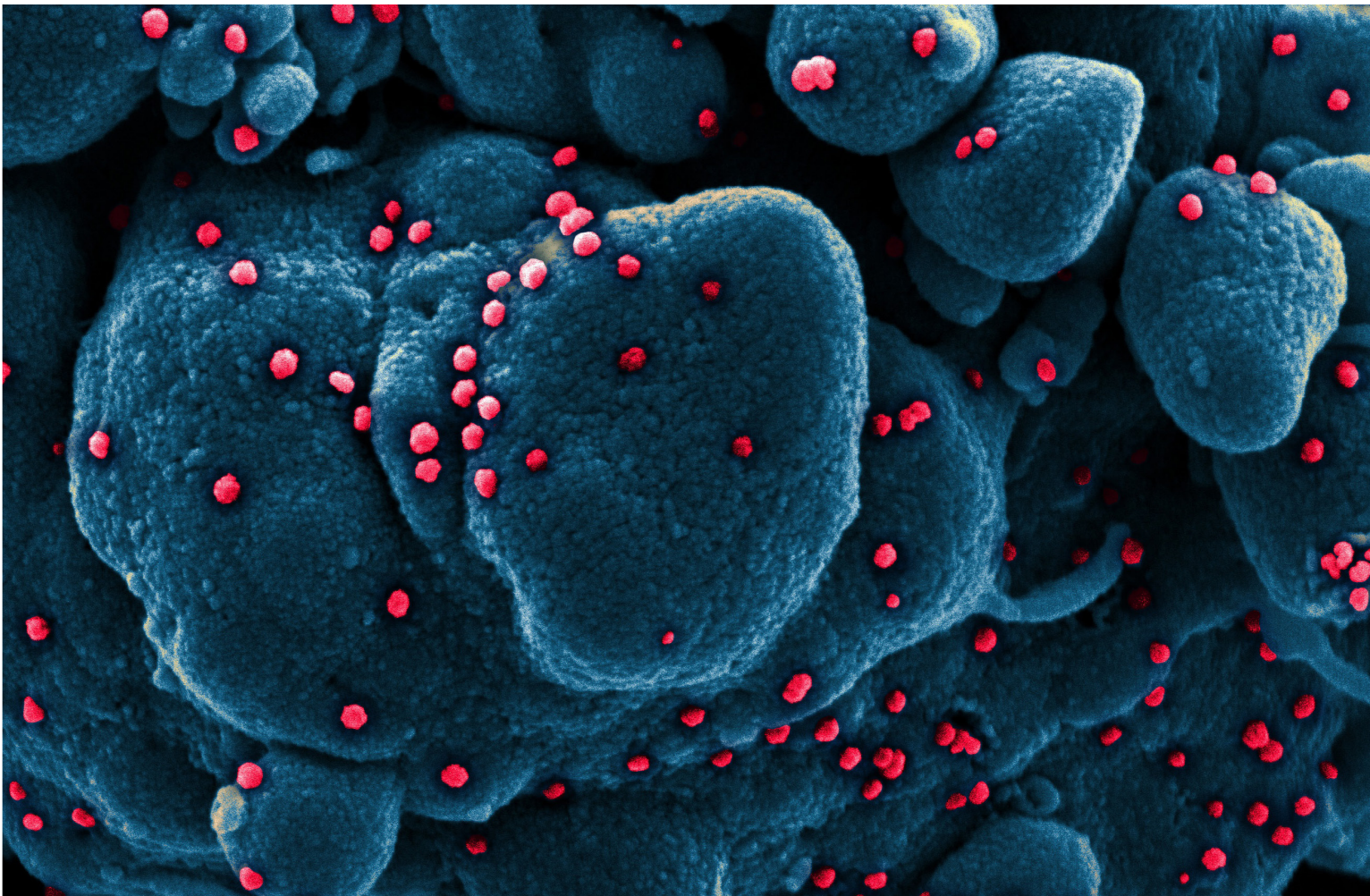


COVID-19:

The CIDRAP Viewpoint



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Part 5: SARS-CoV-2 infection and COVID-19 surveillance: a national framework

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CIDRAP, founded in 2001, is a global leader in addressing public health preparedness and emerging infectious disease response. Part of the Office of the Vice President for Research (OVPR) at the University of Minnesota, CIDRAP works to prevent illness and death from targeted infectious disease threats through research and the translation of scientific information into real-world, practical applications, policies, and solutions. For more information, visit: www.cidrap.umn.edu. COVID-19 Viewpoint reports are made possible with support from the University of Minnesota OVPR and the Bentson Foundation.

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Part 5: SARS-CoV-2 Infection and COVID-19 Surveillance: A National Framework

Preface

Welcome to “COVID-19: The CIDRAP Viewpoint,” our series of reports that add key information, address issues that haven’t garnered the attention they deserve, and reflect the unique expertise among the CIDRAP team and our expert consultants. In our reports we address timely issues with straight talk and clarity. And the steps we recommend are based on our current reality and the best available data. Our goal is to help planners envision some of the situations that might present themselves later this year or next year so that they can take key steps now, while there’s still time.

Our [first report](#) laid out potential pandemic scenarios, our [second report](#) covered crisis communication, our [third report](#) was on “smart testing,” and our [fourth report](#) was on contact tracing.

Our hope is that our efforts can help you plan more effectively and understand the many aspects of this pandemic more clearly—and for you and your family, friends, and colleagues to be safer. Thank you.

– *Michael T. Osterholm, PhD, MPH, CIDRAP Director*

Introduction

Disease surveillance includes the ongoing and systematic collection, analysis, and interpretation of data on the occurrence of disease in the population ([CDC 2020a](#)). Surveillance is the cornerstone of public health practice, because it allows public health officials to identify opportunities for disease control and evaluate the impact of policies and interventions. For surveillance to have a meaningful impact, the data collected from the surveillance system must be organized and analyzed in a thoughtful, structured way, and the results must be communicated regularly, clearly, and effectively to the public health workforce, policy makers, and the public.

Disease surveillance systems can be classified based on their method of reporting as active, passive, or sentinel. In active surveillance, health officials actively search for disease information by contacting healthcare providers, laboratories, schools, assisted living facilities, and workplaces, while in passive surveillance, healthcare providers and/or laboratories initiate the reporting of cases to health officials. Regardless of how cases are detected, all surveillance involves the active analysis, use, and dissemination of the data. Passive surveillance is generally used for routine disease surveillance activities and can be more easily conducted on an ongoing basis, but it can result in underreporting. Conversely, active surveillance systems are resource-intensive and, as such, are generally reserved for investigating diseases that pose a high risk to the public’s health, and for which complete ascertainment of cases is essential. Sentinel surveillance selects a small subset of disease reporting sites (e.g., clinics or hospitals) to gather additional detailed data on all cases from that site. It is ideal if intensive case investigation is warranted, but it is time- and resource-intensive.

Surveillance systems can also be classified based on the purpose of the system (e.g., infectious disease surveillance or risk factor surveillance), location (e.g., clinic-based or community-based), or on the target population (e.g., youth, adults). All public health surveillance systems must balance the attributes of simplicity, flexibility, data quality, acceptability, sensitivity, positive-predictive value, representativeness, stability, timeliness, and regularity of reporting to meet the objectives of the system ([CDC 2001](#)). A surveillance system can be judged to be effective, or useful, if it helps prevent and control its targeted health event and helps improve people’s knowledge of how the event affects the public’s health.

Effective surveillance of an emerging infectious disease such as COVID-19 poses unique challenges. Public health agencies have had to significantly increase their disease surveillance capacities to be able to rapidly

identify new COVID-19 patients, follow up with their contacts, monitor disease trends over time, and identify hot spots of disease transmission, often with limited testing. Despite this increase in COVID-19 surveillance capacities, gaps remain. It's essential, therefore, to outline the main goals of COVID-19 surveillance and address key challenges to its effective implementation.

Fundamentals of Surveillance for COVID-19

The overarching aims of COVID-19 surveillance are to “limit the spread of disease, enable public health authorities to manage the risk of COVID-19, and thereby enable economic and social activity to resume to the extent possible” ([WHO 2020a](#)). More specific functions for COVID-19 surveillance are as follows:

- **Monitor disease activity at the local, state, and national levels.** Public health officials must be able to monitor acute disease activity and trends in disease incidence to assess the effectiveness of public health control measures, such as school closures, shelter-in-place recommendations, and contact tracing with quarantine of contacts. Ongoing surveillance also helps identify hot spots of new emerging infections as they develop, allowing implementation of specific interventions to stem local disease transmission.
- **Conduct disease control interventions.** To effectively control or slow disease spread, health department officials must have rapid reporting of COVID-19 cases to conduct follow-up investigation of cases and to trace their contacts. To perform contact tracing, adequate data must be available from the reporting source to interview patients, or their next of kin, and the patient's close contacts. At a minimum, these data should include how the person may have been exposed to COVID-19 and demographic information such as age, gender, and race/ethnicity. To date, this information has not been collected systematically across jurisdictions. Also, whether race/ethnicity reporting is required by law varies by state ([AMA 2020](#)). Relevant information, such as workplace and recent attendance at large events or other high-risk community exposure settings including confined indoor areas (e.g., gyms, bars, salons) and large events (e.g., at houses of worship), should also be collected and reported to quickly identify case clusters where targeted interventions may be needed.

Pressing Issues

1. Lack of consistent methods and strategies for conducting COVID-19 surveillance across the country create a challenge to defining the epidemiology of this infection and monitoring the impact of disease control strategies.
2. Testing is a key feature of an effective surveillance system, but the lack of consistent, widespread access to testing within and between states complicates the meaningful interpretation of data at the state and national levels.
3. Data collected at the jurisdiction level are not reported quickly and uniformly across the country. State-level data do not always include critical elements, such as the number of cases, hospitalizations, and deaths, nor additional important demographic information such as age, gender, race/ethnicity, and location.
4. COVID-19 surveillance systems lack flexibility to adapt and become more targeted as the changing epidemiology of COVID-19 is clarified (e.g., identification of higher-risk populations, environments, activities, and behaviors).
5. Comprehensive surveillance data, including race and ethnicity of each case, are needed to address racial and ethnic COVID-19-related disparities.
6. Efforts are needed to expand serosurveillance across the country using comparable methodologies as part of a national strategy.

- **Define the epidemiology and burden of COVID-19.** Surveillance data should be used to define the disease burden, spectrum of illness, and characteristics of infected individuals. Surveillance data can also inform trends in disease spread and identify high-risk settings for disease transmission. The data can help to identify disparities in risk for infection and adverse health outcomes associated with race, ethnicity, socioeconomic status, and neighborhood.

Enhanced capabilities of surveillance during the pandemic

- **Monitor and predict impact on the healthcare system.** Surveillance data can be used to monitor the impact of ongoing COVID-19 spread on the US healthcare system. Tracking the availability and shortages of key resources such as test supplies, intensive care unit (ICU) beds, ventilators, and personal protective equipment (PPE) for healthcare workers can help officials elucidate resource capacity and better advise about the allocation of available resources to areas in critical need. This is not typically part of most public health departments' surveillance activities and, as such, may not be highly developed in most localities.
- **Monitor changes in antibodies over time.** Surveillance of the presence of antibodies (or “serosurveillance”) can help estimate the number of people who have had previous infection with SARS-CoV-2, the virus that causes COVID-19. It is not yet known how long antibodies persist or if antibodies are protective against future infection.
- **Inform modeling.** Surveillance is also used to inform mathematical and computational modeling with real-world data and to forecast future trends in the incidence of COVID-19 at local, state, and national levels so that resources can be allocated accordingly.
- **Monitor viral changes over time.** As with influenza surveillance, laboratory testing of isolates from specimens submitted through surveillance systems can help identify changes in the SARS-CoV-2 virus and determine if such changes affect the epidemiology, treatment, or prevention of the disease. Surveillance isolates are also used for evolutionary biology analyses to understand molecular epidemiology and transmission dynamics. Techniques such as whole-genome sequencing of SARS-CoV-2 isolates might enable better understanding of viral evolution and the epidemiologic characteristics of transmission. Tremendous progress in tracking viral evolution has already been accomplished using the GISAID platform and phylodynamic analysis ([GISAID 2020](#)). Surveillance of drift, shift, and susceptibility issues will be essential once vaccines and antiviral drugs become available to prevent and treat COVID-19, respectively. There is a role for an ongoing laboratory-based surveillance system to monitor the virus over time similar to CDC's PulseNet or CaliciNet, which track other pathogens ([CDC 2020b](#), [CDC 2020c](#)). The COVID-specific system would consist of a national network of laboratories using multiple standardized techniques that would support ongoing prevention and control efforts. A COVID-19 laboratory-based system could be integrated or coordinated with other lab-based respiratory disease surveillance systems, particularly those for influenza. Such linkages would not only facilitate the present pandemic response but also enhance our ability to address the next potentially pandemic respiratory agent.

Surveillance Data Sources

Effective surveillance relies on multiple forms of data from various sources; in combination, these data can provide an accurate picture of COVID-19 burden and spread in the community.

Laboratory-based virologic surveillance

Laboratory-based surveillance is the cornerstone of monitoring the incidence of infection in any given community and includes diagnostic molecular tests that detect the genetic sequence of the SARS-CoV-2 virus (e.g., reverse transcription polymerase chain reaction [RT-PCR]) or proteins on the surface of the virus (i.e.,

Recommendations

1. A state-by-state assessment of COVID-19 surveillance practices needs to be conducted to identify inconsistencies in timely case detection and reporting and to determine resource needs. Since the Council of State and Territorial Epidemiologists (CSTE) establishes and implements the use of national case definitions, it should conduct this review in collaboration with the Centers for Disease Control and Prevention (CDC).
2. Information from this assessment can then be used to develop a national standardized approach to COVID-19 surveillance by states. The approach needs to adapt to the changing epidemiology of the pandemic and as new data on the nature of the disease are published.
3. Automated electronic reporting should be incorporated into surveillance whenever possible, and the federal government needs to provide the additional resources needed to develop such systems.
4. States should publish on their COVID-19 dashboards standardized and detailed data for demographic subgroups defined by combinations of age, gender, race/ethnicity, and location. These should be publicly available (if data privacy can be maintained) for different periods so that temporal trends can be analyzed.
5. A coordinated campaign at the federal, state, or territorial level with consistent guidance from the CDC regarding key messages is needed to inform and educate applicable facilities (e.g., commercial and clinical laboratories, healthcare providers and facilities) on what information is required and why it is important.
6. State and local health departments need to have the data systems, informatics expertise, and trained epidemiologists necessary to conduct effective COVID-19 surveillance. This includes upgrading data surveillance infrastructure and ensuring federal support to provide resources needed to accomplish this goal.
7. The CDC should implement the agency's serosurveillance program as quickly as possible.
8. The CDC should continue to promote consistency for COVID-19 surveillance across the country and ensure that a cohesive national surveillance system emerges by the end of 2020.
9. With the fall influenza season approaching, federal, state, local, tribal and territorial health officials need to begin now to determine strategies for coordinating surveillance for both COVID-19 and influenza.

antigen tests). Most SARS-CoV-2 molecular tests are performed by hospitals and commercial labs rather than public health labs ([Farmer 2020](#)). It is critical that labs report negative tests, in addition to positive tests, to understand the adequacy of testing and positivity rates. It is also important to track multiple tests on individuals over time to differentiate between the total number of tests and the total number of people who have been tested. It would be very useful to also distinguish tests performed in people who have symptoms versus people who do not have symptoms.

It is essential that public health agencies receive the corresponding individual-level contact information (e.g., phone, address, email address, physician contact information) from healthcare providers and facilities to allow public health officials to rapidly follow up patients to advise them on isolation and prevention methods, obtain information on close contacts who need immediate follow-up and advice on quarantine and prevention,

perform case investigations, track trends in disease burden, identify hot spots, and obtain essential additional demographic, exposure, and medical information. Such data could include personal characteristics such as socioeconomic status, race, and ethnicity, as well as any preexisting medical conditions.

One of the major indicators of disease spread in the community is the proportion of lab-confirmed cases with no known source of exposure. Trends in this metric will be useful to gauge community spread and assess containment efforts.

Hospitalization surveillance

Hospitalization surveillance data, which include the number and proportion of hospitalized patients with COVID-19, is a valuable indicator of trends in disease burden over time compared with COVID-19 laboratory-based surveillance alone; hospitalization rates may reflect different demographic populations from the overall infected group. Hospitalization data must include race/ethnicity to track trends and assess health disparities. These data, however, are not useful for detecting early community spread because of the lag time between exposure, illness onset, and hospitalization, and the relatively small proportion of cases that involve hospitalization. Other hospital-related metrics that can indicate the level of COVID-19 burden in a community include the percent of total institutional and ICU beds that are occupied and the number and percent of ventilators in use for COVID-19 patients.

Mortality and excess death data

Mortality-based surveillance measures deaths attributed to COVID-19, and is a key indicator of the overall epidemic impact and trajectory ([Setel 2020](#)). US mortality data are based on the cause of death listed on the death certificate. The CDC has released detailed guidance for certifying deaths due to COVID-19, and obtaining accurate data relies on the appropriate completion of death certificates ([CDC 2020d](#)). The CDC recommends testing for COVID-19 whenever possible in the event of a death suspected to be caused by COVID-19. In the event that a test is not possible, the CDC recommends reporting COVID-19 on the death certificate as “probable” or “presumed” when specific criteria are met. Mortality data reporting also should include race/ethnicity. Similar to hospitalization data, mortality surveillance is a lagging indicator of disease spread in the community but is a useful metric to track over time.

Estimates of excess deaths can also provide information about the burden of mortality related to the pandemic. Measures of excess death can account for deaths that are directly attributed to COVID-19 that may or may not have been listed on the death certificate, as well as deaths that may be indirectly attributed to COVID-19. Excess deaths are typically defined as the difference between observed and expected numbers of deaths in a specific period.

Syndromic surveillance

Syndromic surveillance is an approach to detect and monitor health events by tracking who is seeking care in a healthcare setting for symptoms consistent with COVID-19. For example, emergency department (ED) and inpatient data for cases of COVID-like illness (CLI; fever and cough, shortness of breath, or pneumonia) can be collected before COVID-19 cases are officially diagnosed or laboratory results are confirmed to allow for more rapid detection of increases in disease rates in the community ([CDC 2020e](#)). Syndromic surveillance such as the CDC’s National Syndromic Surveillance Program (NSSP) allows health departments to monitor the volume of hospital and ED visits related to COVID-19, and can assist in detecting hot spots ([CDC 2020f](#)). Similarly, the US Outpatient Influenza-like Illness Surveillance Network (ILINet) monitors symptoms reported at outpatient facilities, such as urgent care centers, outpatient doctors’ offices, and clinics, and may identify early increases

in cases ([CDC 2020g](#)). Syndromic surveillance does not usually collect the names of infected persons, so its usefulness in initiating follow-up investigations and contact tracing may be limited.

Sentinel surveillance

Sentinel surveillance is an active surveillance system and is used when high-quality data are needed about a disease. A sentinel surveillance system comprises select reporting units that are enrolled in the surveillance system. Surveillance of these sentinel sites is used to signal trends, identify outbreaks, and monitor the burden of disease in a community ([WHO 2020b](#)). Rapid sentinel surveillance has been used to identify trends in SARS-CoV-2 community transmission and to guide selection and implementation of community mitigation measures ([Zwald 2020](#)). ILINet provides data on visits for influenza-like illness (ILI) (fever 100°F or higher and a cough and/or a sore throat) from primary care providers, emergency departments, and urgent care centers in all 50 states, Puerto Rico, the District of Columbia, and the US Virgin Islands. Mild COVID-19 illness presents with symptoms similar to ILI, so scientists are using ILINet to track trends of mild to moderate COVID-19 illness and compare them with prior influenza seasons ([CDC 2020g](#)). Increasing the percentage of patients tested by PCR for both influenza and SARS-CoV-2 could enhance the value of this sentinel surveillance network. At the international level, the Global Influenza Surveillance and Response System (GISRS) has been very successful for monitoring influenza virus evolution and epidemiology. GISRS could be adapted and funded to include SARS-CoV-2 in its mission ([WHO 2020c](#)).

Point-prevalence surveys

Point-prevalence surveys are used to identify the number of infected people at a specific point in time. Repeated point-prevalence surveys can be useful to identifying asymptomatic persons during outbreaks in populations where symptom-based screening is inadequate to detect SARS-CoV-2 transmission, such as in skilled nursing facilities, long-term care settings, or college campuses ([Sanchez 2020](#)).

Serosurveillance

An additional way to measure how widespread SARS-CoV-2 infection is in a given community is through serosurveillance studies. Serosurveillance involves antibody/serology testing of the blood from a sample of people within a given population to determine the proportion who may have been previously infected with the virus, whether they had symptoms or not. Conducting serosurveillance studies over time can be used to assess infection and transmission trends. Serosurveys should be carefully designed, selecting enough representative people that match the demographics of the population being tested to allow for meaningful statistical analysis and inferences ([Gronvall 2020](#)). Serosurveillance was employed by states and the CDC in the 1980s and 1990s to monitor the HIV epidemic in selected populations, such as pregnant women ([Gronvall 2020](#)). The CDC is working with state, local, territorial, academic, and commercial partners to implement a national COVID-19 serology surveillance strategy ([CDC 2020h](#)).

While serologic testing can provide useful information, a number of caveats must be considered. In a population with a relatively low prevalence of SARS-CoV-2 antibodies, which is likely the case in much of the United States, a high proportion of positive tests will be false-positives even with a test that has high sensitivity (i.e., the ability to return a positive test result if antibodies are present) and high specificity (i.e., the ability to return a negative

In a population with a relatively low prevalence of SARS-CoV-2 antibodies, which is likely the case in much of the United States, a high proportion of positive tests will be false-positives even with a test that has high sensitivity and high specificity.

test result if antibodies are not present). Second, it is unclear how long immunity to the virus will last, and if and how positive serology results correlate with immunity. Until the incidence of the disease in the population is higher and correlates of protection are defined—if they are available at all—serology testing cannot provide information on what proportion of the population is immune to SARS-CoV-2.

Other forms of surveillance

Pooled screening, or combining samples from multiple people into batches (or “pools”) and testing each sample individually only if the pool is positive, is used for widespread screening for other infectious diseases and can conserve testing resources. Pooled screening may be appropriate to test for SARS-CoV-2 in asymptomatic persons in populations with low prevalence of disease, while recognizing the limitations such as possible decreased sensitivity of tests and the extra time required to run additional tests if the pools need to be tested separately. Researchers are also exploring wastewater monitoring as a form of environmental surveillance to estimate the presence of the disease and the number of COVID-19 cases in some municipalities. Other types of COVID-19 surveillance that are being used or could be considered include workplace surveillance and newer types of surveillance such as GPS tracking, social media, internet, and data mining.

Key Challenges to COVID-19 Surveillance

COVID-19 surveillance is a complex undertaking that poses a number of challenges.

Limited COVID-19 testing, especially early on

In the first few months of the COVID-19 pandemic, surveillance of deaths and hospitalizations was used by governors and other policy makers to guide mitigation and control strategies. Although some forms of surveillance can be conducted without laboratory-based tests, accurate and reliable surveillance hinges on the ability to accurately and reliably test the population, particularly those who are symptomatic. In the very early days of COVID-19, the US testing infrastructure was inadequate to appropriately monitor disease incidence and spread across the country. Testing availability and consistency still remain an important challenge in certain areas and in certain populations, especially among groups at highest risk of complications, complicating interpretation of trends and comparisons between regions.

Early in the pandemic, testing was extremely variable, owing to a lack of reliable tests, followed by a lack of test kits, and limited testing reagents and other supplies (e.g., swabs, PPE for providers). To further complicate the testing process, recommendations for who should and should not be tested have varied by jurisdiction and by time, based on the evolving understanding of the epidemiology of the disease as well as availability of testing resources. This has led to inaccurate and incomparable data across jurisdictions and there is no way to accurately determine how many people were infected early on.

The percent of positive tests compared with the total number of tests performed (the percent positivity) should be used to indicate whether a community is conducting enough tests to find active cases ([Johns Hopkins 2020](#)). A high percent positivity indicates that there are many additional cases not being detected and that testing should be increased. As a measure of disease burden, however, percent positivity is biased, because it is correlated with the testing criteria.

Incomplete reporting of critical information

It is critical that surveillance systems capture enough information about cases to define the epidemiology of the disease and inform disease control activities in real-time. Time-varying, granular data on subgroups such as age, gender, race/ethnicity, and location should be publicly available for every state in a standardized format to

facilitate rapid epidemiologic analyses within and between jurisdictions ([Rivers 2020](#)). Although many states are publishing state-level data on online dashboards, reporting has been incomplete and data has been reported in non-standardized ways.

In particular, missing data on race and ethnicity severely limit conclusions that can be drawn from analyses. State and territorial health departments provide daily reports to the CDC on aggregate counts of COVID-19 cases and deaths; from January 22 through May 30, 2020, 55% of the cases reported to the CDC were missing information on race or ethnicity ([Stokes 2020](#)). Symptom status (symptomatic or asymptomatic) was provided for only 47% of cases, nearly 80% had unknown underlying health condition status, and outcomes for hospitalization, ICU admission, and death were available for 46%, 14%, and 36%, respectively. The Coronavirus Aid, Relief, and Economic Security (CARES) Act requires that data elements, including race, be collected and reported for positive SARS-CoV-2 laboratory tests no later than August 1, 2020 ([HHS 2020](#)). Geocoded data, based on zip code or census tract, could be of value if individual data on race/ethnicity are missing, or to explore other health equity issues.

Mildly symptomatic and asymptomatic exposed people

Many mildly symptomatic cases of COVID-19 have been missed in disease surveillance because they weren't consistently captured in the CDC/CSTE case definition ([CDC 2020i](#)) or the person did not seek medical care. Because of a shortage of laboratory testing materials at the beginning of the pandemic, mildly symptomatic cases were not recommended for testing. Similarly, symptomatic people who choose not to seek testing (e.g., people in underserved communities, undocumented persons, uninsured persons) are also missed in disease surveillance.

As testing becomes more widely available, those with mild or no symptoms may be eligible for testing. For example, testing criteria in many areas have expanded recently to include all presurgical patients ([APSF 2020](#)), all hospital admissions ([UW Medicine 2020](#)), or all patients prior to discharge to a skilled nursing facility ([CMS 2020](#)). There is currently no practical method, however, to capture mild and asymptomatic cases, and it's not realistic to repeatedly and frequently test the entire population to detect asymptomatic cases, as was done in Wuhan, China ([Wee 2020](#)). Furthermore, when laboratory testing capacity is strained, particularly during surges, testing algorithms should prioritize testing for symptomatic over asymptomatic people. If testing of asymptomatic individuals occurs, case counts and the proportion of positive tests should be tracked separately for asymptomatic and symptomatic people.

Detection of mild cases of infection is important for monitoring disease in the community and for contact tracing. This may mean encouraging all those who are mildly symptomatic to seek testing, especially if there is evidence of community transmission, and encouraging those who have had a known exposure to a COVID-19 patient to seek testing, even if they are asymptomatic. A testing strategy that prioritizes testing of mildly symptomatic and asymptomatic people with known COVID-19 exposures would need to consider whether mildly symptomatic or asymptomatic exposed people should be tested for free, since there is limited benefit for the person but high benefit for public health surveillance and disease control. The role of repeated testing among

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populations at high risk of infection (e.g., prisoners and prison staff, migrant workers, long-term care facility residents and staff, healthcare workers, meatpacking plant employees, and university communities) remains unclear. Since testing guidelines and recommendations have changed since the beginning of the pandemic, public messaging would need to clearly convey testing priorities, and this should include the use of social media campaigns.

Inconsistent data collection and reporting

The lack of reliable and comparable national data on COVID-19 makes it difficult to develop, assess, and evaluate public health policies across the country. Much of this is the result of a patchwork of variable policies for testing and surveillance in different jurisdictions, despite recommendations from the CDC for standardized reporting (CDC 2020j). For example, not all states report probable cases in addition to confirmed cases and deaths (D'Ambrosio 2020, Holcombe 2020), and some states combine results of positive molecular tests with positive antibody tests, while others do not (Madrigal 2020). In general, states should not include results from serology tests when reporting COVID-19 cases, since such results do not represent acute cases, and serology testing may be inaccurate. If states choose to include results from serology tests, they should be reported separately from molecular test results.

Furthermore, some but not all states report important information, such as the number of cases in the ICU and the percent of available ventilators being used to treat COVID-19 patients in cities or counties. The accurate monitoring and reporting of healthcare system status is complicated and variable from system to system, making cross-system comparisons challenging.

Non-specific case definition

Public health surveillance systems rely on surveillance case definitions, or a set of uniform criteria used to define disease. Surveillance case definitions enable public health officials to classify and count cases consistently across jurisdictions. It's important to note that surveillance case definitions are not intended to be used for clinical diagnoses or to determine how to care for individual patients. CSTE approved an interim COVID-19 case definition on April 5, 2020 (CDC 2020i) that includes criteria for classifying both confirmed and probable cases. Symptoms of COVID-19 are non-specific, and thus clinical criteria to classify probable COVID-19 cases lack specificity. Moreover, in practice, the COVID-19 case definition itself may drive testing and thus may influence who is ultimately confirmed as a case-patient.

Clustering of cases detected in outbreaks

The “clustering factor” must be accounted for when case clusters occur, for example in congregate settings such as long-term-care facilities or in certain work settings like meat packing plants, farms, and healthcare facilities. If clusters occur in nursing homes, for example, and extensive testing is initiated in response to the cluster, this can skew surveillance data to reflect a higher proportion of cases associated with cluster investigations than in the general population. Similarly, large numbers of cases can result from cruise ships and fishing vessels that are acquired out of jurisdiction but diagnosed in port cities. In these settings, it is important for jurisdictions to differentiate between resident and non-resident cases.

Difficulties in assessing exposures

With many forms of disease surveillance (e.g., foodborne disease surveillance), it is important to gather and assess relevant exposures to generate useful data to reduce ongoing transmission to others. This information is useful for COVID-19 surveillance, because it can shed light on the level of transmission in the community

based on the proportion of new patients who report a known exposure compared with those who acquired their infection from an unknown source in the community. It may also help identify hot spots or transmission clusters if a shared exposure source is identified, and it can lead to policy changes to reduce transmission.


This type of surveillance led to the identification of several specific bars as exposure settings for case clusters of young adults following the loosening of restrictions in Minnesota and elsewhere ([Olson 2020](#)) and led to the reclosing of bars in several areas during the recent surge in cases among younger people ([Freitas-Tamura 2020](#)).

However, the broader utility of exposure assessment to determine an exposure source for a respiratory disease, such as COVID-19, that is widespread in the community is challenging, especially with many cases, numerous interviewees, co-circulating respiratory viruses, a long incubation period, and no uniform system in place to systematically catalogue the myriad of potential exposures.

Guidance about how to approach community exposure assessment could be useful and should consider the fact that cases may have multiple potential exposure sources that can be challenging to disentangle. For example, cases linked to workplaces will often have several other potential exposure settings (e.g., carpool, living in extended family settings, outings to public spaces). Furthermore, transmission from a person without symptoms (i.e., asymptomatic or presymptomatic) also complicates exposure assessment. It may not be feasible to design databases and standardized protocols for investigators to use to catalogue myriad potential exposures over a 2-week period when virus is circulating at high levels.

Lack of timeliness and regularity of reporting

Timeliness and regularity of reporting are essential components of an effective surveillance system. This includes the timely reporting of results from both point-of-care and laboratory tests. To assess the burden of severe illness, the number of hospitalizations and deaths should be incorporated in a timely manner into each report provided by state health departments.



Timeliness and regularity of reporting are essential components of an effective surveillance system.

Laboratory tests should be reported rapidly to public health officials. Batch reporting from major labs has been reported to be up to 7 to 10 days from specimen collection, which creates a barrier to identifying temporal trends as well as for contact tracing and effective quarantine of contacts. The Department of Health and Human Services (HHS) now requires that all laboratories must report data to the appropriate state or local health department for all tests within 24 hours of results being known ([HHS 2020](#)). HHS also requires that test result date, date of test ordered, and date of specimen collected be reported with each sample. Ideally, the date of symptom onset should also be reported, with date of specimen collection being the next best alternative.

Lack of integrated reporting infrastructure

Currently, no integrated electronic data infrastructure exists for reporting SARS-CoV-2 test results to state public health departments and to the CDC. Data management and informatics must be developed and adapted to meet the realities of this pandemic and associated public health information needs. Automated reporting of SARS-CoV-2 tests to health departments and the CDC may not be feasible in the middle of a pandemic, but it would maximize reporting compliance and minimize the reporting burden on institutions. Expert database developers, informatics professionals, and analysts are needed in the public health workforce, in addition to epidemiologists and disease investigators. Long-term investments in infrastructures are needed so that public health officials can respond more effectively to future pandemics.

Defining the role of serosurveillance

Serosurveillance is critical to better understand how many infections have occurred at different points in time, in different locations, and within different populations in the country ([CDC 2020h](#)). However, antibody tests are not a diagnostic tool for identifying active COVID-19 infection and cannot be used to indicate whether enough testing is being done in the community. Further, the accuracy of antibody tests is highly variable because of the initial influx of antibody tests to the market before strict controls were implemented by the Food and Drug Administration (FDA). Many substandard tests are still in use, even with the FDA's control measures. In addition, immunoglobulin G antibody levels wane over time, especially in asymptomatic individuals ([Long 2020](#)).

Carefully designed serosurveillance studies are needed across geographic areas and in different populations, but these studies must use robust and comparable methodologies ([Gronvall 2020](#)). Inferences drawn from serosurveillance studies must recognize the challenge of data interpretation due to the potential for false-positives, and upper and lower bounds should be presented with all estimates.

Ongoing surveillance of other diseases

The ongoing surveillance of other notifiable diseases will be complicated by the non-specific symptoms of COVID-19 infection. Examples of notifiable diseases that could be affected this summer include Legionnaires' disease, and vectorborne diseases—those transmitted by tick or mosquito bites. Legionnaires' disease is critical, as it may sometimes be clinically indistinguishable from COVID-19. In the summer and fall, Legionnaires' disease may account for a non-trivial proportion of all hospitalized patients with pneumonia. With stagnant water systems in buildings vacant because of COVID-19, the risk of Legionnaires' disease has likely increased. Clinicians must continue to test for other reasonable infectious causes during the COVID-19 pandemic and must have the ability to test for all suspected illnesses, since co-infections may occur.

The co-circulation of influenza viruses and SARS-CoV-2 this fall will create significant surveillance challenges, particularly if a large influx of COVID-19 cases occur in the coming months. It will be critical to rapidly distinguish CLI from ILI and rule out co-infections to be able to guide care, isolation, and containment strategies. Likewise, syndromic surveillance during the influenza season poses challenges given that influenza and COVID-19 symptoms are similar. Sentinel surveillance with PCR testing for both viruses may be one way to address this challenge.

The COVID-19 pandemic has also challenged public health surveillance of other infectious and non-communicable diseases. Enhanced surveillance will be needed to monitor the impact of falling immunization rates ([Santoli 2020](#)); the consequences of delayed screening, diagnosis, and treatment for other conditions ([Rosenbaum 2020](#)); and the effect of the reassignment of public health staff to respond to COVID-19.

The Critical Need for a Directed, Unified Approach

As noted, the complexities of surveillance activities during an evolving pandemic are myriad, but, done well, it's a crucial foundation of the public health response. The country's approach to surveillance thus far has been lacking in consistent methods and strategy, which has hamstrung response efforts. But with leadership from the CSTE and CDC, as noted in our list of recommendations on page 5, and a nimble, adaptable strategy, US surveillance efforts can effectively guide public health decisions for COVID-19 response efforts going forward.

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