


Goal-Aligned, Epidemic Intelligence for the Public Health Response to the COVID-19 Pandemic

 See also Morabia, p. 1111, and the *AJPH* COVID-19 section, pp. 1123–1172.

For the COVID-19 pandemic, and for future pandemics, public health authorities at the local, state, and national levels must develop, deploy, and routinely disseminate, in as timely a manner as possible, a standard set of metrics that are goal-aligned with the public health response and that enable collective action by the whole of society, including the general public. An effective response to the COVID-19 pandemic requires nimble, intensive, and effective public health action to minimize spread, suffering, and deaths—as well as socioeconomic and racial inequities in these outcomes. “Epidemic intelligence”—a well-chosen, publicly facing set of metrics aligned with the goals of the public health response—is an important public good sometimes neglected early in emergency responses.

The early construction and dissemination of metrics can exert strong effects themselves and can have meaningful and real-time influence on public health action in at least four ways. First, in the absence of a centrally managed national response, many levels of government and allied organizations must act together and will benefit from the alignment of actions to common

metrics. Second, metrics will reveal heterogeneity and inequity in disease burden that can be used to guide resource allocation and course corrections. Third, common metrics create an expectation that health agencies and other government actors will share data. Fourth, and importantly, publicly facing metrics create a mechanism for accountability between affected communities and leaders by tracking progress (or lack thereof). We propose specific types of metrics for three key goals of the public health response to the COVID-19 pandemic for use by state, local, and national health authorities.

GOAL 1

Mitigate or suppress community transmission of SARS-CoV-2 through physical distancing and other nonpharmaceutical interventions.

Metrics are needed to assess the level of ongoing SARS-CoV-2 transmission in the community and where it is increasing, stabilizing, or decreasing. Where the availability of testing is limited or changing rapidly, positive tests poorly reflect trends in transmission or the true size of the infected population. In such settings, trends in the number of

COVID-19–related hospitalizations and COVID-19 deaths should be used to infer trends in SARS-CoV-2 transmission 5 to 15 days earlier. In addition, syndromic surveillance that tracks influenza-like illness and pneumonia admissions to hospitals via emergency departments in near real time offer another critical and rapid assessment of surges or retreats of cases.

In New York City and other jurisdictions, syndromic surveillance¹ (<https://on.nyc.gov/2yx0NDO>) played a crucial role in alerting the public to the rapid rise in COVID-19 cases in late March 2020 (Figure A, available as a supplement to the online version of this article at <http://www.ajph.org>) and the subsequent wave of hospitalizations and deaths (<https://on.nyc.gov/2YEzOks>). Other metrics to assess success or failure of strategies to prevent, mitigate, or suppress community transmission of

SARS-CoV-2 are shown in the box on page 1155. Finally, given the vulnerability of older populations and persons with comorbidities living in congregate settings, and the need to prevent the introduction of SARS-CoV-2 into these settings, the number of settings with active outbreaks should be tracked.

It is also critical to track implementation metrics for physical-distancing strategies aimed at sustained reductions in community transmission of SARS-CoV-2. Some of the most extensive physical-distancing strategies in generations have been implemented around the world in response to the COVID-19 pandemic.² These have included mandating the closure of schools, universities, restaurants, bars, and cafes; prohibiting mass gatherings; and issuing stay-at-home orders, which include self-isolation and quarantine. The sustained mitigation of community transmission of SARS-CoV-2 reduces the total number of COVID-19 hospitalizations and deaths.³ These metrics can give very early information on whether course corrections or additional messaging is needed to optimize uptake and community engagement.

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This editorial was accepted May 14, 2020.
doi: 10.2105/AJPH.2020.305794

METRICS ALIGNED WITH THE GOALS OF THE PUBLIC HEALTH RESPONSE TO THE COVID-19 PANDEMIC

Goal	Stratification Variables
Public health goal 1: Mitigate or suppress community transmission of SARS-CoV-2 through physical distancing and other nonpharmaceutical interventions	
Syndromic surveillance No. and rate of ED visits for ILI and pneumonia No. and rate of hospital admissions to the ED for ILI and pneumonia	Age, geography (zip code/county)
No. and rate of hospitalizations for COVID-19 No. and rate of deaths from COVID-19 (in and out of the hospital) No. COVID-19 diagnoses No. persons testing positive for SARS-CoV-2	Age, sex, race/ethnicity, HCW status, symptom onset date, diagnosis date, geography (zip code), setting (hospital, nursing home, assisted living, adult care facility, skilled nursing facility)
Contact tracing, isolation, quarantine No. newly diagnosed COVID-19 cases that have been interviewed No. close contacts identified No. close contacts notified No. tested No. isolated No. quarantined	Geography (zip code/county)
Physical-distancing and nonpharmaceutical intervention implementation metrics Work from home Mass gatherings Stay-at-home orders, self-isolation, self-quarantine	Geography
Public health goal 2: Prevent or minimize morbidity and mortality from COVID-19	
No. confirmed and possible COVID-19 cases newly hospitalized No. confirmed COVID-19 cases currently in the hospital No. in hospital No. in ICU No. on ventilator No. discharged/recovered No. COVID-19-related deaths	Age, HCW status, symptom onset date, geography (zip code), hospitalization date
Capacity No. and % of hospital beds available No. and % of ICU beds available	
Public health goal 3: Protect the health care workforce and other essential workers from becoming infected with SARS-CoV-2	
No. active, hospital-based frontline HCWs and staff Total No. tested for SARS-CoV-2 No. positive No. negative No. pending No. deaths among those with confirmed or suspected COVID-19	Cadre (e.g., medical doctor, physician's assistant, nurse practitioner, registered nurse, other)

Note. ED = emergency department; HCW = health care worker; ICU = intensive care unit; ILI = influenza-like illness.

GOAL 2

Prevent or minimize morbidity and mortality from COVID-19. To assess care and treatment activities aiming to minimize morbidity and mortality from COVID-19, state and local health departments should publicly disseminate metrics derived from key clinical outcomes, including vital status, among all suspected and laboratory-confirmed cases of COVID-19 (see the box on this page). These data can be combined to generate case fatality rates by age for confirmed versus possible COVID-19. It is critical to prioritize timely reporting of deaths, because other metrics could become distorted if and when the health care system becomes overwhelmed (e.g., resulting from changing admissions practices) and deaths increasingly occur outside the health care setting and before a formal COVID-19 diagnosis.

GOAL 3

Protect the health care workforce and other essential workers from becoming infected with SARS-CoV-2. The protection of frontline health care workers, hospital personnel, first responders, and other essential workers who cannot fully engage in physical distancing should be an explicit goal of any public health response to a pandemic like the one we are now experiencing. Public health should prioritize tracking routine health screening and testing of all frontline health care workers, hospital personnel, first responders, and other essential employees during a pandemic. Metrics include the number tested, testing positive, not tested each week as well as the number tested by health care worker cadre and type of hospital or urgent care facility where the health care

worker is employed (see the box on page 1155).

DISSEMINATION

Even the best designed metrics will be of little value unless they are disseminated in the form of timely, actionable information that rapidly reaches the wide array of stakeholders and actors who need to be informed or are in a position to support the larger public health goals. In the case of the COVID-19 pandemic, this is essentially everyone in society, including the general public, governments, elected officials and political leaders, and the public and private sectors. Health departments' broad and timely dissemination of these metrics should be viewed, in and of itself, as a major component of the public health response to pandemics. Everyone must be on same page to be informed, to do their part, and to hold society and our leaders accountable. This framework of goals and metrics will apply equally to future pandemics. We recommend that metrics be disseminated by state and local health departments in a way that gives everyone in society access to reliable, useful, objective, and up-to-date information for their local jurisdiction. A publicly available app or a Web-based dashboard system, like those recently deployed in New York for COVID-19 (<https://on.nyc.gov/2YEzOks>) and for HIV (etedashboardny.org) serve as good examples. Health departments must be explicitly resourced for this critical dissemination activity.

As we have recently argued for public health efforts to end the HIV epidemic⁴, well-chosen metrics combined with a well-designed, timely dissemination system can serve as essential tools

to inform, enlist, and empower the public; identify and disseminate lessons learned quickly; and accelerate the public health response within and across jurisdictions aiming to limit the impact of the COVID-19 and future pandemics. At the time of this writing, the peak in COVID-19 hospitalizations and deaths has not yet been reached in many US jurisdictions. When and where physical-distancing measures succeed in reducing community transmission of SARS-CoV-2 and the burden of COVID-19 on the health care system, public health goals will shift back to a focus on expanded testing, contact tracing, isolation, and quarantine, making it critical to track an additional set of metrics (see the box on page 1155).

Moreover, a broad, but expert-driven and evidence-informed, consensus on specification of a priori thresholds of key metrics that trigger both lifting and reinstating stay-at-home and other physical-distancing restrictions is critical for transparency, safety, efficacy, and optimal collective impact.⁵ Where available, thresholds based on near real-time metrics derived from syndromic surveillance systems will be particularly important early warning systems for when it is time to reinstate restrictions. All key aspects of the public health response to pandemics will require ongoing, real-time, meaningful metrics at local, regional, and national levels to enable responsive and impactful public health action. **AJPH**

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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