VIEWPOINT

Preparation for Possible Sustained Transmission of 2019 Novel Coronavirus

Lessons From Previous Epidemics

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Transmissibility and severity are the 2 most critical factors that determine the effect of an epidemic. Neither the 2009 pandemic influenza A(H1N1) virus ([H1N1]pdm09) pandemic or the severe acute respiratory syndrome coronavirus (SARS-CoV) or the Middle East respiratory syndrome coronavirus (MERS-CoV) epidemics had the combination of both high transmissibility and severity. Control strategies are driven by this combination. R_0, the basic reproduction number, is a commonly used measure of transmissibility and is defined as the number of additional persons one case infects over the course of their illness. An R_0 of less than 1 indicates the infection will die out "eventually." An R_0 of greater than 1 indicates the infection has the potential for sustained transmission.

For example, influenza A(H1N1)pdm09, first identified in southern California on April 15, 2009, was highly transmissible. By May 5, 2009, influenza A(H1N1)pdm09 had spread to 41 US states and 21 countries.[1]

> In preparing for possible sustained transmission of 2019-nCoV beyond China, applicable lessons from previous experiences with epidemics/pandemics of respiratory viruses should be carefully considered...

While influenza A(H1N1)pdm09 was highly transmissible, it was not severe. Initial estimates of the R_0 of influenza A(H1N1)pdm09 were 1.7.[2] Although an estimated 201 200 respiratory deaths due to influenza A(H1N1)pdm09 occurred during the first year of the pandemic, the number of deaths per population was 30 times lower than that seen during the 1968 influenza pandemic, 1000 times less than the 1918 pandemic, and even less than typical seasonal influenza epidemics (estimated by the World Health Organization [WHO] to be 250 000 to 500 000 per year, although estimation methods differ).[3] Influenza A(H1N1)pdm09 was highly transmissible but not severe.

SARS-CoV (2003) and MERS-CoV (2012-current) cause severe disease, but despite the initial R_0 estimations of greater than 2.0 for SARS-CoV (indicating sustained and even worldwide transmission could occur), and some large outbreaks, neither were as transmissible as initial concerns suggested. SARS-CoV caused 8098 reported cases and 774 deaths (case-fatality rate, 9.6%) in 37 countries before the epidemic was controlled. Control was thought to have been possible because a high proportion of cases were severe, making it easier to rapidly identify and isolate infected individuals. In addition, the virus was present at lower levels in upper airway secretions. There was no secondary transmission in the United States from the 8 imported cases, although in Toronto, Canada, a single importation is thought to have led to about 400 cases and 44 deaths. Later estimates of R_0 were less than 1, indicating that SARS-CoV may not have been capable of sustained transmission, especially in the setting of control measures.[4]

Similarly, MERS-CoV appears to have high severity and low transmissibility. Since 2012, MERS-CoV has caused 2494 reported cases and 858 deaths (case-fatality rate, 34%) in 27 countries. MERS-CoV has also caused some rapid outbreaks, mainly in hospitals in Saudi Arabia, Jordan, and South Korea, but estimates of MERS-CoV R_0 are less than 1, and thus far it has been contained.[5]

Can a respiratory virus that is both transmissible and severe be contained? In preparation for an influenza pandemic, the US Department of Health and Human Services' Pandemic Influenza Plan included a combination of nonpharmaceutical (border and school closing, infection control measures) and pharmaceutical (antiviral prophylaxis, vaccines) interventions meant to be used in combination to interrupt or slow influenza transmission. Despite implementation of some of these interventions, influenza A(H1N1)pdm09 spread to 120 countries in 3 months.

With the emergence of MERS-CoV in the Middle East, a preparedness plan was developed that included a surveillance plan, laboratory testing, and contact tracing guidance. Infection control guidance was developed for use in health care settings and traveler guidance was developed for the public.[6] The US Centers for Disease Control and Prevention (CDC) distributed MERS-CoV polymerase chain reaction test kits to state health departments. Two cases were imported into the United States. Contacts were traced, including household, hospital, and airline contacts. No secondary cases were identified in the United States. MERS-CoV was thought to be severe and control measures relied on recognition of suspect cases. However, during a hospital outbreak in Jeddah, Saudi Arabia, among hospitalized patients only 5 of 53 (9%) health care–associated cases had documented presence in the same room as a patient with MERS.[5] Despite the high case-fatality rate (an important measure of severity), MERS cases can be

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asymptomatic and mild (25% in one outbreak). Although it is not known how often asymptomatic or mildly symptomatic patients transmit MERS, initiating comprehensive measures such as isolating patients suspected of having or having been exposed to the virus and using personal protective equipment when caring for them may be extremely difficult because so many patients have mild and nonspecific symptoms.

Is the world ready for a respiratory virus with high transmissibility and severity? After a new influenza virus (H7N9) was identified in China in 2013, a series of modeling articles described the effect of, and level of preparedness for, a severe, single-wave pandemic in the United States.[7] In scenarios that used clinical attack rates (the proportion of individuals who become ill with or die from a disease in a population initially uninfected) of 20% to 30% (for comparison the clinical attack rate was 20% in the first year of the 2009 H1N1 pandemic), depending on severity there would be an estimated 669 000 to 4.3 million hospitalizations and an estimated 54 000 to 538 000 deaths without any interventions in the United States. The models suggested that without a vaccine, school closures would be unlikely to affect the pandemic, an estimated 35 000 to 60 000 ventilators would be needed, up to an estimated 7.3 billion surgical masks or respirators would be required, and perhaps most important, if vaccine development did not start before the virus was introduced, it was unlikely that a significant number of hospitalizations and deaths could be averted due to the time it takes to develop, test, manufacture, and distribute a vaccine.

It is impossible to know what will happen so early in this novel 2019 coronavirus (2019-nCoV) epidemic. The scope, morbidity, and mortality will depend on the combination of severity and transmissibility. Numerous experts have "nowcasted" how many cases have occurred and forecasted how many cases will likely occur. A recent study suggests rapid person to person transmission can occur.[8] Disease modelers have estimated R_0 to be 2.2.[9] The University of Hong Kong estimates the outbreak could infect more than 150 000 persons per day in China at its peak.

Is 2019-nCoV infection severe? To date approximately 14% of cases of 2019-nCoV have been described as severe by WHO, with a case-fatality rate of 2.1%.[10] Estimates of severity are usually higher in the beginning of an epidemic due to the identification of the most severely affected cases and decline as the epidemic progresses. However, because many infected persons have not yet recovered and may still die, the case-fatality rate and severity could be underestimated. On January 30, 2020, WHO officially declared the 2019-nCoV epidemic as a Public Health Emergency of International Concern, indicating its concern that countries aside from China could be affected by 2019-nCoV.

In preparing for possible sustained transmission of 2019-nCoV beyond China, applicable lessons from previous experiences with epidemics/pandemics of respiratory viruses should be carefully considered to better control and mitigate potential consequences. Influenza preparedness plans have been developed that aim to stop, slow, or limit the spread of an influenza pandemic to the United States. These plans address limiting domestic spread and mitigating disease but also sustaining infrastructure and reducing the adverse effects of the pandemic on the economy and society. These plans would be useful to enact during the 2019-nCoV epidemic should the United States experience sustained transmission. Countries have been successful in the past and there is nothing yet to predict that this time it is likely to be worse. Effective prevention and control will not be easy if there is sustained transmission and will require the full attention of public health, federal and local governments, the private sector, and every citizen.

ARTICLE INFORMATION

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