COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

Coronaviruses: Understanding the Spread of Infectious Diseases and Mobilizing Innovative Solutions

March 5, 2020
9:00 a.m.
2318 Rayburn House Office Building

PURPOSE

The purpose of the hearing is to discuss emerging infectious diseases, in light of the recent coronavirus outbreak, and the modeling tools used to detect, predict, and understand the spread of such diseases. The Committee will discuss how some infectious agents spread from animals to humans and how predictive modeling can help control and mitigate the effects of emerging diseases. The Committee will also explore how investments in U.S. research may help combat epidemics and pandemics.

Given that COVID-19 is an emerging, rapidly evolving situation, please note that some information is subject to change.

WITNESSES

- **Dr. Suzan Murray**, Program Director, Smithsonian Global Health Program, Smithsonian's National Zoo & Conservation Biology Institute.
- **Dr. John Brownstein**, Chief Innovation Officer, Boston Children's Hospital; Professor, Harvard Medical School.
- **Dr. Peter Hotez**, Professor and Dean, National School of Tropical Medicine, Baylor College of Medicine; Co-Director, Texas Children's Hospital Center for Vaccine Development.
- **Dr. Tara Kirk Sell**, Senior Scholar, Johns Hopkins Center for Health Security; Assistant Professor, Johns Hopkins Bloomberg School of Public Health.

KEY QUESTIONS

- What factors contribute to the emergence of new infectious diseases, and how can we learn from past outbreaks to inform next steps?
- How can we apply predictive modeling to anticipate present day and future geographic distributions of infectious diseases?
- What are cutting-edge tools that can help decision-makers understand and manage the effects of emerging infectious diseases?
- How can investments in U.S. research contribute to global preparedness and response to emerging infectious diseases?
- What steps can we take to mitigate harmful social stigmas surrounding infectious diseases?

Background

Since 1980, outbreaks of emerging infectious diseases have been occurring with greater frequency and have been causing higher numbers of human infections.[1] Nearly 75% of all emerging infectious diseases identified in humans during the 21st century have been caused by zoonotic pathogens,[2] meaning the pathogen spreads from animals to humans, often through a vector (e.g., a mosquito).[3] Each year, zoonotic pathogens cause an estimated one billion cases of human illness, including 15 million deaths.[4]

An epidemic is an unusual, often sudden, increase in the number of cases of a disease above what is normally expected. An outbreak carries the same definition but is typically used for a more limited geographic area. A pandemic refers to an epidemic that has spread over several countries or continents, usually affecting many people. Changing ecosystems, economic development and land use, climate and weather, and international travel and commerce are all examples of ecological, environmental, and social factors that will increase the emergence and spread of infectious diseases in the future.[5]

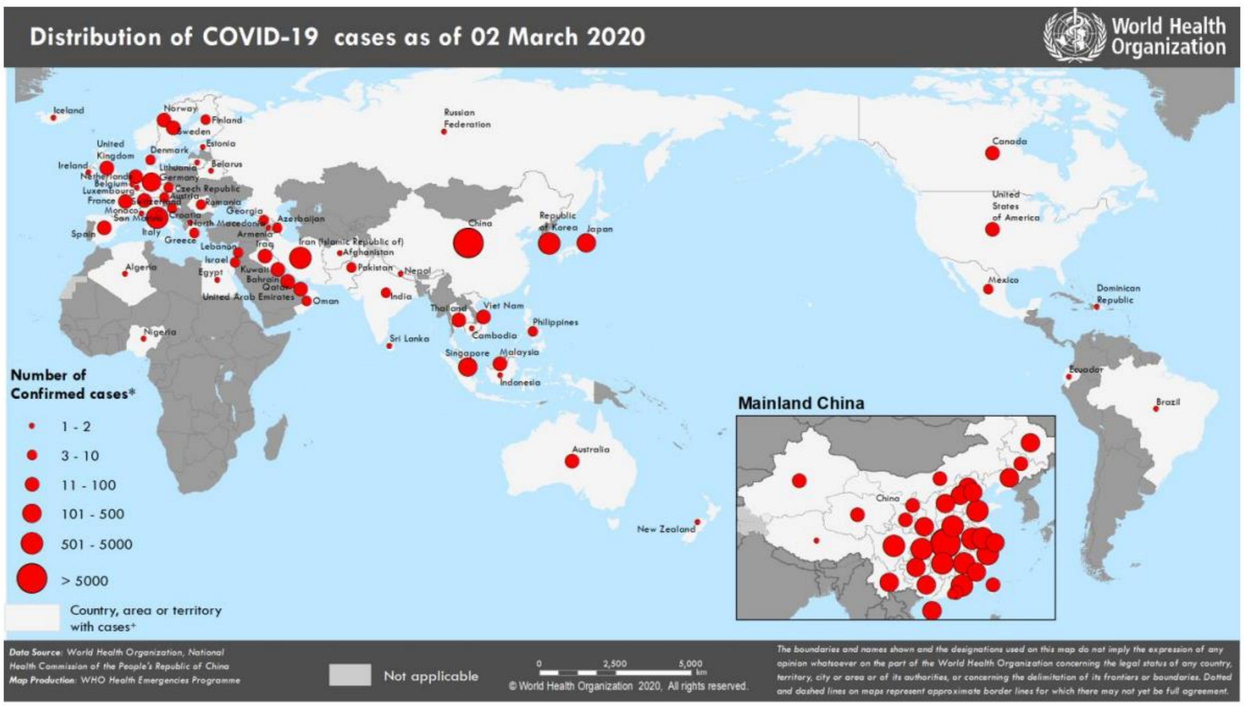
Coronaviruses are a large family of zoonotic viruses that cause respiratory illness ranging from the common cold to more severe diseases like MERS (Middle East respiratory syndrome) and SARS (severe acute respiratory syndrome).[6] There are seven coronaviruses known to infect humans, including the novel coronavirus (COVID-19) first identified in Wuhan City, Hubei Province, China in December 2019.[7] The most common symptoms among confirmed COVID-19 patients include high fever, cough, and shortness of breath.[8]

Global Effects of COVID-19

The size of the COVID-19 outbreak has created a public health crisis with significant international dimensions. As of March 2, 2020, COVID-19 has been detected in 60 locations internationally, including in the United States.[9] While the overwhelming number of cases and deaths have occurred in China, significant outbreaks are now arising in other countries such as

[1] Katherine Smith et al., "Global Rise in Human Infectious Disease Outbreaks," *Journal of the Royal Society Interface*, volume 11 (August 2014); Stephen Morse et al., "Prediction and Prevention of the Next Panemic Zoonosis," *The Lancet*, vol. 380 (December 1, 2012), pp. 1956-1965; and A. Marm Kilpatrick and Sarah Randolph, "Drivers, Dynamics, and Control of Emerging Vector-Borne Zoonotic Diseases," *The Lancet*, vol. 380 (December 1, 2012), pp. 1946-1955.
[2] Smithsonian's National Zoo & Conservation Biology Institute, Global Health Program.
[3] Katherine Smith et al., "Global Rise in Human Infectious Disease Outbreaks," *Journal of the Royal Society Interface*, volume 11 (August 2014); and Stephen Morse et al., "Prediction and Prevention of the Next Pandemic Zoonosis," *The Lancet*, vol. 380 (December 1, 2012), pp. 1956-1965.
[4] William Karesh et al., "Ecology of Zoonoses: Natural and Unnatural Histories," *The Lancet*, vol. 380 (December 1, 2012), pp. 1936-1945; Barbara Han et al., "Rodent Reservoirs of Future Zoonotic Diseases," *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, vol. 112, no. 22 (June 2, 2015), pp. 7039-7044; and Wu XiaoXu et al., "Impact of Global Change on Transmission of Human Infectious Diseases," *Science China*, (April 19, 2013).
[5] Institute of Medicine. 2014. The Influence of Global Environmental Change on Infectious Disease Dynamics: Workshop Summary. Washington, DC: The National Academies Press.
[6] Johns Hopkins Center for Health Security, Coronaviruses: SARS, MERS, and 2019-nCoV, January 21, 2020.
[7] Centers for Disease Control and Prevention. Human coronavirus types. January 10, 2020. The virus has been named "SARS-CoV-2" and the disease it causes has been named "coronavirus disease 2019" (abbreviated "COVID-19").
[8] Chaolin Huang, Yeming Wang, and Xingwang Li, et al., "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China," *The Lancet*, January 24, 2020.
[9] Centers for Disease Control and Prevention, "Coronavirus Disease 2019 (COVID-19)," COVID-19 Situation Summary.

South Korea, Italy, and Iran. The global spread of the COVID-19 virus prompted the World Health Organization (WHO) to take action by declaring a "public health emergency of international concern" on January 30, 2020, only the sixth time in the organization's history that it has declared a public health emergency since it gained the authority to do so in 2005.[10] The WHO's declaration is advisory in nature and cannot compel any nation to undertake any specific policy or action. Nevertheless, it is viewed as an important signal of severe concern from the world's leading international public health organization, and it may galvanize further responses to the outbreak at the national and sub-national level.



The impacts of COVID-19 will extend broadly throughout the U.S. and global economies. Depending on the size of the eventual outbreak and the length of time that it persists, the U.S. economy could suffer significant disruption due to a decline in tourism from China and elsewhere, decreased demand for American exports, the disruption of global supply chains for American companies, and disruptions to daily life in the United States.[11] The financial sector has taken note of these concerns, as the S&P 500 index experienced its worst week since the 2008 financial crisis last week, although it rebounded somewhat on March 2, 2020.[12] The technology and automotive sectors could be particularly vulnerable due to the potential for shortages to occur among critical parts for their production lines.[13]

The U.S. international public health response to COVID-19 has centered around the goal of overseas containment through the imposition of severe travel restrictions on foreign nationals

[10] Sui-Lee Wee, Donald G. McNeil Jr., and Javier C. Hernandez, "W.H.O. Declares Global Emergency as Wuhan Coronavirus Spreads," *New York Times*, January 30, 2020.
[11] Paul Davidson, "How is the coronavirus in China casting a widening shadow across the US economy," *USA Today*, February 20, 2020.
[12] New York Times, "Asian Markets Seesaw, Bonds Rise as Coronavirus Fears Linger," March 1, 2020.
[13] *Id*.

from China and Iran, the issuance of heightened warnings for U.S. citizens traveling to South Korea and Italy, and the use of mandatory quarantines for American citizens returning from some affected areas.[14] The United States has also sent two public health experts to China as part of a WHO team of international disease experts deployed to assist the Chinese government's response.[15] Finally, the United States has offered an additional $100 million in support of the WHO's international response efforts to study the virus and contain the outbreak.[16] Due to the outbreak of the virus within the country, the United States is increasingly shifting its focus to confronting the effects of COVID-19 domestically.

On February 26, 2020, President Trump named Vice President Pence to coordinate the government's response to COVID-19. The White House submitted a $2.5 billion plan to Congress to address the outbreak. Senate Minority Leader Chuck Schumer proposed to increase the President's emergency request substantially, to $8.5 billion in new funds, including $3 billion for a public health emergency fund, $1.5 billion for the Centers for Disease Control and Prevention (CDC), $1 billion for vaccine development, and $2 billion for reimbursing states and cities for efforts they have so far made to monitor and prepare for potential cases of the virus.[17]

COVID-19: A Rapidly Evolving Situation

In an effort to contextualize COVID-19 as the outbreak is rapidly evolving, attempts have been made to explain the threat through comparisons to other well-known outbreaks, like the seasonal flu, SARS, and H1N1. For example, the CDC has confirmed two COVID-19-related deaths as of March 2, 2020,[18] while this year's seasonal flu has killed more than 18,000.[19] However, it is important to note that such comparisons are complicated while the virus continues to spread. Not all those who have contracted the virus have been diagnosed, and most of those who have been diagnosed have neither died nor recovered yet. When the H1N1 influenza pandemic broke out in the spring of 2009, the mortality rate appeared to be 10%. However, as time progressed, it became clear that there were many cases of people whose infections were so mild that they didn't seek medical help. Ultimately, the death rate of H1N1 was below 0.1%.[20]

Like with any other outbreak, outcomes of COVID-19 cases will vary based on the resources available to the impacted communities. H1N1, for example, had a death rate over four times higher for American Indians and Alaska Natives than for all other racial and ethnic groups combined. Reasons for this include a high prevalence of chronic health conditions, poverty, and delayed access to healthcare.[21] In the Hubei province, medical resources are stretched very thin, exacerbated by a lockdown that is slowing the delivery of protective wear for hospital staff.[22]

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[14] Rob Stein, "U.S. Coronavirus Quarantine and Travel Limits: Needed Protection or Overreaction?" *NPR*, February 3, 2020.
[15] Steven Lee Myers and Edward Wong, "Coronavirus Worsens U.S.-China Ties and Bolsters Hawks in Washington," *New York Times*, February 19, 2020.
[16] Reuters, "U.S. announces aid for China, other countries impacted by coronavirus," February 7, 2020.
[17] Jordain Carney, "Schumer requesting $8.5 billion in emergency funding on coronavirus," February 26, 2020.
[18] "Coronavirus Disease 2019 (COVID-19)," Centers for Disease Control and Prevention, March 2, 2020.
[19] "Weekly U.S. Influenza Surveillance Report (FluView)," Centers for Disease Control and Prevention, February 15, 2020.
[20] Emily Baumgaertner, "How deadly is the new coronavirus? Scientists race to find the answer," *LA Times*, February 12, 2020.
[21] "Deaths Related to 2009 Pandemic Influenza A (H1N1) Among American Indian/Alaska Natives – 12 States, 2009," Center for Disease Control *MMWR Weekly*, December 11, 2009.
[22] Chris Buckley, Sui-Lee Wee, Amy Qin, "China's Doctors, Fighting the Coronavirus, Beg for Masks," *New York Times*, February 14, 2020.

Over 3,000 medical workers have now been infected with COVID-19 in China, largely in the Hubei province.[23] Meanwhile, according to the CDC, there have been 43 cases of COVID-19 confirmed in the United States as of March 2, 2020 including 26 cases of transmission to people who had not recently been to China or had known contact with someone who had. There have been 48 confirmed cases among individuals repatriated to the United States from Asia, including three from Wuhan and 45 from the Diamond Princess, a cruise ship on which 695 people were infected.[24]

Epidemiologists believe that, despite the Chinese government's lockdown of areas surrounding Wuhan, COVID-19 will infect more people in the United States and around the world.[25] Like SARS and MERS, it will be more dangerous for elderly patients and those with existing cardiovascular disorders.[26] Beyond that, it is difficult at the moment to make predictions about how contagious or deadly COVID-19 will be outside China.

Using Technology to Detect, Predict, and Understand the Spread of Infectious Diseases

During outbreaks of novel viruses—especially ones with pandemic potential—public health leaders use epidemiological models to detect, predict, and control the spread and impact of disease.[27] These models can assist in answering critical questions, such as: '*When will the disease reach its peak?*' or '*How transmissible is the disease*?' or '*Who in the population should be prioritized for vaccination or treatment?*'.[28] The researchers using such models require quality data but are limited by time; as time passes and the outbreak progresses, more data become available to analyze.[29]

Traditional models or techniques that track outbreaks often use manually coded data, like confirmed infections and hospitalizations. However, it can take a long time to collect and verify this data. For example, a physician might identify a cluster of patients with a new set of similar symptoms and contact the CDC for further follow-up and testing. The CDC (or one of its designated laboratories) would then analyze and verify patient specimens before making recommendations and issuing an official alert. While necessary, this process can delay critical policies and interventions during the early stages of an outbreak.

One of the key differences between the SARS outbreak in 2003 and COVID-19 is the greater availability and amount of non-traditional data like social media posts, Google Search queries, and online news reports. Researchers are now using artificial intelligence (AI) applications to identify and track outbreaks faster and more precisely. HealthMap, for example, is a tool that collects and analyzes online informal sources to generate visualizations that show how and

[23] "China says more than 3,000 medical staff infected by COVID-19," *Channel News Asia*, February 24, 2020.
[24] Coronavirus Disease 2019 (COVID-19), Centers for Disease Control and Prevention.
[25] James Hamblin, "You're Likely to Get the Coronavirus," *The Atlantic*, February 24, 2020.
[26] Katarina Zimmer, "Why Some COVID-19 Cases Are Worse than Others," *The Scientist*, February 24, 2020.
[27] Manoj Gambhir, et al., "Infectious Disease Modeling Methods as Tools for Informing Response to Novel Influenza Viruses of Unknown Pandemic Potential," *Clinical Infectious Diseases*, 2015;60(S1):S11-9.
[28] Typically, descriptive modeling tries to estimate what probably occurred or is occurring now, while predictive modeling predicts cases in the future. Government Accountability Office, "Emerging Infectious Diseases: Actions Needed to Address the Challenges of Responding to Zika Virus Disease Outbreaks," May 23, 2017.
[29] Manoj Gambhir, et al., "Infectious Disease Modeling Methods as Tools for Informing Response to Novel Influenza Viruses of Unknown Pandemic Potential," *Clinical Infectious Diseases*, 2015;60(S1):S11-9.

where communicable diseases like COVID-19 are spreading.[30] The WHO uses HealthMap as part of its Epidemic Intelligence from Open Sources initiative, facilitating early detection of global public health threats.[31]

While advancements in AI could help predict infectious disease outbreaks before they happen, these methods are considered a supplement to, and not a replacement for, traditional surveillance and diagnostic processes. Decision-makers could use a hybrid approach to allocate resources faster and contain the spread of an outbreak more effectively.

Halting the Spread of Misinformation around Infectious Disease Outbreaks

Researchers generally define misinformation as information that is false or misleading but promulgated with sincerity by a person who believes it is true. Disinformation, on the other hand, is shared with the deliberate intent to deceive. The Subcommittee on Investigations & Oversight of the House Committee on Science, Space, and Technology held a hearing on this important topic on September 26, 2019, particularly focusing on the tools needed to combat these threats.[32]

The outbreak of global viruses is often followed by the spread of misinformation about the virus, such as its origins, causes, and government response. The WHO has even labeled this outbreak an "infodemic," meaning there is "an over-abundance of information – some accurate and some not – that makes it hard for people to find trustworthy sources and reliable guidance when they need it."[33] There have been multiple reports documenting the international spread of public health disinformation on COVID-19.[34,35,36]

Stigma is a central theme of public health misinformation. Johns Hopkins' Center for Health Security describes stigma as something that comes from an impulse to assign blame during an outbreak of infectious disease. People are often trying to answer basic questions, such as: '*Where did this come from?*' and '*How is it spreading?*'. To understand and avoid illness, people often create a mental distinction between "us" (the uninfected) and "them" (the infected). According to Johns Hopkins, this phenomenon can contribute to an inaccurate picture of health risk and reflect preexisting social differences and prejudices. A whole country or group of people may be singled out as the source of the problem—rather than the pathogen.

Misinformation about infectious diseases is hardly a new phenomenon, but the spread of misinformation is accelerated by social media. Several social media companies have taken steps to mitigate misinformation around COVID-19. In late January, Facebook released a statement saying that their "third-party fact-checkers are continuing their work reviewing content and

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30 Will Knight, "How AI is Tracking the Coronavirus Outbreak," *WIRED*, February 8, 2020.
31 Alejandro De La Garza, "Coronavirus Researchers Are Using High-Tech Methods to Predict Where the Virus Might Go Next," *TIME*, February 11, 2020.
32 "Online Imposters and Disinformation," hearing before the Subcommittee on Investigations and Oversight, H. Comm. On Sci., Space, and Tech. (September 26, 2019).
33 World Health Organization, "Novel Coronavirus (2019-nCoV) Situation Report -13," February 2, 2020.
34 Malaka Gharib, "Fake Facts Are Flying About Coronavirus. Not There's a Plan To Debunk Them," *NPR*, February 21, 2020.
35 Beatrice Dupuy and Arijeta Lajka, "Not Real News: An outbreak of virus-related misinformation," *AP News*, February 28, 2020.
36 Makena Kelly, "The World Health Organization has joined TikTok to fight coronavirus misinformation," *The Verge*, February 28, 2020.

debunking false claims" related to COVID-19.[37] Around the same time, Twitter launched a prompt for individuals searching *#coronavirus* to receive credible information from the CDC.[38] Similarly, users searching "coronavirus" on YouTube are met with a link to the WHO guidance on COVID-19.[39] Unfortunately, despite these efforts, misinformation surrounding the virus persists.[40,41]

Investments in Research and Development to Prevent and Respond to Outbreaks

Recent infectious disease outbreaks have highlighted certain strengths and weaknesses of the international research and development (R&D) response. For example, there is broad consensus that global research efforts were hampered by insufficient collaboration and transparency during the Ebola epidemic in 2014-2015, which led to a slow and uncoordinated response.[42] According to the National Academies of Science, Engineering, and Medicine, the mobilization of a rapid and robust research response during the next epidemic will depend not just on what happens during the epidemic, but on what happens before or between epidemics.[43]

There are numerous ways the United States can work with its international partners on priority research that can curtail ongoing outbreaks and prepare for future ones. For example, the WHO R&D Blueprint is a global strategy and preparedness plan that outlines research actions which can help identify key knowledge gaps and accelerate the development of critical scientific information.[44] The WHO activated its R&D Blueprint in early January 2020 in response to the COVID-19 outbreak. Some of the Blueprint's recommended actions include:

- **R&D for Emerging Pathogens:** Understanding where zoonotic viruses originate and how they are transmitted from animals to humans is a key research priority identified by the WHO. U.S. research on the human and ecological drivers of disease spillover could help detect novel pathogens likely to cause severe outbreaks and facilitate faster and more effective responses to public health emergencies across the globe.

- **R&D for Diagnostics, Therapeutics, and Vaccines:** The WHO suggests taking advantage of all available technological innovations to improve survival and recovery. Further, the WHO recommends close collaboration among researchers to expedite the development of tests that quickly identify sick people, but also to optimize the use of currently available treatments and evaluate candidates for new drugs and vaccines. U.S. research in this area could help develop health technologies that would control the effects of disease and increase global preparedness between crises. The House Committee on

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[37] Kang-Xing Jin, "Keeping People Safe and Informed About the Coronavirus," *Facebook*, January 30, 2020.
[38] Jun Chu and Jennifer McDonald, "Helping the world find credible information about novel #coronavirus," *Twitter*, January 29, 2020.
[39] Ryan Broderick, "YouTube Has Been Cracking Down on Coronavirus Hoaxes, But They Are Still Going Viral," *BuzzFeed News*, February 12, 2020.
[40] Tony Romm, "Fake cures and other coronavirus conspiracies are flooding WhatsApp, leaving governments and users with a 'sense of panic'," *Washington Post*, March 2, 2020.
[41] Tony Romm, "Millions of tweets peddled conspiracy theories about coronavirus in other countries, an unpublished U.S. report says," *Washington Post*, February 29, 2020.
[42] World Health Organization, "An R&D Blueprint for Action to Prevent Epidemics," Plan of Action, May 2016.
[43] National Academies of Sciences, Engineering, and Medicine 2017, "Integrating Clinical Research into Epidemic Response: The Ebola Experience," Washington, DC: The National Academies Press.
[44] World Health Organization, "A research and development Blueprint for action to prevent epidemics."

Science, Space, and Technology held a hearing on vaccine innovation on November 20, 2019.[45]

- **R&D for Social Science:** According to the WHO, integrating social scientists into outbreak responses helps communities accept and adhere to public health measures aimed at limiting disease transmission.[46] Fear, anxiety, and stigma can drive sick people to hide their symptoms to avoid discrimination, prevent some individuals from seeking health care immediately, and discourage others from adopting healthy behaviors.[47] U.S. research on how to combat misinformation during outbreaks could improve prevention and control measures and strengthen global public health communication.

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[45] "Fighting Flu, Saving Lives: Vaccine Science and Innovation," hearing before the H. Comm. On Sci., Space, and Tech. (November 20, 2019).
[46] World Health Organization and Global Research Collaboration for Infectious Disease Preparedness, "2019 Novel Coronavirus Global Research and Innovation Forum: Towards a Research Roadmap," February 2020.
[47] World Health Organization, "Coronavirus disease 2019 (COVID-19) Situation Report – 35."