oligonucleotide production and molecular assay development (takes days to weeks)
Serology	Serum	IgM and/or IgG, or total antibodies	Past exposure; immune status	Recombinant/ purified protein	*Intermediate:* production of viral protein (recombinant/purified) and assay development/optimization (takes 2 to several weeks)
Protein detection	NP swab and/ or other clinical fluids[a]	Viral antigen	Active infection	Antibody to viral protein(s)	*Slowest:* requires antibody production, assay development, and optimization (takes several weeks to months)

Abbreviations: *RT-PCR, reverse transcription polymerase chain reaction; NP, nasopharyngeal; Ig, immunoglobulin.*
[a]*NP swabs are difficult to access using this method.*

use by the United States Food and Drug Administration (FDA) for SARS-CoV-2 testing, 81 of them were molecular assays (**Table 2**). We note that many of these commercial assays require a laboratory to have vendor-specific instrumentation and equipment to utilize these test kits. The FDA also has authorized 37 molecular-based laboratory developed tests (LDTs) that can be used in the single laboratory that developed the test.

Given that true NP specimens are often difficult to obtain, the FDA has stated that oropharyngeal (OP), nasal midturbinate, and anterior nares swabs are acceptable when using an NP swab is not possible.[4] Also, the FDA recently granted an Emergency-Use Authorization (EUA) to Rutgers Clinical Genomics Laboratory-Rutgers University for an RT-PCR LDT for qualitative detection of SARS-CoV-2 in saliva specimens as well as OP, NP, anterior nasal, and midturbinate nasal swabs. Saliva testing presents potential benefits of eliminating the need for swabs and decreasing the risk posed to the healthcare workers collecting these specimens. However, this specimen type might require additional dilution or pretreatment due to its viscosity. Also, viral RNA might be more difficult to detect in this specimen type, although the results of a previous study[5] found that saliva and NP specimens were comparable for detection of respiratory viruses by RT-PCR.

The possibility of false negative results with molecular assays should also be considered. One report[6] documents a patient with multiple RT-PCR NP/OP specimens that tested negative; this patient ultimately had SARS-CoV-2 detected in a bronchoalveolar lavage (BAL) fluid specimen. For lower respiratory tract specimens, currently, the FDA recommends testing BAL fluid only under certain clinical circumstances such as invasive mechanical ventilation. Sputum should be tested from patients who develop a productive cough, although the FDA does not recommend induction of sputum for SARS-CoV-2 testing.[4]

The other main type of assay is serological. These assays determine the exposure history and/or immune status of a patient. They detect the presence of antibodies against SARS-CoV-2 antigens in serum, plasma, or whole blood specimens. After initial viral infection, there is a delay before the production of antibodies by the immune system (**Figure 1**). During this time, known as the *window period*, a patient who is infected with SARS-CoV-2 but has no detectable antibodies, would have negative test results on a serologic assay. Typically, when the immune system mounts a response against a virus, short-lived immunoglobulin (Ig)M antibodies are initially produced, followed by a more durable IgG antibody response. However, there are limited data thus far in the literature regarding the longevity of anti–SARS-CoV-2 antibodies.

The graph in **Figure 1** demonstrates estimated viral RNA, IgM, and IgG detection levels for SARS-CoV-2 based on the limited published literature to date. The estimated median seroconversion time is 7 to 12 days; most patients with COVID-19 have detectable antibodies approximately 15 days after the onset of symptoms. Due to the subjectivity

Table 2. Current FDA Emergency Use Authorized SARS-CoV-2 Assays, as of May 26, 2020

Molecular

Manufacturer	Test Name	Assay Type
1drop Inc.	1copy COVID-19 qPCR Multi Kit	RT-PCR
Abbott Diagnostics Scarborough, Inc.	ID NOW COVID-19	Isothermal nucleic acid amplification
Abbott Molecular	Abbott RealTime SARS-CoV-2 assay	RT-PCR
Abbott Molecular Inc.	Alinity m SARS-CoV-2 assay	RT-PCR
Altona Diagnostics GmbH	RealStar SARS-CoV02 RT-PCR Kits U.S.	RT-PCR
Applied BioCode, Inc.	BioCode SARS-CoV-2 Assay	RT-PCR
Applied DNA Sciences, Inc.	Linea COVID-19 Assay Kit	RT-PCR
Assurance Scientific Laboratories	Assurance SARS-CoV-2 Panel	RT-PCR
Atila BioSystems, Inc.	iAMP COVID-19 Detection Kit	Isothermal amplification test
Avellino Lab USA, Inc.	AvellinoCoV2 test	RT-PCR
Becton, Dickinson & Company	BD SARS-CoV-2Reagents for BD MAX System	RT-PCR
Becton, Dickinson & Company (BD)	BioGX SARS-CoV-2 Reagents for BD MAX System	RT-PCR
BGI Genomics Co. Ltd	Real-Time Fluorescent RT-PCR Kit for Detecting SARS-2019-nCoV	RT-PCR
BioCore Co., Ltd.	BioCore 2019-nCoV Real Time PCR Kit	RT-PCR
Bio-Rad Laboratories, Inc	Bio-Rad SARS-CoV-2 ddPCR Test	RT-PCR
BioFire Defense, LLC	BioFire COVID-19 Test	RT-PCR
BioFire Defense, LLC	BioFire Respiratory Panel 2.1 (RP2.1) *panel includes 20 other viral or bacterial pathogens	RT-PCR
BioMérieux SA	SARS-COV-2 R-GENE	RT-PCR
Centers for Disease Control and Prevention's (CDC)	CDC 2019-nCoV Real-Time RT-PCR Diagnostic Panel (CDC)	RT-PCR
Cepheid	Xpert Xpress SARS-CoV-2 test	RT-PCR
ChromaCode Inc.	HDPCR SARS-CoV-2 Assay	RT-PCR
Co-Diagnostics, Inc.	Logix Smart Coronavirus Disease 2019 (COVID-19) Kit	RT-PCR
Cue Health Inc.	Cue COVID-19 Test	Isothermal nucleic acid amplification
dba SpectronRx	Hymon SARS-CoV-2 Test Kit	RT-PCR
DiaCarta, Inc	QuantiVirus SARS-CoV-2 Test kit	RT-PCR
DiaSorin Molecular LLC	Simplexa COVID-19 Direct assay	RT-PCR
Everlywell, Inc.	Everlywell COVID-19 Test Home Collection Kit	RT-PCR
Euroimmun US Inc.	EURORealTime SARS-CoV-2	RT-PCR
Fast Track Diagnostics Luxembourg S.á.r.l.	FTD SARS-CoV-2	RT-PCR
Fosun Pharma USA Inc.	Fosun COVID-19 RT-PCR Detection Kit	RT-PCR
Fulgent Therapeutics, LLC	Fulgent COVID-19 by RT-PCR Test	RT-PCR
GeneMatrix, Inc.	NeoPlex COVID-19 Detection Kit	RT-PCR
Genetron Health (Beijing) Co., Ltd.	Genetron SARS-CoV-2 RNA Test	RT-PCR
GenMark Diagnostics, Inc.	ePlex SARS-CoV-2 Test	PCR, electrochemical detection (voltammetry)
GenoSensor, LLC	GS™ COVID-19 RT-PCR KIT	RT-PCR
Gnomegen LLC	Gnomegen COVID-19 RT-Digital PCR Detection Kit	RT-PCR
Gnomegen LLC	Gnomegen COVID-19-RT-qPCR Detection Kit	RT-PCR
Gravity Diagnostics, LLC	Gravity Diagnostics COVID-19 Assay	RT-PCR
Hologic, Inc.	Aptima SARS-CoV-2 assay	Target capture, transcription mediated amplification and dual kinetic assay
Hologic, Inc.	Panther Fusion SARS-CoV-2	RT-PCR
Illumina, Inc.	Illumina COVIDSeq Test	Next-Generation Sequencing (NGS)
InBios International, Inc	Smart Detect SARS-CoV-2 rRT-PCR Kit	RT-PCR
Ipsum Diagnostics, LLC	COV-19 IDx assay	RT-PCR
Kaiser Permanente Mid-Atlantic States	KPMAS COVID-19 Test	RT-PCR
KorvaLabs Inc.	Curative-Korva SARS-Cov-2 Assay	RT-PCR
LabGenomics Co., Ltd.	LabGun COVID-19 RT-PCR Kit	RT-PCR
Laboratory Corporation of America (LabCorp)	COVID-19 RT-PCR Test	RT-PCR
Luminex Corporation	ARIES SARS-CoV-2 Assay	RT-PCR
Luminex Molecular Diagnostics, Inc.	NxTAG CoV Extended Panel Assay	RT-PCR

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Table 2. Continued

Molecular

Manufacturer	Test Name	Assay Type
Maccura Biotechnology (USA) LLC	SARS-CoV-2 Fluorescent PCR Kit	RT-PCR
Mesa Biotech Inc.	Accula SARS-Cov-2 Test	PCR and lateral flow assay
NeuMoDx Molecular, Inc.	NeuMoDx SARS-CoV-2 Assay	RT-PCR
OPTI Medical Systems, Inc.	OPTI SARS-CoV-2 RT PCR Test	RT-PCR
OSANG Healthcare	GeneFinder COVID-19 Plus RealAmp Kit	RT-PCR
P23 Labs, LLC.	P23 Labs TaqPath SARS-CoV-2 Assay	RT-PCR
PerkinElmer, Inc.	PerkinElmer New Coronavirus Nucleic Acid Detection Kit	RT-PCR
Phosphorus Diagnostics LLC	Phosphorus COVID-19 RT-qPCR Test	RT-PCR
Primerdesign Ltd.	Primerdesign Ltd COVID-19 genesig Real-Time PCR assay	RT-PCR
PrivaPath Diagnostics, Inc.	LetsGetChecked Coronavirus (COVID-19) Test	RT-PCR
QIAGEN GmbH	QIAstat-Dx Respiratory SARS-CoV-2 Panel *panel includes 22 other viral or bacterial pathogens	RT-PCR
Quest Diagnostics Infectious Disease, Inc.	Quest SARS-CoV-2 rRT-PCR	RT-PCR
Quidel Corporation	Lyra SARS-CoV-2 Assay	RT-PCR
Quidel Corporation	Lyra Direct SARS-CoV-2 Assay	RT-PCR
Rheonix, Inc.	Rheonix COVID-19 MDx Assay	RT-PCR
Roche Molecular Systems, Inc. (RMS)	cobas SARS-CoV-2	RT-PCR
RTA Laboratories Biological Products Pharmaceutical and Machinery Industry	Diagnovital SARS-CoV-2 Real-Time PCR Kit	RT-PCR
Rutgers Clinical Genomics Laboratory at RUCDR Infinite Biologics - Rutgers University	Rutgers Clinical Genomics Laboratory TaqPath SARS-CoV-2-Assay	RT-PCR
Sansure BioTech Inc.	Novel Coronavirus (2019-nCoV) Nucleic Acid Diagnostic Kit (PCR-Fluorescence Probing)	RT-PCR
ScienCell Research Laboratories	ScienCell SARS-CoV-2 Coronavirus Real-time RT-PCR (RT-qPCR) Detection Kit	RT-PCR
SD Biosensor, Inc.	STANDARD M nCoV Real-Time Detection Kit	RT-PCR
Seasun Biomaterials	U-TOP COVID-19 Detection Kit	RT-PCR
Seasun Biomaterials, Inc.	AQ-TOP COVID-19 Rapid Detection Kit	RT-LAMP
Seegene, Inc.	Allplex 2019-nCoV Assay	RT-PCR
Sherlock BioSciences, Inc.	Sherlock CRISPR SARS-CoV-2 Kit	CRISPR
SolGent Co., Ltd.	DiaPlexQ Novel Coronavirus (2019-nCoV) Detection Kit	RT-PCR
TBG Biotechnology Corp.	ExProbe SARS-CoV-2 Testing Kit	RT-PCR
Thermo Fisher Scientific, Inc.	TaqPath COVID-19 Combo Kit	RT-PCR
Tide Laboratories, LLC	DTPM COVID-19 RT-PCR Test	RT-PCR
Trax Management Services Inc.	PhoenixDx 2019-CoV	RT-PCR
Wadsworth Center, New York State Department of Public Health's (CDC)	New York SARS-CoV-2 Real-time Reverse Transcriptase (RT)-PCR Diagnostic Panel	RT-PCR
Zymo Research Corporation	Quick SARS-CoV-2rRT-PCR Kit	RT-PCR
Serology		
Manufacturer	**Test Name**	**Assay Type**
Abbott Laboratories Inc.	SARS-CoV-2 IgG assay	Chemiluminescent microparticle immunoassay
Autobio Diagnostics Co. Ltd.	Anti-SARS-CoV-2 Rapid Test IgM and IgG	Lateral flow immunoassay
Bio-Rad Laboratories, Inc	Platelia SARS-CoV-2 Total Ab assay	Enzyme-Linked Immunosorbent Assays (ELISA)
Cellex Inc.	qSARS-CoV-2 IgG/IgM Rapid Test	Lateral flow immunoassay
Chembio Diagnostic System, Inc.	DPP COVID-19 IgM/IgG System	Immunochromatography
DiaSorin Inc.	LIAISON SARS-CoV-2 S1/S2 IgG	Chemiluminescent immunoassay
Emory Medical Laboratories	SARS-CoV-2 RBD IgG test	Enzyme-Linked Immunosorbent Assays (ELISA)

Table 2. Continued

Molecular		
Manufacturer	**Test Name**	**Assay Type**
EUROIMMUN US Inc.	Anti-SARS-CoV-2 ELISA (IgG)	Enzyme-Linked Immunosorbent Assays (ELISA)
Hangzhou Biotest Biotech Co., Ltd.	RightSign COVID-19 IgG/IgM Rapid Test Cassette	Lateral flow chromatographic immunoassay
Healgen Scientific LLC	COVID-19 IgG/IgM Rapid Test Cassette	Lateral flow immunoassay
InBios International, Inc.	SCoV-2 Detect IgG ELISA	ELISA
Mount Sinai Laboratory	COVID-19 ELISA IgG Antibody Test	Enzyme-Linked Immunosorbent Assays (ELISA)
Ortho Clinical Diagnostics, Inc.	VITROS Immunodiagnostic Products Anti-SARS-CoV-2 Total Reagent Pack	Immunometric luminescence
Ortho-Clinical Diagnostics, Inc.	VITROS Immunodiagnostic Products Anti-SARS-CoV-2 IgG Reagent Pack	Immunometric luminescence
Roche Diagnostics	Elecsys Anti-SARS-CoV-2	Electrochemiluminescence Immunoassay
Siemens Healthcare Diagnostics Inc.	Dimension Vista SARS-CoV-2 Total antibody assay (COV2T)	Chemiluminescent immunoassay
	Dimension EXL SARS-CoV-2 Total antibody assay (CV2T)	Chemiluminescent immunoassay
	Atellica IM SARS-CoV-2 Total (COV2T)	Chemiluminescent immunoassay
	ADVIA Centaur SARS-CoV-2 Total (COV2T)	Chemiluminescent immunoassay
Vibrant America Clinical Labs	Vibrant COVID-19 Ab Assay	Chemiluminescence immunoassay
Wadsworth Center, New York State Department of Health	New York SARS-CoV Microsphere Immunoassay for Antibody Detection	Microsphere Immunoassay
Antigen		
Manufacturer	**Test Name**	**Assay Type**
Quidel Corporation	Sofia 2 SARS Antigen FIA	Lateral flow immunofluorescent sandwich assay

Abbreviations: *FDA, United States Food and Drug Administration; qPCR, quantitative polymerase chain reaction; RT-PCR, reverse transcriptase polymerase chain reaction; ddPCR, droplet digital polymerase chain reaction; CDC, Centers for Disease Control and Prevention; PCR, polymerase chain reaction; Ig, immunoglobulin; ELISA, enzyme-linked immunosorbent assay; FIA, fluorescence immunoassay analyzer.*

[a]*As of May 26, 2020. For the most up-to-date list, please refer to: https://www.fda.gov/medical-devices/emergency-situations-medical-devices/emergency-use-authorizations. We also note that based on the FDA policy for Diagnostic Tests for Coronavirus Disease–2019 during the Public Health Emergency issued on March 16, 2020, commercial manufacturers can develop and distribute serology tests without an emergency-use authorization (EUA), as long as the test has been validated and the FDA is notified.*

[b]*Panel includes 20 other viral or bacterial pathogens.*

in determining symptom onset, these dates can be highly variable. Also, viral RNA has been shown to peak in the first week of illness and then gradually decline.

Serological tests can be unique to one class of immunoglobulins; can detect IgM and IgG antibodies simultaneously; or can be total antibody tests, which detect IgA antibodies as well. Depending on the exact protocol and platform, such assays can typically be completed in 1 to 2 hours once a specimen arrives in the laboratory and is loaded onto the relevant platform. We note, however, that at the time of publication of this article, there are a few commercial assays available on large, automated analyzers, from diagnostic manufacturers including Roche Diagnostics, Abbott Diagnostics, and Ortho Clinical Diagnostics (with offerings more recently available from Beckman Coulter, Inc and Siemens AG). However, to our knowledge, there are no objective, peer-reviewed data on their performance characteristics.

Many available commercial serological assays use a lateral flow assay format; for many of these assays, there are unsubstantiated, or even false, claims about test performance.[7]The estimated median seroconversion time is 7 to 12 days, with virtually all patients with COVID-19 having detectable antibodies approximately 15 days after onset of symptoms.[8–10] However, the results of a recent acute antibody response study[11] demonstrated simultaneous or sequential IgM and IgG seroconversion, with a slight decrease in IgM antibody titers 3 weeks after symptom onset. Therefore, these assays will be most helpful in determining the exposure status of an individual and in assessing the immune response of that person to SARS-CoV-2.

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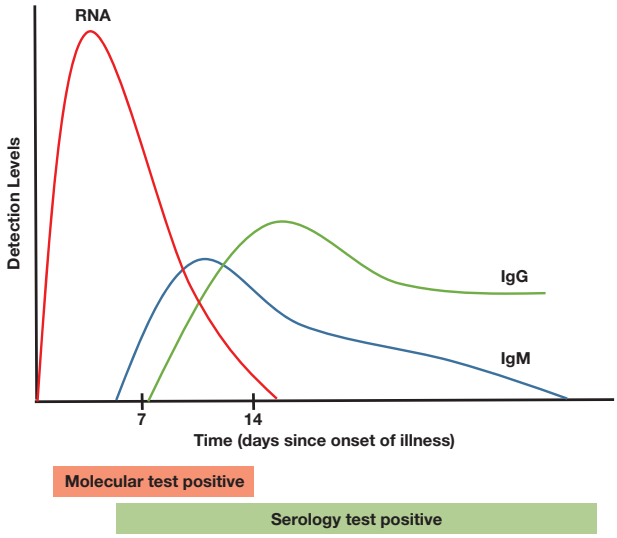

Figure 1

SARS-CoV-2 estimated seroconversion rates.

Because SARS-CoV-2 is a new virus, it is not clear whether an immune response confers immunity and how long the immune response will last—that is, whether it is durable and sustained (years) or if it is short-lived (1–2 months). These assays can be particularly helpful for individuals who may have had symptoms consistent with COVID-19 but who were never tested with an RT-PCR test (due to the severe limitations in testing capabilities in many areas) and now have recovered from their illness. Currently, the Centers for Disease Control and Prevention (CDC) does not recommend using serology testing to determine eligibility to return to the in-person workforce. Individuals who were symptomatic can stop self-isolation as long as their symptoms have improved with 3 days of no fever and at least 10 days have elapsed since the onset of their symptoms.[12]

Finally, these tests can also be used in serosurveillance, in which data are obtained to calculate the prevalence of anti–SARS-CoV-2 antibodies in the community. Such information can help epidemiologists better understand the true burden of disease and to model continued viral-transmission dynamics based on the percentage of the population that is immune vs susceptible. Given that approximately 80% of COVID-19 cases are mild to moderate in severity[10,13] and that molecular testing has been restricted to the most severely ill patients, the true number of cases has likely not been revealed by molecular-based assays. Thus, serological testing can provide a more accurate enumeration of the number of past infections. As with all laboratory testing, however, the results of these assays will only be accurate and maximally useful based on their performance characteristics, including sensitivity and specificity.

COVID-19 testing is also important for identifying potential patients who have recovered from COVID-19 and have detectable antibodies against SARS-CoV-2 (*convalescent donors*) for clinical trials. Currently, studies are underway in which convalescent donors can donate plasma, which can then be transfused into critically ill patients with COVID-19. A review of the published literature to date[14] indicates that treatment with plasma from convalescent donors demonstrates beneficial effects, although further evaluation with clinical trials remains imperative. Potential donors require a serologic assay to detect the presence of anti–SARS-CoV-2 antibodies in their plasma. For this type of plasma to be beneficial, the antibodies present should have neutralizing activity (ie, the antibodies bind to and neutralize infection by active SARS-CoV-2 virus). Such testing is not currently performed in clinical laboratories but rather in research laboratories. Ideally, convalescent plasma donors would be noninfectious (symptom-free for >14 days) and have high titers of virus-neutralizing antibodies (as determined by serologic testing).

Point-of-care (POC) testing is beginning to be available for SARS-CoV-2. POC testing refers to a broad category of diagnostic tests that can be performed where patient care occurs. Functionally, these tests have a rapid turnaround time (TAT) and can potentially be performed by various nonlaboratory clinical personnel. These assays can be molecular or serologic. One molecular POC test by Abbott Diagnostics uses isothermal nucleic acid amplification (a technique similar to polymerase chain reaction [PCR]) to detect SARS-CoV-2 in approximately 15 minutes. The results of recent studies[15–17] have demonstrated low sensitivity for the Abbott ID Now assay with specimens collected in transport media. Thus, the EUA for this test was modified for testing only from direct/dry swabs.

The Cellex serologic POC qSARS-CoV-2 IgG/IgM Rapid Test (Cellex, Inc.) utilizes a lateral flow immunoassay, which qualitatively detects IgM and/or IgG antibodies from whole-blood specimens. A blood specimen flows by

capillary action along the cassette and, if anti–SARS-CoV-2 IgM or IgG antibodies are present, they will bind to recombinant SARS-CoV-2 antigens present on the test strip. The presence of these antibody-antigen complexes are then detected by a colorimetric change, which is revealed when the complexes are captured by anti–human IgG or anti–human IgM antibodies. The results are available in approximately 15 to 20 minutes. Of note, currently POC serology tests must be performed in conjunction with a CLIA (Clinical Laboratory Improvement Amendments)–licensed laboratory and cannot be performed in locations with only a CLIA waiver, such as a physician office.

Finally, there is now an antigen detection assay available from Quidel Corporation (Sofia 2 SARS Antigen FIA) that uses a lateral flow immunofluorescent sandwich assay technique for detection of the nucleocapsid protein antigen of SARS-CoV and SARS-CoV-2. In theory, viral proteins can be detected using one of a number of antigen capture methods (eg, antibodies, aptamers). Such tests are used routinely for other viral assays (eg, human immunodeficiency virus [HIV] p24 antigen as part of 4th- and 5th-generation HIV tests), and also for hepatitis B surface antigen.[18] Like molecular assays, antigen detection tests can be used to detect active SARS-CoV-2 infection.

In summary, molecular and serological tests provide meaningful data for treating patients with COVID-19. However, each category has different clinical utility, different characteristics, and different limitations. Clinical laboratories continue to develop new assays and implement increased testing capabilities to meet the high demands for patient testing during this pandemic. **LM**

Personal and Professional Conflicts of Interest
None reported.

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