The Need for Science in the Practice of Public Health
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When H5N1 avian influenza emerged in 1997, much of the world began planning for an eventual pandemic. Most planners expected the pandemic to begin in Asia and believed the virus would be highly lethal. In the United States, planning efforts for pandemic influenza escalated again in November 2005, with the publication of the National Strategy for Pandemic Influenza. The H1N1 pandemic that emerged in the spring of 2009 did not conform to prior planning assumptions. It began in Mexico rather than Asia and to date has not been as lethal as first feared.

Since 2005, global influenza surveillance has vastly improved. Many countries, including China, markedly increased disease-surveillance efforts after the outbreak of severe acute respiratory syndrome (SARS) in 2003. The report by Cao and colleagues in this issue of the Journal demonstrates the progress China has made in developing robust surveillance in a relatively short period. Surveillance has also improved in the United States, where detection of the first two cases of H1N1 infection was the result of investments leading to experimental diagnostic tests and enhanced border surveillance.

The planners involved in efforts to contain pandemics called for a layered approach to protecting the population, including steps to prevent or slow the spread of disease, communication with the public, and treatment with antiviral medications until a vaccine could be manufactured and made widely available. The world’s response to this pandemic is far better than it would have been without the aggressive planning that has been done since 1997, but experience with the H1N1 virus to date reminds us that even though we have made great strides, additional science is needed to better inform public health responses.

By the time the H1N1 virus was recognized, infection was already widespread in Mexico and in several sites in the United States. From the perspective of many in the public health community, it made little sense to try to close the border with Mexico, since doing so would not stop the spread of disease within the United States. In addition to the preventive measures recommended for the individual person (e.g., hand washing, covering one’s cough), early prevention efforts focused on isolation of infected persons, early detection, and postexposure prophylaxis. As local outbreaks progressed, some communities closed their schools. Unfortunately, we still have little science to tell us whether and under what circumstances measures such as school closures are most effective, but we do know the closures were disruptive to children’s learning and to working parents and their employers.

China built on its post-SARS disease-surveillance capability and focused first on early detection and postexposure prophylaxis. China also implemented a strict isolation and quarantine policy in the hope of preventing or slowing the spread of disease. But as Cao and colleagues remind us, further data are needed to inform screening and the actions based on it. For example, the accuracy of large-scale thermal screening is variable. As noted by Cao and colleagues and by other investigators, roughly one quarter of those infected are afebrile. Hence, screening that relies on the presence of fever will mean that many infected persons will be overlooked. Testing with real-time reverse transcriptase–polymerase chain reaction (RT-PCR) is important in making a diagnosis, but it is both expensive and of limited practicality on a very large scale. Since people are likely to remain PCR-positive for several days after they stop shedding viable
virus and are infectious, the practice of basing either community mitigation or social distancing policies on PCR-positivity could result in unnecessary interventions for people who are no longer able to transmit the virus. This speaks to the need to better understand the practical aspects of transmission and the need for simple, accurate tests with rapidly produced results that can be used to guide decisions about diagnosis, treatment, and social distancing.

Many observers think that China's isolation and quarantine policy, like the school closures in the United States, was disruptive. Unfortunately, we do not yet have adequate data to help us understand whether any of these measures worked, nor do we have a good understanding of the levels of individual or social disruption that are acceptable to different people, communities, and countries. Clarifying the benefits of social distancing and mitigation measures will be critical to understanding whether the burdens to society are worth bearing.

The ultimate way to protect individual persons and populations from disease is with vaccination, and the rapid development and manufacture of the H1N1 vaccine represent a triumph of modern science. Even so, the United States, which was one of the first countries to mount a large-scale vaccination campaign, has not yet reached the aspirational goal articulated in the pandemic preparedness plan published in November 2005 — that is, to attain within 5 years the domestic manufacturing capacity to produce sufficient pandemic vaccine for the U.S. population within 6 months of pandemic onset. Additional breakthroughs in the development of safe cell-based, plant-based, and recombinant vaccines, combined with large-scale manufacturing capacity, are needed to reach this goal. Analogous global goals — and plans for achieving them — are badly needed.

Once vaccine is widely available, it must rapidly reach those who need it. Comparatively little research has been conducted in operations and logistics to inform us of how best to do this. Although methods of reaching high-risk patients are admittedly country-specific and health system—specific, a substantial effort in operations research would be likely to help us better understand how to accomplish more rapid delivery of vaccine — or any other countermeasure — to those who most need it anywhere in the world.

Effective communication with the public is central to any public health emergency response. The widespread misunderstanding of vaccine safety and effectiveness speaks to the need to improve not only safety science but also communication science — to enhance our ability to reach and educate the public, especially those who are at highest risk for disease.

We will all have the opportunity to learn lessons from the 2009 pandemic H1N1 virus. Although we would like to believe that pandemics occur rarely and that we have plenty of time until the next one, new infectious diseases, as well as other kinds of threats, can emerge at any time. One challenge will be to continue to invest in science — whether that means basic virology; surveillance; mitigation measures; vaccine development, manufacture, and distribution; operations and logistics; or communication — so that when the next pandemic or other emerging infectious disease appears, we will have the data we need to make informed decisions about how to confront it. A second challenge will be to strengthen the nation's public health infrastructure so that we can rapidly turn scientific knowledge into action.

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