Testimony

# China's Health System Reform and Global Health Strategy in the Context of COVID-19

# 新冠肺炎（COVID-19）背景下的中国卫生体制改革和全球卫生战略

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*China's Health System Reform and Global Health Strategy in the Context of COVID-19*

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Chairman Cleveland, Commissioner Lee, and members of the Commission, thank you for inviting me to assess China's pandemic-related issues regarding its public health system, health care system, and global health strategy in the context of COVID-19. Specifically, I review China's public health system restructuring over the past 20 years, focusing primarily on the development of various disease surveillance systems and infectious disease reporting processes. I then give an overview of China's health care system reforms during the last ten years, its investment in biomedical and clinical research, and China's global health strategy. Throughout the testimony, I will discuss the implications of these developments on China's response to the COVID-19 pandemic. The testimony ends with my recommendations to the U.S. government on how to engage China in global pandemic response and where investments in China's new health care technology markets could be mutually beneficial to both countries.

## China's Public Health System in the Context of COVID-19

### *Center for Disease Control and Prevention's Structure*

There is perhaps nothing like a pandemic to uncover the defects in a public health system. Eighteen years ago, the outbreak of Severe Acute Respiratory Syndrome (SARS), another coronavirus, led China to radically rethink its public health system. Before SARS, China's public health system was comprised primarily of Epidemic Prevention Stations (EPSs) at the town and village, prefecture, and provincial levels. EPSs implemented immunizations and led local public health campaigns. The surveillance data collected from these stations were often only shared

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among local-level EPSs and did not filter upward to higher-level EPSs, reducing the Ministry of Health's access to critical health information.[3] To consolidate the fragmented system, China created a Center for Disease Control and Prevention (CDC) in 2002. The decision was made shortly before the SARS epidemic started; therefore, much of the infrastructure for a nationally integrated public health surveillance and response system had yet to be established when SARS struck.

The index case of the SARS outbreak was recorded in Guangdong Province in November 2002. A few similar cases emerged in December and prompted the provincial government to dispatch a local public health investigation team with a few representatives from the national Ministry of Health. In an internal report, the team suggested that the provincial health bureau should establish a case-reporting system. The provincial government finally announced 305 pneumonia cases on February 11, 2003, after rumors of a deadly influenza terrified the public. SARS was still considered to be a local health problem, but by mid-March 2003, SARS clusters started to appear in Vietnam, Hong Kong, Singapore, and Canada. The World Health Organization (WHO) subsequently picked up the alerts from the Global Outbreak Alert and Response Network. On March 27, 2003, a WHO team went to China and concluded that the "atypical pneumonia" cases reported from China in February were caused by SARS, and China announced 792 cases and 31 deaths.[4] The Chinese government publicly acknowledged the SARS outbreak at the end of March 2003 and established a national command and control center supervised directly by Vice-Premier Wu Yi to provide effective coordination and communication for the emergency response. By the end of May 2003, more than 1,000 officials had been fired or penalized for their "slack" responses to SARS.[5] The remaining officials began to seal off villages, apartment complexes, and university campuses; quarantined tens of thousands of people; and set up checkpoints to take temperatures. The epidemic started to subside in late May 2003. By June 27, 2003, WHO announced that China was "SARS-free." SARS infected more than 8,000 people (mostly in China) in 26 countries and led to 774 deaths before it disappeared.

The SARS outbreak revealed the state of China's unprepared public health system. The government invested $850 million to restructure the Chinese CDC. The outbreak also spurred China to strengthen its relationships with the United States and the wider international community around issues of public health. The change in China was welcomed and enthusiastically supported by governments and scientists around the world.

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[3] Yuanli Liu, "China's Public Health-Care System: Facing the Challenges," *Bulletin of the Health Organization*, Vol. 82, No. 7, 2004, pp. 532–538.

[4] WHO, "Severe Acute Respiratory Syndrome (SARS) Multi-Country Outbreak—Update 10: Disease Outbreak Reported," March 26, 2003. As of February 3, 2020: https://www.who.int/csr/don/2003_03_26/en

[5] Yanzhong Huang, "The SARS Epidemic and Its Aftermath in China: A Political Perspective," in Stacey Knobler, Adel Mahmoud, Stanley Lemon, Alison Mack, Laura Sivitz, and Katherine Oberholtzer, eds., *Learning from SARS: Preparing for the Next Disease Outbreak: Workshop Summary*, Washington, D.C.: The National Academies Press, 2004.

In the aftermath of SARS, China adopted the U.S. CDC model for its own CDC.[6] Personnel from China's precursor model, the Shanghai CDC, studied different models of public health structures, including those of the United States, Europe, Russia, Japan, and Singapore. The U.S. model was considered outstanding because of its stellar global reputation and its strength in epidemiology and lab science. After its 2004 restructure, China's CDC was tasked with helping to meet emerging infectious disease threats by leading and coordinating disease prevention and control efforts and providing technical guidance and support for local and regional EPSs, which were converted into CDC branch offices.[7] The CDC branches at municipal levels are now responsible for infectious disease surveillance, epidemiological investigation, epidemic reporting, and other prevention and control activities.[8]

In 2004, the Chinese National Influenza Center (CNIC) and the U.S. CDC initiated cooperative agreements to build Chinese capacity in influenza surveillance and establish the center. From 2010 to 2014, China expanded CNIC to include 408 laboratories and 554 sentinel hospitals, and it trained 2,500 public health staff. CNIC became the fifth WHO Collaborating Center for Reference and Research on Influenza. CNIC now conducts viral drug resistance surveillance and provides platforms for gene sequencing, reverse genetics, serological detection, and development of vaccine strains. CNIC also has built a bioinformatics deck to strengthen data analysis, publishing weekly online influenza surveillance reports in English and Chinese. The surveillance system collects between 200,000 and 400,000 specimens and tests more than 20,000 influenza viruses annually, which provides valuable information for WHO influenza vaccine strain recommendations. CNIC also provides training for other countries to improve global capacity for influenza control.[9]

China's CDC restructuring seemingly gave it the necessary financial and organizational levers and provided the incentives for the local branches to report to the upper levels of programs. However, China's CDC still faces many challenges.[10]

First, China has consistently decreased its investments in public health, including preparedness and response, over the past decade. As an increasing disease burden comes from chronic diseases and an aging population, Chinese government agencies have prioritized health care reform and investments in health care innovation and technology. Public health capabilities,

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[6] J. Peng, S. N. Zhang, W. Lu, and A. T. Chen, "Public Health in China: The Shanghai CDC Perspective," *American Journal of Public Health*, Vol. 93, No. 12, 2003, pp. 1991–1993.

[7] Liu, 2004; Chen Zhuo, "COVID-19 and the Case for Empowering China's CDC, *Sixth Tone*, March 27, 2020. As of April 24, 2020:
https://www.sixthtone.com/news/1005370/covid-19-and-the-case-for-empowering-chinas-cdc

[8] L. Wang, X. Ren, B. J. Cowling, L. Zeng, M. Geng, P. Wu, Z. Li, H. Yu, and G. Gao, "Systematic Review: National Notifiable Infectious Disease Surveillance System in China," *Online Journal of Public Health Informatics*, Vol. 11, No. 1, 2019, e414.

[9] Yuelong Shu, Ying Song, Dayan Wang, Carolyn M. Greene, Ann Moen, C. K. Lee, Yongkun Chen, Xiyan Xu, Jeffrey McFarland, Li Xin, Joseph Bresee, Suizan Zhou, Tao Chen, Ran Zhang, and Nancy Cox, "A Ten-Year China-US Laboratory Collaboration: Improving Response to Influenza Threats in China and the World, 2004–2014," *BMC Public Health*, Vol. 19, No. 520, 2019.

[10] Chinese Center for Disease Control and Prevention, "One Hundred Years of Influenza Since the 1918 Pandemic—Is China Prepared Today?" *CCDC Weekly*, Vol. 1, No. 4, 2018, pp. 56–61.

such as training and research on cross-sector risk communications and research on public health law, and pandemic response have been relatively underfunded. For example, the National Health Commission cut the Chinese CDC's budget by 70 percent, from a peak of $157.5 million in 2015—during an outbreak of H7N9 avian influenza—to $40 million in 2019, while the health care system reform received an eight percent increase in funding each year since 2014.[11] China's CDC also has far fewer employees than its U.S. counterpart: It had 2,120 full-time employees in 2016, while the U.S. CDC has 11,195 full-time employees and access to thousands of contractors.[12]

In addition to a comparative lack of staff, staff resources are also a problem.[13] China's municipal CDCs are primarily supported by provincial governments. If the local government's resources are less robust or declining, local public health resources, including personnel, might suffer from insufficient funding. Low salaries are a significant barrier to the recruitment and retention of high-quality professionals, and Chinese CDC staffing has declined at all levels.[14] In addition, a 2005 regulation blocking the Chinese CDC and its local counterparts from charging service fees for administering vaccines deprived the organization of an important source of revenue. (Indirectly, this might also explain the extremely low adoption rate of influenza vaccine in China [less than two percent], given that the production and supply of vaccines is not a problem.)

Second, poor coordination between different health sectors, such as inadequate communication and inconsistent data sharing between doctors and veterinarians and between clinicians and public health professionals, has delayed the early detection of emerging diseases. In a 2019 China-U.S. CDC joint review of China's pandemic preparedness readiness, researchers suggested building an official technical framework to communicate an epidemic's intensity, severity, and risks to the public.[15]

Third, unlike the U.S. CDC, which is part of the federal government and has both the legal authority to quarantine patients and the ability to disburse federal funding to local health authorities, China's CDC only advises the National Health Commission. It does not have the authority to announce outbreaks or take legal actions to control them. In April 2018, the central and the provincial governments of China established the National Emergency Management Department; the primary function of this department is the management of natural and accidental disasters. Public security incidents were assigned to the Political and Legal Committee, and

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[11] Evelyn Chang, "Virus Disclosure in China Was Delayed Because Disease Control Group Lacks Authority, Top Scientist Says," *CNBC*, February 28, 2020. As of April 24, 2020: https://www.cnbc.com/2020/02/28/chinas-cdc-lacks-authority-to-alert-public-on-virus-scientist-says.html

[12] Chen Zhuo, 2020.

[13] J. Yang, K. E. Atkins, L. Feng, M. Pang, Y. Zheng, X. Liu, B. J. Cowling, and H. Yu, "Seasonal Influenza Vaccination in China: Landscape of Diverse Regional Reimbursement Policy, and Budget Impact Analysis," *Vaccine*, Vol. 34, No. 47, 2016, pp. 5724−5735.

[14] Chinese Center for Disease Control and Prevention, 2018.

[15] Chinese Center for Disease Control and Prevention, 2018.

public health events became the responsibility of the Health Committee.[16] The CDC can only provide technical guidance to provincial- and county-level CDCs, which are funded and staffed by local health commissions and subject to the control of local government, which might have differing priorities in a crisis.

These underlying issues with the Chinese CDC—its dwindling funding, lack of effective communication with local health care and government, and lack of legal and political power—might explain China's early missteps in warning the public of the person-to-person transmission capacity of COVID-19. From late December 2019 to January 19, 2020, three Chinese CDC expert teams were dispatched to Wuhan to investigate a viral pneumonia cluster that was associated with a wholesale seafood market. The first team arrived in Wuhan a day after the local government announced the pneumonia cluster on December 31, 2019. The local government announced 27 cases; however, a retrospective study by China's CDC revealed there already were 104 cases, including 15 deaths, in December.[17] In January, Wuhan and Hubei political leaders met in Wuhan for annual meetings, while the Wuhan Health Commission kept the announced number of the infected artificially low. China's CDC sent a second expert investigative team to Wuhan on January 8. Both the first and second teams concluded that there were no person-to-person transmissions and limited the epidemiologic case definition to those with contact at the seafood market, based on discussions with the local health team. It was not until COVID-19 cases appeared in Thailand and South Korea without a link to the market, and a third China CDC team was sent to Wuhan on January 19, that Chinese CDC officials finally concluded that the coronavirus was highly contagious. Later, the Chinese CDC accused local health commissions of covering up health care workers' cases and causing inaction during three crucial weeks in January. To keep things in perspective, however, the three weeks' delay was much shorter than the four months' delay observed in SARS.

In addition to the dysfunctional relationship and troubled communications between China's CDC and the local government, the pandemic exposed another failure involving the alert and rapid response from the surveillance system, which I will describe in the next section. Multiple independent reports indicated that the CDC director, Gao Fu, was alerted to the atypical pneumonia outbreak by his personal social media group chats, not by the national surveillance system.[18] What happened to the infectious disease reporting systems that should have been functioning is still unclear.

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[16] J. Wang, B. Yuan, Z. Li, and Z. Wang, "Evaluation of Public Health Emergency Management in China: A Systematic Review," *International Journal of Environmental Research and Public Health*, Vol. 16, No. 18, 2019, p. 3478.

[17] Dali L. Yang, "China's Early Warning System Didn't Work on Covid-19. Here's the Story," *Washington Post*, February 24, 2020. As of April 27, 2020:
https://www.washingtonpost.com/politics/2020/02/24/chinas-early-warning-system-didnt-work-covid-19-heres-story

[18] Yang, 2020.

### *China's Infectious Disease Reporting Systems*

At about the same time as the China CDC restructuring in 2004, China was revising its notifiable disease diagnostic criteria and launching a centralized nationwide network connected by a real-time, web-based hierarchical reporting system. The notifiable disease diagnostic criteria now defined suspected cases (detected by symptoms), probable cases (detected by clinical tests), and confirmed cases (detected by pathogen-specific antibody tests) for 39 infectious diseases.[19] A health care provider was expected to report each case to the Notifiable Infectious Disease Reporting Information System (NIDRIS), under the auspices of China CDC local offices, using a web-based standard form.[20] Each China CDC level could now analyze its own data in NIDRIS and data from subordinate levels within its own administrative boundaries. By 2013, this system had over 70,000 reporting units covering 100 percent of county-and-above level CDCs, 98 percent of county-and-above level medical institutes, and 94 percent of township-level health care units.[21] Approximately 5 million infectious disease cases are now reported annually.[22]

Separately, the China Infectious Disease Automatize-Alert and Response System (CIDARS), under the auspices of the China CDC central office, was launched in 2008 to facilitate early warning for 33 of the 39 infectious diseases on the national notifiable disease list. The 33 diseases were divided into type 1 and type 2 diseases: Type 1 diseases have a high severity but a low incidence, and type 2 diseases are more common but typically less severe. For type 1 diseases, a fixed-threshold detection method with real-time monitoring is used; for type 2 diseases, a temporal and/or spatial detecting method with daily monitoring is in place. When a disease is detected, it is reported to the county-level China CDC in the affected regions by text. After receiving the message, county-level specialists conduct verification and field investigation to confirm an outbreak. The conclusions from the field observations are entered into CIDARS.[23] Although the system is built to be sensitive and effective, false positives and the sheer amount of SMS signals distributed make using it a challenge.[24]

While NIDRIS and CIDARS are focused on already-designated infectious diseases, two new surveillance systems were built after 2003 to concentrate on emerging diseases. One of the systems, the sentinel influenza-like illness (ILI) surveillance system, was supported by the CNIC. China has been quite successful in using ILI and NIDRIS (which includes seasonal influenza) to monitor and evaluate the transmission and evaluation of influenza. The ILI system

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[19] David Hipgrave, "Communicable Disease Control in China: From Mao to Now," *Journal of Global Health*, Vol. 1, No. 2, 2011, pp. 224–238.

[20] W. L. Vlieg, E. B. Fanoy, L. van Asten, X. Liu, J. Yang, E. Pilot, P. Bijkerk, W. van der Hoek, T. Krafft, M. A. van der Sande, and Q. Y. Liu, "Comparing National Infectious Disease Surveillance Systems: China and the Netherlands," *BMC Public Health*, Vol. 17, No. 1, 2017, p. 415.

[21] Wang et al., 2019.

[22] W. Yang, Z. Li, Y. Lan, J. Wang, L. Jin, Q. Sun, W. Ly, S. Lai, Y. Liao, and W. Hu, "A Nationwide Web-Based Automated System for Outbreak Early Detection and Rapid Response in China," *Western Pacific Surveillance and Response Journal*, Vol. 2, No. 1, 2011, pp. 10–15.

[23] Yang et al., 2011.

[24] Vlieg et al., 2017.

is anchored by more than 500 sentinel hospitals in 31 provinces.[25] Since the network is hospital-based, ILI uses hospital information systems for case recording and outpatient monitoring.

The second system, the pneumonia of unexplained etiology (PUE) surveillance system, was built in 2003 after the SARS outbreak. All Chinese health care facilities are required to report patients who have a clinical diagnosis of pneumonia with an unknown causative pathogen and whose disease meets the five criteria of pneumonia diagnosis to the PUE system. Such cases are also entered into NIDRIS.[26] Once a PUE case is registered in NIDRIS, the data are further analyzed in CIDARS as a (possible) type 1 disease. However, the PUE system might be missing cases; one study found that 29 percent of community-acquired pneumonia cases that met PUE criteria were not reported to the PUE system in 2009, and during a nine-year period, only 1,016 PUE were reported in all of China.[27] The number of reported cases surged when an outbreak, such as the SARS outbreak or the H5N1 outbreaks, occurred. This surge could reflect enhanced administrative requirements from health authorities or enhanced clinician awareness of respiratory viruses.[28] However, under-reporting by physicians still apparently happens quite frequently, either because the criteria for PUE notification are not well defined or because physicians are not aware of the requirement to report.[29]

In summary, China has benefitted from international collaborations on building disease surveillance systems and the global health community has benefited from the access to infectious disease data and technical expertise in China. China's ILI and PUE systems and the use of automated electronic components in its Risks Assessment and Early Warning units are comparable with those used in the U.S. CDC and the European CDC.[30] However, even a comprehensive and sophisticated reporting system requires frontline health care providers to be properly trained and required to use the system to function properly. China's CDC needs funding

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[25] Dennis K. M. Ip, Qiaohong Liao, Peng Wu, Zhancheng Gao, Bin Cao, Luzhao Feng, Xiaoling Xu, Hui Jiang, Ming Li, Jing Bao, Jiandong Zheng, Qian Zhang, Zhaorui Chang, Yu Li, Jianxing Yu, Fengfeng Liu, Michael Y. Ni, Joseph T. Wu, Benjamin J. Cowling, Weizhong Yang, Gabriel M. Leung, and Honjie Yu, "Detection of Mild to Moderate Influenza A/H7N9 Infection by China's National Sentinel Surveillance System for Influenza-Like Illness: Case Series," *BMJ*, Vol. 346, June 24, 2013.

[26] N. Xiang, F. Havers, T. Chen, Y. Song, W. Tu, L. Li, Y. Cao, B. Liu, L. Zhou, L. Meng, Z. Hong, R. Wang, Y. Niu, J. Yao, K. Liao, L. Jin, Y. Zhang, Q. Li, M. A. Widdowson, and Z. Feng, "Use of National Pneumonia Surveillance to Describe Influenza A (H7N9) Virus Epidemiology, China, 2004–2013," *Emerging Infectious Diseases*, Vol. 19, No. 11, 2013, pp. 1784–1790; Y. H. Qian, J. Su, P. Shi, E. Q. He, J. Shao, N. Sun, R. Q. Zu, and R. B. Yu, "Attempted Early Detection of Influenza A (H1N1) Pandemic with Surveillance Data of Influenza-Like Illness and Unexplained Pneumonia," *Influenza and Other Respiratory Viruses*, Vol. 5, No, 6, 2011, pp. e479–e486.

[27] Nijuan Xiang, Fiona Havers, Tao Chen, Ying Song, Wenxiao Tu, Leilei Li, Yang Cao, Bo Liu, Lei Zhou, Ling Meng, Zhiheng Hong, Rui Wang, Yan Niu, Jianyi Yao, Kaiju Liao, Lianmei Jin, Yanping Zhang, Qun Li, Marc-Alain Widdowson, and Zijian Feng, "Use of National Pneumonia Surveillance to Describe Influenza A(H7N9) Virus Epidemiology, China, 2004-2013," *Emerging Infectious Diseases*, Vol. 19, No. 11, 2013, pp. 1784–1790.

[28] Xiaorong Guo, Dong Yang, Ruchun Liu, Yaman Li, Qingqing Hu, Xinrui Ma, Yelan Li, Heng Zhang, Xixing Zhang, Benhua Zhao, and Tianmu Chen, "Detecting Influenza and Emerging Avian Influenza Virus by Influenza and Pneumonia Surveillance Systems in a Large City in China, 2005 to 2016," *BMC Infectious Diseases*, Vol. 19, No. 825, September 18, 2019.

[29] Vlieg et al., 2017.

[30] Vlieg et al., 2017.

to recruit and retain qualified professionals, regular training, a sufficient travel budget for its monitoring systems, better communication capabilities, and an official legal and political role in the fight against epidemics.

## China's Health Care System

While COVID-19 revealed flaws in China's public health system, the first wave of the outbreak in the country in January and February 2020 did not overwhelm the health care system except in Wuhan. This was largely the result of the decision to lock down Wuhan on January 23, 2020. The decision was made three days after the government accepted the fact that the outbreak was fueled by person-to-person transmission. All public transportation, including airports and railways, from the city were shut down two days before the Chinese New Year. Five days later, on January 28, 2020, 16 more cities in Wuhan's Hubei Province were under a similar lockdown policy. By January 29, 2020, all 31 provinces in China declared the highest level of emergency, enabling local governments to enforce self-quarantine, cancel public events, and prohibit crowd gatherings across the country. Most of the highways, railroads, and flights in China were shut down or cancelled, and people were asked to stay home as much as possible. In rural areas, most villages closed traffic and set entrance checks. In cities, residential areas were divided into "neighborhood districts" in which residents had to show identification; a daily quota of people was allowed to go in and out of the area. All business and recreational facilities, except grocery stores, were closed during the extended Chinese New Year period. All residents were required to wear face masks outdoors.

This unprecedented quarantine policy helped reduce the spread of the disease to other parts of China, but overwhelmed the health care system in Wuhan, a city of 11 million people. In the first two weeks of the lockdown, most residents in Wuhan were not prepared mentally for the sudden and severe intervention, and many panicked. People swarmed to the hospitals at the first sign of a cold. The initial lack of testing kits and protective gear also caused anxiety. By February 21, 2020, the end of China's first wave of COVID-19 infection, Wuhan had had 83 percent of all the COVID-19 cases and 95 percent of the COVID-19 deaths in China.[31] Wuhan had a 100-fold higher infection rate (per million population) and a four-times-higher case fatality rate than other areas of China (4.2 percent versus 0.9 percent).[32]

Most of the health care system in China outside of Wuhan was not heavily affected by the surge of COVID-19 patients. Given the concentration and the severity of the COVID-19 cases in Wuhan, the Chinese government mobilized resources, medical personnel, public health teams, and testing kits to support Wuhan. Two field hospitals with more than 1,000 beds each were constructed in 12 days. The new hospitals, as well as three existing venues that were converted to hospitals, housed COVID-19 patients with mild symptoms, who had initially swamped the hospitals in Wuhan. Meanwhile, 41,000 health care workers around the country were mobilized

[31] WHO, "Coronavirus Disease 2019 (COVID-19) Situation Report—33," February 22, 2020. As of April 24, 2020: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200222-sitrep-33-covid-19.pdf?sfvrsn=c9585c8f_4

[32] WHO, 2020.

to support Wuhan hospitals. Eighteen thousand public health workers were organized to form epidemic case tracing teams in Wuhan. By early February 2020, three weeks after the lockdown, Wuhan's new COVID-19 case numbers had peaked. On April 8, 2020, after 76 days of lockdown and a week of single-digit case number reports, Wuhan's quarantine order was lifted.

It might surprise many who have not followed China's health care reform closely that even before the COVID-19 pandemic, Wuhan had more health care resources per capita than the U.S. average, with a higher physician density (3.6 doctors per 1,000 people in Wuhan versus 2.6 per 1,000 people in the United States) and a higher number of hospital beds (7.4 beds per 1,000 people in Wuhan versus 4.7 beds per 1,000 people in United States).[33] Most Wuhan residents also did not have to worry about health care costs for treating COVID-19, as China's social health care insurance has covered 95 percent of its 1.4 billion citizens since 2013. These statistics reflect the accomplishment of the ten-year health care reform that was launched in China in 2009.

Like many other countries, China has been trying to provide wider health care coverage, lower the cost of health care, and raise health care quality. Before the 2009 reform, health insurance and other forms of risk pooling in China were uncommon; providers had minimal accountability, and the predominance of fee-for-service payments drove up costs. In addition, new problems threatened to bankrupt the health care system, including a fast-aging population (accelerated by three decades of the one-child policy), a surge of chronic diseases caused by unhealthy lifestyle changes, and health conditions caused by quick urbanization, pollution, and a deteriorating environment.

The goal of the Chinese government's health reform was "establish[ing] a basic, universal health system that can provide safe, effective, convenient, and low-cost health services to all of China's 1.38 billion citizens."[34] Between 2008 and 2011, China's government health expenditure (GHE) more than doubled. Nearly half of the GHE funded premium subsidies to expand social health insurance coverage. The remaining funds were used to provide supply-side subsidies to primary health care facilities to deliver free preventive public health services, build infrastructure, construct health information systems, and train a new cadre of primary health care providers.

The reform's first phase, from 2009 through 2011, emphasized expanding social health insurance coverage for all and strengthening infrastructure. Ninety-five percent of Chinese citizens have been covered by the single-payer insurance system since 2013. To reduce drug expenditures (which constituted 41 percent of total health expenditures in 2008, compared with the Organization for Economic Co-operation and Development countries' average of 16 percent),

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[33] Zhu Heng-Peng, "Trends in Healthcare Insurance Reform And Strategy for Industries," Chinese Academy of Social Science, Institute of Economic and Public Policy Research, undated.

[34] Claudia Sussmuth-Dyckerhoff and Jin Wang, "China's Healthcare Reforms," *Health International*, Vol. 10, 2010, pp. 54–67.

mitigate inappropriate pharmaceutical drug use, and improve access to safe and effective essential medications, the government also established an essential medicines program.[35]

The second phase (from 2012 onwards) prioritized reform of China's health care delivery system through (1) systemic reform of public hospitals by removing mark-up for drug sales, adjusting fee schedules, and reforming provider payment and governance structures and (2) an overhaul of China's hospital-centric and treatment-based delivery system. In the past ten years, China has made substantial progress in improving equal access to care and enhancing financial protection, especially for people of a lower socioeconomic status.[36] The Chinese government injected massive funding into the health care sector for the reform: from 2008 to 2017, GHE quadrupled from 359 billion yuan to 1.52 trillion yuan (equivalent to $217 billion). China's total health care spending in 2018 —$842 billion—was 5.6 percent of its gross domestic product.

China's reforms have achieved nearly universal basic health insurance coverage and improved equal access to health care between urban and rural residents. The low-income population benefited most from the reduction in financial risks. However, the noncommunicable disease burden must still be lowered through prevention and effective management. The GHE has also grown at 12.3 percent annually, greater than the eight percent average GDP growth in the last ten years. Although government funding focused primarily on primary health care, qualified professionals still concentrate in specialized hospitals and clinics; most patients prefer these specialized facilities, driving up cost. Improving the performance of the primary health care–based system will be key to success;[37] a robust, decentralized primary health care system would have helped divert the COVID-19 cases that overwhelmed Wuhan's hospitals in the beginning of the lockdown.

In 2020, the Chinese government will be formulating its next five-year plan, including its "1+4+2" health care reform strategy. This plan is meant to deepen health care reform and ensure the proper government guidance on strengthening the health care insurance system through law, social norms, standardization, and artificial intelligence (AI) and machine learning. This strategy includes continuing to strengthen the national insurance system (the "1") by adding supplemental health care insurance (e.g., long-term care) with new options from commercial insurance companies, charities and humanitarian aid, and public-private collaboration. It also includes the completion of four new systems, including a health care quality assurance system, a logistics and supply chain system, a health insurance payment system, and a health care funding monitoring and regulation system. Finally, the strategy is meant to stabilize the two pillars of medicine supply and health care supply.

The Chinese health care system still faces challenges, including the ineffective regulation of providers, treatments, and medical products, as well as great variation in the training and

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[35] Winnie Yip, Hongqiao Fu, Angela T. Chen, Tiemin Zhai, Weiyan Jian, Roman Xu, Jay Pan, Min Hu, Zhongliang Zhou, Qiulin Chen, Wenhui Mao, Qiang Sun, and Wen Chen, "10 Years of Health-Care Reform in China: Progress and Gaps in Universal Health Coverage, *Lancet*, Vol. 394, No. 10204, September 28, 2019, pp. 1192–1204.

[36] Yip et al., 2019.

[37] Yip et al., 2019.

education of providers.[38] In addition, the overuse of pharmaceuticals, intravenous solutions, and hospital-centered care contributes to excess costs. There are inequalities in government spending on health care in urban versus rural areas.

COVID-19 likely will enhance the government's commitment to health care infrastructure building. This includes a high-quality primary health care system and better-equipped intensive care units and infectious disease special clinics (especially in medium-size regional hospitals); Internet-assisted remote health care and remote surgery; smart clinics; standardization and digitalization of medical records; AI-assisted medical health care; digitalized medical image processing; and medical robots for surgery, rehabilitation, and service.[39] Testing kits and facilities will most likely be supported by independent testing centers. Wearable medical devices and 5G network digital data centers are also proposed as potential public health components to help feed data to the emergency alert system and manage the medical protective gear supply chain.

## China's Biomedical and Clinical Research

Biotechnology is a strategic priority of China's central government. China is also seeing higher investment in this field from the private sector. The compound annual growth rate of biomedical research and development expenditure was 32.8 percent from 2007 to 2012, far ahead of other countries (South Korea's 11.4 percent, Singapore's 10 percent, Europe's –0.4 percent, and the United States' –1.9 percent).[40]

Since the start of the COVID-19 pandemic, Chinese scientists led the way in deciphering the novel virus. In January 2020, a team led by the Shanghai Public Health Clinical Center and School of Public Health published the initial viral genome on two open-access sites just eight days after the announcement of the pneumonia cluster. Later that month, Chinese doctors and scientists reported the first descriptions of the new disease in English in the *Lancet* medical journal. By January 30, 2020, a little more than one week after the lockdown and the Chinese New Year, at least 54 academic papers about COVID-19 had been published, many from researchers in China. These papers provided timely information on epidemiology, clinical features of COVID-19, and the structure or genetics of the virus.[41] In comparison, pathological and histopathologic data based on autopsies are lacking because of the lack of routine medical

[38] Lawton Robert Burns and Gordon G. Liu, *China's Healthcare System and Reform*, Cambridge: Cambridge University Press, 2017.

[39] Huaxia Xinfu, "Infrastructure Building for Healthcare and Public Health—Stimulate New Energy of Urban Circles," China Fortune Research Institute, undated.

[40] Burns and Liu, 2017.

[41] Yu-Tao Xiang, Wen Li, Qinge Zhang, Yu Jun, Wen-Wang Rao, Liang-Nan Zeng, Grace K. I. Lok, Ines H. I. Chow, Teris Cheung, and Brian J. Hail, "Timely research papers about COVID-19 in China," *Lancet*, Vol. 395, No. 10225, February 29, 2020, pp. 684–685.

autopsies in China. The first such study from Wuhan was only published in April 2020.[42] Along with dozens of clinical trials on COVID-19 treatment, China also hopes to promote traditional Chinese medicine in treatment routines.

At the time of writing, China has more COVID-19 vaccine candidates approved for human testing than any other country. On April 10, 2020, CanSino Biologics, a biotech firm based in Tianjing, and its partners at the Academy of Military Medical Science, were the first vaccine makers to move into Phase II trials for vaccine development. On April 12, 2020, Chinese health authorities approved vaccine candidates developed by two Chinese companies—the state-owned Wuhan Institute of Biological Products and the Beijing-based biotech firm Sinovac—for phase I testing on humans. China has targeted five mechanisms for vaccine development: (1) DNA plasmid (Inovia Pharmaceuticals Beijing Advanccine Biotechnology); (2) replicating viral vector flu vaccine; (3) RNA (Fudan University/Shanghai Jiaotong University/RNAcure biopharma; China CDC/Tongji University/Stermina); (4) inactivated (Wuhan Institute of Biological Products/Sinovac); and (5) nonreplicating viral vector (CanSino Biologics/Beijing Institute of Biotechnology).[43]

## China's Global Health Strategy

As I described in my July 2019 testimony before this Commission, China's global health assistance programs to developing countries in Africa and beyond date back to the 1960s.[44] For about half a century, China's foreign aid on health mainly took five forms: the China Medical Teams program, hospital and clinic construction, health care professional training programs, health security and humanitarian aid programs, and pharmaceutical and medical donation programs. These programs are driven by China's motivation to protect its economic activities and investments overseas, reduce the impact of pandemics on national security, and improve China's global image and soft power. In recent years, China's overseas aid budget has grown, while contributions from the United States and other Western countries have plateaued. Although there were criticisms of some of these programs, there is no doubt that China is poised to become a vital global donor on health. The new China International Development Cooperation Agency (CIDCA), which is modeled after the U.S. Agency for International Development (USAID), signals China's political commitment to improve the efficiency and effectiveness of its foreign aid programs and differentiate its aid from commercial investments.

As one of the first countries to recover from the first wave of the COVID-19 pandemic and reopen its manufacturing sector, China is poised to bolster its global image by sending its

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[42] S. Tian, W. Hu, L. Niu, H. Liu, H. Xu, and S. Y. Xiao, "Pulmonary Pathology of Early-Phase 2019 Novel Coronavirus (COVID-19) Pneumonia in Two Patients With Lung Cancer," *Journal of Thoracic Oncology : Official Publication of the International Association for the Study of Lung Cancer*, Vol. 15, No. 5, 2020, pp. 700–704.

[43] Milken Institute, "COVID-19 Treatment and Vaccine Tracker," undated. As of April 21, 2020: https://milkeninstitute.org/covid-19-tracker; Grady McGregor, "China Now Has More Leading Coronavirus Vaccine Candidates Than Any Other Country," *Fortune*, April 17, 2020.

[44] Jennifer Bouey, *Implications of U.S.-China Collaborations on Global Health Issues*, Santa Monica, Calif..: RAND Corporation, CT-516, July 31, 2019. As of April 24, 2020: https://www.rand.org/pubs/testimonies/CT516.html

medical teams, medical supplies, and aid abroad. China is the largest producer of face masks, creating 50 percent of the global supply. In 2019, China's global production revenue from face masks (including industrial and medical) was about $1.5 billion. About 21,000 factories produce masks in China; only 348 factories specialize in medical masks, of which 58 specialize in N95 and KN95 masks.[45] Most of these factories are small- and medium-sized and are located in Henan, Hubei, Jiangxi, and Jiangsu Provinces. Hubei Province (of which Wuhan is the capital) produces about 60 percent of the cloth used for these masks. China's factories for medical clothing, N95 masks, medical googles, ambulances, and medicine were the first to resume production, on January 29, 2020.

In the campaign for soft power and global public opinion, China is emphasizing aid from its government, private sector, and individual billionaires to countries hit by the pandemic. The government claimed to have sent medical supplies to 125 countries and 17 medical teams to 11 countries by mid-April.[46] General Secretary Xi Jinping spoke with Italian Prime Minister Giuseppe Conte and called for collaboration between the two countries to build a "health Silk Road" after China donated 10,000 pulmonary ventilators, 2 million face masks, and 20,000 protective suits to Italy in mid-March.[47]

Jack Ma, the founder of Alibaba, donated 1 million masks to Japan on March 3, shipped 500,000 testing kits and a million masks to the United States on March 13, and announced a donation of 1.1 million test kits and 6 million masks to all 54 African countries.[48] Chinese tech giant Tencent Holdings committed $100 million to support international efforts at pandemic control.[49] (Tencent also played a key role in getting more than a million N95 masks delivered to Boston in April, courtesy of the New England Patriots football team's private jet.[50]) Huawei, a telecom firm restricted in the United States due to national security concerns, delivered 10,000

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[45] Zhang Chang, "Introduction to China's Supply Chain for Medical Devices," IQVIA Consulting, undated.

[46] Statistics provided by Consul General Zhang Ping in a speech on April 16, 2020 at RAND COVID-19 speakers series.

[47] Eran and Lavi, 2020.

[48] Myah Ward, "Chinese Businessman to Donate 500,000 Test Kits and 1 Million Masks to the U.S.," *Politico*, March 13, 2020. As of April 27, 2020:
https://www.politico.com/news/2020/03/13/jack-ma-coronavirus-test-kits-128522

Anita Patrick, "Rwanda's Kagame Thanks Jack Ma for 'Huge Shot in the Arm' After Receiving Donation of Test Kits," *CNN*, March 22, 2020. As of April 27, 2020:
https://www.cnn.com/2020/03/16/africa/jack-ma-donate-masks-coronavirus-africa/index.html

[49] Brian Heater, "Tencent Launches $100M Fund to Fight COVID-19," *Techcrunch,* March 25, 2020. As of April 27, 2020:
https://techcrunch.com/2020/03/25/tencent-launches-100m-fund-to-fight-covid-19

[50] Kim Lyons, "Go Read This: The New England Patriots Plane Brought 1 Million N95 Masks from China," *The Verge*, April 2, 2020. As of April 27, 2020:
https://www.theverge.com/2020/4/2/21204120/new-england-patriots-plane-n95-masks-china-wsj

N95 masks, 50,000 medical goggles, and 20,000 isolation gowns to hospitals in New York; it also donated to Canada and the Netherlands.[51]

Some critics say that China has exported $1.45 billion of medical supplies globally, and the donated amount is small in comparison. Some complained about the poor quality of the products. Many in Western countries are still angry about China's early handling of the outbreak and anxious about China's control of the supply chain of critical medical devices and ingredients. Whether China can assume its leadership image in global health will depend on the development of the COVID-19 pandemic in the coming months.

## Recommendations

At the time of writing, 2.5 million COVID-19 cases have been reported from over 200 countries, and more than 175,000 people have died in the five months since the virus was first discovered.[52] One-third of these COVID-19 cases and one-quarter of the deaths have occurred in the United States, where more than 20,000 new cases and thousands of deaths are being reported each day. The world economy is largely halted by quarantine, and oil prices have dropped precipitously. As we brace for the days to come and the aftermath of this unprecedented pandemic, it will require solidarity among all countries to fight the pandemic and reduce collective suffering and the loss in human lives. Here are three recommendations for the U.S. government.

### *Restore Research Partnership and Collaboration on Public Health Between the U.S. and Chinese CDCs*

In my previous testimony to the Committee on Foreign Affairs of the House of Representatives, I reviewed the collaborations between the U.S. and Chinese CDCs.[53] The U.S. CDC has helped China to restructure its CDC, build multiple disease surveillance systems, train field epidemiologists and lab technicians, and foster collegial relationships between public health officials in the two countries. Both teams have been partners in every single epidemic involving China or the United States since then, including the avian influenza, H1N1, HIV, and Ebola epidemics. However, in recent years, key collaborations have stalled as the United States increasingly views China as a strategic competitor and China uses new laws to restrict foreign nongovernmental organizations to reduce "Western influence." As a result, the U.S. National Science Foundation and USAID closed their offices in Beijing, and the U.S. Department of Agriculture and the U.S. CDC have shrunk their programs in Beijing since 2018. The U.S. CDC office in China now has 14 staff, down from 47 people at the beginning of the current

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[51] Liu Yinmeng, "Huawei Joins Lists of Donors to New York Amid Pandemic," *China Daily*, March 30, 2020. As of April 27, 2020:
https://www.chinadaily.com.cn/a/202003/30/WS5e816a46a310128217282fd7.html

[52] Worldometer, "Covid-19 Coronavirus Pandemic," undated. As of April 27, 2020:
https://www.worldometers.info/coronavirus/#countries

[53] Jennifer Bouey, *From SARS to COVID-19: US China Collaborations on Pandemic Preparedness*, Santa Monica, Calif.: RAND Corporation, CT-523, February 5, 2020.

administration, and the number of its Chinese employees has fallen from 40 to ten. Several months before the COVID-19 pandemic began, a key U.S. public health position in Beijing was eliminated—a trainer of Chinese field epidemiologists whose specialty was to conduct outbreak investigations.

The U.S. government should consider renewing the bilateral collaboration on public health research. Recently, the U.S. CDC decided to add a global health threats program director to its China staff. In a statement, the CDC stated that it "is continuing to look long term at the possible additions to enhance CDC's 30-plus year presence in China."[54] I welcome a similar spirit in the current global fight against COVID-19 and hope that the system will be rebuilt and reformed beyond this pandemic. Collaboration with China on health issues benefits not only China, but can provide a benefit to global public health efforts in general, especially as China is about to emerge as a valuable partner. When a long-term partnership ends, both sides can be harmed and become more vulnerable to a common enemy—this time, COVID-19.

### *Restart Bilateral Dialogues to Strengthen Global Health Strategy*

The United States and China should join forces to seek reforms and strengthen the existing multilateral organizations, such as WHO, to scale up efforts on global coordination of pandemic surveillance, technical support, and coordination of medical resources. There is a need for such coordination; some countries are experiencing a first wave of COVID-19, some only recently overcame the first wave of the pandemic, some are challenged by second waves from imported cases, and still others are contemplating how to manage the threat. Safely restarting travel among nations relies on global cooperation in effectively managing the epidemic and reducing transmission.

China and the United States have cooperated on pandemic issues in the very recent past; they were the first responders to the Ebola epidemic of 2015. The United States sent surveillance teams, established treatment facilities, and deployed thousands of public health experts. China mounted its largest-ever overseas global health effort—delivering medical supplies, deploying clinical and public health experts, and building laboratory and clinical facilities. At the time, both countries were committed to supporting the Global Health Security Agenda. After the Ebola epidemic ended, the U.S. National Institutes of Health hosted a meeting of high-level U.S. and Chinese health officials to discuss lessons learned during the epidemic and how to enhance global health security. Both countries agreed to renew a longstanding commitment to collaboration on the prevention, detection, and response to global infectious disease outbreaks.

This is the time to reconsider a bilateral dialogue meeting similar to the one in 2015 to renew the commitment to build global infrastructure for health. As former U.S. Secretary of Health and Human Services Sylvia Burwell said then, "Challenges will continue to threaten the health and

[54] Marisa Taylor, "Exclusive: U.S. Slashed CDC Staff Inside China Prior to Coronavirus Outbreak," Reuters, March 25, 2020. As of April 27, 2020:
https://www.reuters.com/article/us-health-coronavirus-china-cdc-exclusiv/exclusive-u-s-slashed-cdc-staff-inside-china-prior-to-coronavirus-outbreak-idUSKBN21C3N5

security of our nations. But with better strategies and a strong partnership, we can be ready to face whatever comes our way, and better deliver for the people we serve."[55]

Unfortunately, such high-level collaborative dialogue, along with the bilateral dialogue on economy and security, stopped before the deterioration in trade relations between the United States and China. COVID-19 offers an opportunity to reset U.S.-China dialogues on how to collaborate and reach consensus on strengthening surveillance systems, clinical trials on treatments, and mechanisms to support COVID-19 vaccine development, licensing, financing, production, and distribution and dissemination. USAID and CIDCA should have a conversation on how to coordinate foreign aid from both countries to support the fight against COVID-19 and to mitigate the global economic downturn in developing countries in the aftermath of pandemic. Both countries can collaboratively invest in the Coalition for Epidemic Preparedness Innovations to support vaccine development.

### *U.S.-China Collaborative Investment in Innovations for Health*

Finally, I would encourage the U.S. government and businesses community to consider investing and collaborating with Chinese counterparts to foster innovations in public health and health care. For example, in the next few years, a mutually benefiting travel health certificate can reduce the barriers for travel between the two countries and mitigate the economic loss due to the disruption of travel among millions of international students and businesspeople; South Korea and China started such a program recently.[56]

China continues to expand on its health care reform and open up for private investment and partnership for breaking new ground in remote medicine, medical robots, digitalized health management, and supplemental private insurance. Under the new trade agreement reached in January 2020, China agreed to make a number of improvements on trade secret issues and protect patents and pharmaceutical-related intellectual property. The U.S. government and businesses have criticized China for taking insufficient action to protect intellectual property in the past, but if followed in good faith, these agreements could benefit U.S.-Chinese collaboration on business development, which, in turn, will create more opportunities for U.S. businesses to benefit from joint ventures in biomedicine and technology. COVID-19 will inevitably create a structural break from the traditional ways of doing business and propel the applications of AI, machine learning, and smart systems to advance precision medicine. The United States and China can work together to lead the way of achieving the ultimate goals of a world-class health care system that can be efficient, easy to access, and high quality, and a global health coalition that can fight epidemics like COVID-19 more efficiently.

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[55] National Institutes of Health, Fogarty International Center, "US–China Renew Commitment to Global Health Security," July/August 2015. As of April 27, 2020:
https://www.fic.nih.gov/News/GlobalHealthMatters/july-august-2015/Pages/chinese-delegation.aspx

[56] Presentation of South Korean Deputy Consul General Insang Hwang at RAND at the COVID-19 speaker series: Asia Experience, April 23, 2020.