different pathogens than those species, and alter the tickborne disease landscape. We believe it's essential for practitioners and the public to develop a heightened awareness of the health risks associated with emergent tick vectors such as the lone star tick and their potential for changing the dynamics of tickborne diseases in the northeastern United States and elsewhere.

An audio interview with Dr. Molaei is available at NEJM.org

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1. Ogden NH, Radojevic M, Wu X, Duvvuri VR, Leighton PA, Wu J. Estimated effects of projected climate change on the basic reproductive number of the Lyme disease vector *Ixodes scapularis*. Environ Health Perspect 2014;122:631-8.
2. Stafford KC III, Molaei G, Little EAH, Paddock CD, Karpathy SE, Labonte AM. Distribution and establishment of the lone star tick in Connecticut and implications for range expansion and public health. J Med Entomol 2018;55:1561-8.
3. Nelder MP, Russell CB, Clow KM, et al. Occurrence and distribution of *Ambylomma americanum* as determined by passive surveillance in Ontario, Canada (1999-2016). Ticks Tick Borne Dis 2019;10:146-55.
4. Jordan RA, Egizi A. The growing importance of lone star ticks in a Lyme disease endemic county: passive tick surveillance in Monmouth County, NJ, 2006-2016. PLoS One 2019;14(2):e0211778.
5. Telford SR III, Buchthal J, Elias P. Early questing by lone star tick larvae, New York and Massachusetts, USA, 2018. Emerg Infect Dis 2019;25:1592-3.

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Preparing for the Next Pandemic — The WHO's Global Influenza Strategy

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Last year, the world marked 100 years since the beginning of the 1918 influenza pandemic. Over a little more than 2 years, the virus infected more than half a billion people, spreading to remote parts of the globe and causing more deaths than either World War I or World War II — and possibly more than both combined.[1] There have been four additional influenza pandemics in the past century (the most recent being the 2009 H1N1 pandemic), although none has caused the same scale of infection and mortality as the 1918 pandemic. Virologists studying influenza are clear, however: another pandemic will hit again.

Seasonal influenza also represents an important yet often underestimated global health burden. Although the annual cycle of influenza seasons is predicable, the severity of a given influenza strain and precisely when it will arrive are less certain. The Southern Hemisphere's influenza season arrived earlier in 2019 than in the past 19 years. Australia had its highest number of confirmed influenza cases on record, most of them influenza A H3N2, although it wasn't a particularly severe year in terms of the number of deaths and intensive care admissions. Despite the common belief that influenza trends in the Southern Hemisphere predict those in the Northern Hemisphere, there is no set pattern in the direction of virus migration for the current circulating H3N2.

Given the ongoing threat posed by influenza, the World Health Organization (WHO) earlier this year released its Global Influenza Strategy 2019–2030. Its goals include reducing the burden of seasonal influenza, minimizing the risk of zoonotic influenza, and mitigating the effects of pandemic influenza.

The new strategy is a welcome step. However, we believe that it should address several current and emerging challenges to preventing and responding to influenza, among them potential barriers to pathogen sharing, use of influenza genetic-sequence data for vaccine development, and global response capabilities, including medical countermeasures. Although these challenges may be addressed in other ongoing initiatives, influenza preparedness and response strategies must be sufficiently agile for new technologies, transparent for accountability, and equitable for global health justice.

Rapid and comprehensive sharing of influenza viruses among countries, researchers, pharmaceutical and diagnostic manufacturers, and the WHO is vital to global pandemic preparedness. Virus sharing facilitates surveillance of emerging and reemerging viruses with pandemic potential, enables the development of seasonal and pandemic influenza vaccines, and contributes to the development of medical countermeasures. Global pandemic response also requires the equitable

sharing of vaccines, diagnostics, antivirals, and data resulting from virus sharing.

The Nagoya Protocol could complicate the virus-sharing process, however. This agreement among 123 countries, which entered into force in 2014, aims to ensure that the benefits that arise from the use of genetic resources are shared equitably. But a study prepared by the WHO noted concern that implementation of the protocol could slow or limit virus sharing.[2] Although the agreement excludes resources that are specifically covered by other legal instruments — as pandemic influenza viruses are by the WHO's Pandemic Influenza Preparedness (PIP) Framework — consensus on the exclusion of such viruses hasn't been made explicit. In addition, the terms of the Nagoya Protocol still apply to seasonal influenza viruses. The WHO's strategy states that the agency is to "provide leadership on global public health matters regarding the sharing of influenza data and viruses, including within the context of other international bodies and agreements," such as the Nagoya Protocol, but no additional details are provided regarding how the WHO will seek to limit the protocol's effect on virus sharing and pandemic preparedness.

The move toward using influenza genetic-sequence data for developing vaccines represents another challenge affecting influenza preparedness and response. In 2016, the PIP Framework review group noted that genetic-sequence data could in some cases be used instead of virus samples during pandemic risk assessment and for vaccine development.[3] The PIP Framework encourages all countries to share genetic-sequence data. But unlike pandemic influenza virus samples, such data aren't included in the framework's access and benefit-sharing regime, and the WHO's strategy gives limited recognition to the current and potential effects of the use of genetic-sequence data on influenza preparedness and response.

The strategy notes that the "underpinning principle" of the PIP Framework is that "rapid and timely sharing of influenza viruses with human pandemic potential and genetic sequence data must be pursued on an equal footing with the sharing of benefits." We believe, however, that long-term planning for influenza needs to anticipate changes in virus sharing and the challenges and opportunities associated with the use of genetic-sequence data. In particular, if vaccine manufacturers are increasingly able to rely solely on genetic-sequence data to develop products, they will no longer need to provide benefits in accordance with the PIP Framework.[4] Since the adoption of the framework, 13 vaccine and antiviral manufacturers have entered into agreements that the WHO has reported would provide the agency with 400 million doses of pandemic influenza vaccine, 10 million treatment courses of antiviral drugs, 250,000 diagnostic kits, and 25 million syringes in the event of a pandemic. As vaccine development and manufacturing using genetic-sequence data move closer to becoming viable, both virus-sharing obligations and the millions of vaccine doses that have been committed to the WHO could be under threat.

Access to countermeasures is at the heart of the WHO's strategy, which includes objectives of expanding seasonal-vaccine uptake and ensuring equitable access to vaccines and antiviral drugs and other treatments during a pandemic. However, scholars have expressed concern that during a severe pandemic, countries with the capacity to manufacture pandemic influenza vaccines may restrict vaccine exports until domestic demand has been satisfied.[5] These concerns aren't reflected in the strategy. To model scenarios in which governments might consider restricting exports, the WHO could conduct robust, open simulations of the effectiveness of the PIP Framework that involve vaccine manufacturers, governments, and the WHO. We believe that the WHO should develop strategies for mitigating the effects of vaccine-export restrictions and for distributing vaccines once commitments are met.

Once a pandemic begins, a vaccine probably won't be available for at least several months. Nonpharmaceutical interventions will therefore be crucial, particularly in developing countries that are especially vulnerable to pandemic influenza. Although nonpharmaceutical interventions form part of the response outlined in the strategy, the document offers little guidance or detail regarding these methods. We believe that the WHO should commit to providing technical support for social-distancing measures and community-based interventions during a pandemic. Guidance could address not only the public health elements of a response but also the importance of evidence- and human-rights–based approaches to nonpharmaceutical interventions.

Finally, the strategy misses an opportunity to address ongoing barriers to executing components of the International Health Regulations (IHR), an agreement adopted in 2005 with a goal of preventing, detecting, and responding to the spread of disease without unnecessarily interfering with

international travel and trade. Under the IHR, countries are required to meet certain laboratory, surveillance, notification, and reporting requirements. The strategy notes that all state parties were required to meet these obligations by 2012; however, it doesn't address the challenges most countries have experienced trying to fully implement the IHR. Acknowledging these challenges would allow the WHO to evaluate which core capacities might be prioritized for influenza preparedness.

In creating its Global Influenza Strategy 2019–2030, the WHO has shown the ambition and foresight required to ensure that the world can be better prepared for the next influenza pandemic and the ongoing burden of seasonal influenza. But additional challenges will test the effectiveness of the strategy unless efforts are made to ensure that they are also addressed.

Disclosure forms provided by the authors are available at NEJM.org.

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1. Taubenberger JK, Morens DM. 1918 Influenza: the mother of all pandemics. Emerg Infect Dis 2006;12:15-22.
2. Implementation of the Nagoya Protocol and pathogen sharing: public health implications: study by the secretariat. Geneva: World Health Organization, 2016 (https://www.who.int/influenza/pip/2016-review/NagoyaStudyAdvanceCopy_full.pdf).
3. Review of the Pandemic Influenza Preparedness Framework for the sharing of influenza viruses and access to vaccines and other benefits: report of the 2016 Pandemic Influenza Preparedness Framework Review Group. Geneva: World Health Organization, November 18, 2016 (https://www.who.int/influenza/pip/2016-review/ADVANCE_EB140_PIPReview.pdf).
4. Eccleston-Turner MR. The Pandemic Influenza Preparedness Framework: a viable procurement option for developing states? Med Law Int 2017;17:227-48.
5. Rourke MF. Access by design, benefits if convenient: a closer look at the Pandemic Influenza Preparedness Framework's Standard Material Transfer Agreements. Milbank Q 2019;97:91-112.

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HISTORY OF MEDICINE

Sir William Osler (1849–1919) — The Uses of History and the Singular Beneficence of Medicine

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Sir William Osler died on December 29, 1919, at his home in Oxford from hemorrhage after surgery for loculated empyema. Two days later, Richard C. Cabot (1868–1939) wrote in the *New York Evening Post:* "I doubt if any single man has ever so deeply influenced any other profession." Cabot's was among the first of more than 400 obituaries and posthumous tributes, including a five-page obituary in the *Journal.* Few, if any, physicians have been more widely loved by their contemporaries. A century later, Osler is revered for his efforts to place clinical medicine on a rational foundation (in part through the multiple editions of his *Principles and Practice of Medicine*, first published in 1892), his transformation of graduate medical education (with the 1910 Flexner Report later formalizing the Hopkins model of critical, hospital-based teaching), and his attempt to keep medicine informed by a sense of humanism, even as it became ever more scientific.

Osler was many things to many people, but his ultimate gift to physicians was the sense of belonging to a splendid profession committed to the public interest. In addresses and essays, and in taking a celebratory approach to the history of medicine, Osler nurtured the notion of the medical profession as a global force for human betterment. He sometimes conceptualized the profession as an apostolic succession of cultured clinicians dating back to Hippocrates. He gave physicians what certain national historians gave their countries: warm feelings of togetherness, pride, and purpose.[1] He accomplished this task in part by deploying medical history and medical biography, which in his hands often amounted to hagiographic endorsements of what we would today call "role models."

As Osler opined in his address on "Books and Men," at the dedication of the new building of the Boston Medical Library in 1901, the "higher" education of the physician "so much needed to-day" is best achieved through "the silent influence of character on character and in no way more potently than in the contemplation of the lives of the great and good of the past, in no way more than in 'the touch divine of noble natures gone.'" A year later, in an address