

**HEARING ON CHINA'S EVOLVING HEALTHCARE ECOSYSTEM:
CHALLENGES AND OPPORTUNITIES**

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BEFORE THE
U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

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CHINA'S EVOLVING HEALTHCARE ECOSYSTEM: CHALLENGES AND OPPORTUNITIES

THURSDAY, MAY 7, 2020

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Washington, DC

The Commission met via videoconference at 2:00 p.m., Chairman Robin Cleveland and Commissioner Thea Mei Lee (Hearing Co-Chairs) presiding.

OPENING STATEMENT OF CHAIRMAN ROBIN CLEVELAND HEARING CO-CHAIR

CHAIRMAN CLEVELAND: Good afternoon, and welcome to the fourth hearing of the U.S.-China Economic and Security Review Commission's 2020 reporting cycle. Today's hearing will examine opportunities for U.S. researchers and companies, and the risks and challenges, presented by the Chinese leadership's approach to healthcare, biotechnology, and medical sciences. I want to welcome our witnesses and thank them for participating.

This hearing comes at a critical juncture. When we began planning the hearing, COVID-19 was a largely localized problem in Wuhan. We had intended to focus on the overhaul of China's domestic healthcare system, improvements in training of skilled health care workers, and the delivery of basic healthcare services, which have contributed to measurable progress in mortality rates and the quality of life in China. We wanted to emphasize China's effective collaboration with global experts after the 2003 SARS outbreak and its commitment to strengthen monitoring systems for early identification and remediation of variations of flu and new types of pneumonia.

As we gather today to discuss the development of China's healthcare systems, COVID-19 has claimed the lives and livelihoods of millions of people. The global economy and citizens around the world are paying a crushing price, in part, because of the lack of transparency and accountability by China's leaders. Regrettably, under General Secretary Xi Jinping, China's political climate has become intolerant of dissent. Any news or any individuals seen as critical of the CCP leadership is censored. This authoritarian control distorts policy and decision making in the best of times. With COVID-19 the outcome has been catastrophic, not just for China but around the world.

During the early stages of outbreak, doctors were silenced, officials destroyed case samples, and the government suppressed or delayed public disclosure of key information. And despite its early and continued mismanagement of the crisis, Beijing has cynically exploited the pandemic to bolster its international image and promote its authoritarian model of governance.

Beijing's behavior during the current pandemic reflects its broader approach to engagement with the United States. Whether we look at biomedical research collaboration, trade, commercial and research opportunities, or cooperation on public health issues, the Chinese

government has pursued a well-worn path of subsidies, stonewalling, and often stealing, undermining foreign access to Chinese markets, and compromising improvements and the health and well-being of all of us.

To retain its well-earned position as a global leader in the production of the safest and most innovative healthcare products and services, the U.S. must move decisively to protect sensitive genetic and medical information of our citizens, as well as protect critical research, corporate assets, intellectual property, and our supply chains. Just as one example of the inherent risks in the current system, I think we're all relieved to learn of the curative potential of remdesivir. Unfortunately, the compound is comprised of ten chemicals, eight of which are made exclusively in China.

COVID has focused needed attention on how to ensure U.S. access and perhaps onshore production of an array of critical products from the ingredients in lifesaving drugs to new materials like graphene, so essential to national security. Tomorrow's hearing will focus on China's bid for control of commodities and minerals in Africa, which will add to our understanding of the scope of concerns about U.S. supply chains and threats to industrial capabilities.

I look forward to our witnesses today shedding light on China's healthcare policy objectives and offering recommendations on how the U.S. can more effectively manage its relationship with China in the healthcare domain. I'd also like to thank the Senate Recording Studio and its staff for help in conducting this hearing, and our staff who have done a fantastic job during this period of telework. So now let me turn to my co-chair for this hearing, Commissioner Lee.

**PREPARED STATEMENT OF CHAIRMAN ROBIN CLEVELAND
HEARING CO-CHAIR**

Good afternoon, and welcome to the fourth hearing of the U.S.-China Economic and Security Review Commission's 2020 reporting cycle. Today's hearing will examine opportunities for U.S. researchers and companies and the risks and challenges presented by the Chinese leadership's approach to health care, biotechnology and medical sciences. I want to welcome our witnesses and thank them for their participation.

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As we gather today to discuss the development of China's healthcare system, COVID-19 has claimed the lives and livelihoods of millions of people. The global economy and citizens around the world are paying a crushing price due to the lack of transparency and accountability by China's leaders. Regrettably, under General Secretary Xi Jinping, China's political climate has become intolerant of dissent. Any news or individual seen as critical of the CCP leadership is censored. This authoritarian control distorts policy and decision making in the best of times; with COVID-19 the outcome has been catastrophic, not just for China but for the entire world.

During the early stages of the outbreak, doctors were silenced, officials destroyed case samples, and the government suppressed or delayed public disclosure of key information about the outbreak. Despite its early and continued mismanagement of the crisis, Beijing has cynically exploited the pandemic in an attempt to bolster its international image and promote its authoritarian model of governance.

Beijing's behavior during the current pandemic reflects its broader approach to engagement with the United States. Whether we look at biomedical research collaboration, trade, commercial and research opportunities or cooperation on public health issues, the Chinese government has pursued a well-worn path of subsidies, stonewalling and stealing undermining foreign access to Chinese markets and compromising improvements in the health and wellbeing of all of us. To retain its well-earned position as a global leader in the production of the safest and most innovative healthcare products and services, the United States must move decisively to protect the sensitive genetic and medical information of our citizens as well as protect critical research, corporate assets, intellectual property and our supply chains.

As one example of the inherent risks in the current system, we were all relieved to learn of the curative potential of Remdesivir—unfortunately the compound is comprised of 10 chemicals, 8 of which are made in China. COVID has focused needed attention on how to ensure US access to an array of critical products from the ingredients in life-saving drugs to new materials like graphene so essential to national security. Tomorrow's hearing will focus on the Chinese

government's bid for control of commodities and minerals in Africa which will add to our understanding of the scope of concerns about U.S. supply chains and threats to industrial capabilities.

I hope our witnesses today can shed light on China's healthcare policy objectives and offer recommendations on how the United States can more effectively manage its relationship with China in the healthcare domain.

I would also like to thank the Senate Recording Studio and its staff for helping us conduct this hearing virtually. Let me now turn to my co-chair for this hearing, Commissioner Thea Lee.

**OPENING STATEMENT OF COMMISSIONER THEA MEI LEE
HEARING CO-CHAIR**

COMMISSIONER LEE: Thank you, Chairman Cleveland, and thanks again to the witnesses for participating in today's hearing. The Chinese government's efforts to improve its healthcare system offer a potential opportunity for the United States. China confronts an aging population and rising incidence of noncommunicable diseases. The Chinese government correctly recognizes that as the world leader in medical innovation, the United States can help meet China's rapidly expanding demand for healthcare services and close widening gaps in provision of critical services to underserved populations.

In theory, this should provide a lucrative opportunity for U.S. companies to sell goods and services to China, and for U.S. researchers to work collaboratively with their Chinese counterparts on new therapies and devices. In reality, Beijing seems more interested in dominating emerging healthcare industries than in achieving mutually beneficial outcomes. This is a pattern we have seen repeated many times before across a range of industries, from steel to semiconductors.

Although China's Ministry of Commerce has placed certain healthcare subsectors on its list of encouraged investments, U.S. companies hoping to participate in China's healthcare system must comply with byzantine regulations, contend with investment restrictions and lengthy approval wait-times, and navigate procurement processes that systematically favor domestic Chinese firms. Meanwhile, Chinese companies have pursued acquisitions and commercial arrangements in the U.S. healthcare market that would grant them access to large troves of U.S. patient data, invaluable medical intellectual property.

The Chinese government has also used talent recruitment programs and exploited legal gray zones to orchestrate the transfer of pre-commercial research discoveries and develop applications within its own market. Chinese universities and laboratories have simultaneously tightened control over foreign researchers' access to and usage of data that could help lead to future medical breakthroughs.

I look forward to hearing thoughts from today's panelists on these issues. And before we get started, I want to remind everyone that our next hearing, China's Strategic Aims in Africa, will be streamed live tomorrow on the Commission's website starting at 9:30 a.m. For now, I will turn the floor back over to Chairman Cleveland to introduce today's panelists.

CHAIRMAN CLEVELAND: Uh-oh. I thought you were doing that.

COMMISSIONER LEE: Oh, I'm happy to do it. We've had back and forth. I will do it.

CHAIRMAN CLEVELAND: I have to get up and go get the thing -- the script, otherwise. Go ahead.

**PREPARED STATEMENT OF COMMISSIONER THEA MEI LEE
HEARING CO-CHAIR**

Thank you, Chairman Cleveland, and thank you again to the witnesses for participating in today's hearing.

China's efforts to improve its healthcare system offer a potential opportunity for the United States. China confronts an aging population and rising incidence of noncommunicable diseases. The Chinese government correctly recognizes that as the world leader in medical innovation, the United States can help meet China's rapidly expanding demand for healthcare services and close widening gaps in provision of critical services to underserved populations. In theory, this should provide a lucrative opportunity for U.S. companies to sell goods and services to China and for U.S. researchers to work collaboratively with their Chinese counterparts on new therapies and devices.

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For now, I will turn the floor back over to Chairman Cleveland to introduce today's panelists.

PANEL INTRODUCTION BY COMMISSIONER THEA MEI LEE

COMMISSIONER LEE: I've got it. So with that, I would like now to introduce our witnesses for this afternoon. First, we will hear from Dr. Karen Eggleston, Senior Fellow at Freeman Spogli Institute for International Studies at Stanford University. She will discuss recent developments in China's domestic healthcare system and the policy challenges Beijing faces in delivering high quality, cost effective healthcare services to the population.

Next, we will hear from Dr. Tara O'Toole, who is Executive Vice President and Senior Fellow at In-Q-Tel, and she will talk about China's ambitions in digital healthcare and biotechnology.

After that, Dr. Jennifer Bouey, who is a Senior Policy Researcher and the Tang Chair in China Policy Studies at the Rand Corporation, will tell us about China's epidemic preparedness, both before and after COVID-19.

And finally, John Balzano, a partner at Covington & Burling's Regulatory and Public Policy Practice, will discuss the challenges that U.S. companies face in accessing China's healthcare market and navigating its regulatory environment.

Dr. Eggleston, we will hear from you first.

OPENING STATEMENT OF KAREN EGGLESTON, SENIOR FELLOW, FREEMAN SPOGLI INSTITUTE FOR INTERNATIONAL STUDIES, STANFORD UNIVERSITY

DR. EGGLESTON: Thank you very much for the opportunity to provide testimony at today's hearing. China's national health reforms over the past two decades have brought the system closer to the modern, reliable, and accessible health system that China aspires to provide its citizens. Of course, pandemics can strain any health system, and health systems sometimes can only be as strong as their weakest link. Commitment to strengthening the weakest links in the future, that would be a fitting tribute to the victims of COVID-19.

China's national health reforms of 2009 continued many reforms undertaken since the SARS epidemic in 2003, consolidated a system of social health insurance, covering the entire population for basic health services. This contributed to a surge in healthcare utilization and spending, while reducing out-of-pocket cost burden to patients. Those out-of-pocket costs declined from over half of spending, in 2003, to less than a third.

The Healthy China 2030 blueprint and other policies set forth goals for health and service delivery, and China has achieved considerable progress, I talk about in some parts of my testimony. But of course, there remains several issues of concern to promote healthy aging, such as high male smoking rates, large urban, rural, and regional disparities.

China has 4.3 hospital beds per 1,000. It exceeds that of the U.S. Doctors per 1,000 increased from over 1 to around 2, comparable to the average of upper-middle-income countries. China's density of skilled health workers, which in addition to doctors includes nurses and midwives, that density per 1,000 population rose from a little under 3 in 2002 to 4.6 in 2015, which is a 60 percent increase in just a dozen years. But it's still less than half that of high-income countries, again, with significant urban, rural, and regional disparities in number and in training.

Medical doctors in China typically receive five years of bachelor of science plus three years of required residency, standardized nationwide a few years ago. Of course, this varies by specialty, and some categories such as assistant GPs obtain certification with only a two-year technical degree. In 2010, China also launched a program to recruit and retain doctors in rural areas, which are underserved compared to urban areas.

According to one index, the Healthcare Access and Quality Index by the Global Burden of Disease Researchers, China has achieved large improvements nationally. But there are huge disparities inside. Within China, we have the equivalent of the difference between the highest in the world, Iceland, and North Korea. So that's a huge internal disparity.

Total health expenditures have grown as a share of China's economy as it has grown, representing 5 to 6 percent of GDP, amounting to expenditure per person about average for upper middle-income countries and well below that of high-income countries, much less the United States. Rural and informal sector employees have less generous health coverage. Expanding and equalizing catastrophic insurance coverage will be even more important as medical care technology continues to advance, if they want to provide affordable, equitable access.

The pandemic quite likely will have a significant and long-lasting boost to telemedicine and other aspects of technology-enabled care. Although innovative business models such as WeDoctor have not yet been fully integrated into the health system, online consultations, robots in healthcare and in long-term care have all been given a boost during the COVID-19 response. In the future, China as elsewhere, South Korea, Singapore, will roll out technologies for contact tracing during the remainder of the pandemic, and we'll see what happens in the future.

I was asked to talk about aging. Median age in China is already greater than the median age here in the United States. The proportion of China's population age 60 and older is projected to more than double over the next three decades, reaching a third by 2050. China has tried to revise its healthcare system and provide more accessible primary care in their doctoral system. There's a lot of ongoing reforms related to that.

Financing for nursing home or long-term care remains a challenge. There are pilots for long-term care insurance. But there's uneven coverage and mostly families themselves have to pay to care for their elders. The national rating system for elderly care institutions is an interesting development that I talk about in my testimony.

I will close with a brief listing of some of the recommendations in my testimony. It is in the interest of Americans and Chinese to have a strong, resilient health system in China. Constructive bilateral cooperation can mitigate the impact of the current pandemic and strengthen the global capacity to avoid the devastating human costs and social and economic impacts of future outbreaks on this scale.

The U.S. government and others should encourage China and our own scientists and firms to work collaboratively with multilateral efforts to strengthen health systems, emphasize scientific evidence-based health policy, and encourage China to do so as well. Such as prioritizing efforts to strengthen primary care and address the social determinants of health, and promote health aging, support health education for the disadvantaged, and not forget mental health.

Encourage public-private collaborative governments and support China's efforts to define and regulate the fledgling private not-for-profit sector, which is relatively new in China. Share experience potentially about how to define and make it accountable for community benefits in exchange for tax exemption. Encourage transparent peer review of research and encourage international collaboration between Chinese and American scientists.

Share case studies of U.S. community and health system experiments with integrated care and fostering patient-centered care, which are definite goals of China's health system improvement, and perhaps share experience with bundled payment as China rolls out diagnosed-related groups. Support China's efforts to develop more robust systems of malpractice regulation and accountability for quality care, as well as their efforts to address physician-patient tensions, which occasionally erupt in violence.

Encourage scientific evaluation such as randomized control trials of traditional Chinese medicine, and work in conjunction with partners in other countries around the world in a multilateral approach to support China's healthcare ecosystem development. Thank you very much.

**PREPARED STATEMENT OF KAREN EGGLESTON, SENIOR FELLOW, FREEMAN
SPOGLI INSTITUTE FOR INTERNATIONAL STUDIES, STANFORD UNIVERSITY**

May 7, 2020

Testimony before the U.S.-China Economic and Security Review Commission

China's Evolving Healthcare Ecosystem: Challenges and Opportunities

By Karen N. Eggleston
Stanford University¹ and NBER

Thank you for the opportunity to provide testimony for this hearing. I was asked to testify as part of Panel I, which assesses China's domestic healthcare infrastructure, and the use of technology in China's healthcare system in light of COVID-19. I was asked specifically to focus my testimony on the following questions:

- What are the Chinese government's objectives for the development of its healthcare system? Assess the government's progress to achieving these objectives. What is the cost burden on the Chinese government?
- How has China's healthcare system developed in recent years to cope with an aging population?
- What is the extent of healthcare coverage (e.g., doctors per thousand people, hospital beds per thousand, etc.), and what is the quality of the coverage across different population segments? What is the cost burden on citizens?
- Describe the training pipeline for China's doctors, nurses, and health administrators.
- What are Beijing's ambitions for its domestic healthcare system, and how do they affect its interaction with the healthcare markets in the United States and other countries?
- The U.S.-China Commission is mandated to provide recommendations to Congress for legislative action; what recommendations do you have for congress regarding the development of China's healthcare system and its implications for the United States?

¹ Director, Asia Health Policy Program <http://aparc.fsi.stanford.edu/asiahealthpolicy/>; Deputy Director, Shorenstein Asia-Pacific Research Center (APARC); and Senior Fellow, Freeman Spogli Institute for International Studies (FSI), Stanford University. I gratefully acknowledge Jillayne Ren and Lily Liu for excellent research assistance in preparing this testimony, as well as my many co-authors in China, the US and elsewhere, for the research projects cited in this testimony. All remaining errors are my own.

China's national health reforms over the past two decades have brought the system closer to the modern, safe, reliable and accessible health system that is commensurate with China's dramatic economic growth, improvement in living standards, and high hopes for the next generation.²

China's national health reforms of 2009—continuing many reforms undertaken since SARS (2003)—consolidated a system of social health insurance covering the entire population for basic health services, contributing to a surge in healthcare utilization while reducing out-of-pocket costs to patients – which declined from 56% to 28% of total health expenditures between 2003 and 2017. An expanded basic public health service package, funded by per capita government budget allocations that include a higher central government subsidy for lower income provinces, provides basic population health services to all Chinese. Now the governance structure consolidates the purchaser role for social health insurance schemes under the National Healthcare Security Administration, with most other health sector functions under the National Health Commission. China's world-leading technological prowess in multiple fields spanning digital commerce to artificial intelligence—and accompanying innovative business models such as WeDoctor that have not yet been fully integrated into the health system—hold promise for supporting higher quality and more convenient healthcare for China's 1.4 billion.

However, many challenges remain, from dealing with COVID-19 and its aftermath, to other lingering challenges, from promoting healthy aging to the political economy of addressing patient-provider tensions, changing provider payment to promote “value” rather than volume, and deciding which new medical therapies qualify as “basic” for the basic medical insurance schemes. To make China's investments in universal health coverage and the accompanying rapid medical spending growth sustainable in the longer-run, policies need to help the most vulnerable avoid illness-induced poverty, increase health system efficiency, strengthen primary care, and reform provider payment systems, as Hai Fang and other colleagues and I argued recently (Fang et al. 2019).³

² This section and much of the remainder of this testimony draw from my recent research, individuals works of which I have cited, as well as the text of my Stanford Asia Health Policy program working paper “[Healing One-fifth of Humanity: Progress and Challenges for China's Health System](#),” October 2019, available at https://aparc.fsi.stanford.edu/asiahealthpolicy/research/asia_health_policy_program_working_paper_series. A condensed and edited version of that research appears in *Milken Institute Review: A Journal of Economic Policy*, 4th Quarter 2019.

³ For an overview of China's health system reforms, see the June 2019 special collection of articles in *BMJ* by Professor Qingyue Meng and colleagues of Peking University and their international collaborators.

- What are the Chinese government’s objectives for the development of its healthcare system?

Broadly, China’s government aims to develop its healthcare system to be comparable to the best among similar economies in the world and to meet the expectations of its citizens. At the beginning of the 21st century it set an ambitious goal for achieving universal health coverage after SARS, and has achieved that goal. The resulting system of basic medical insurance programs is gradually reducing disparities in coverage (e.g. between formal sector employees with relatively generous, compulsory coverage, and rural and informal sector workers or dependents, with subsidized voluntary coverage). I discuss these issues more in the healthcare financing section below.

Improved health arises from non-medical factors as much as from medical care, and many of those non-medical factors, and how they are prioritized in governance, can be considered part of the broader health system ecosystem in a society. Accordingly, discussion of China’s health system objectives should include the specific goals for population health as well as healthcare goals over the coming decade, as set forth in October 2016 by President Xi Jinping in the “Healthy China 2030” blueprint (similar to the US “Healthy People” developed for decades, now common in many countries).⁴ Healthy China 2030 includes over 20 chapters covering public health services, environment management, the Chinese medical industry, and food and drug safety. There are five specific goals to improve the level of health nationwide, control major risk factors, increase the capacity of the health services, enlarge the scale of the health industry broadly defined, and improve the health service delivery system. The blueprint sets forth “core principles”—health priority, reform and innovation, scientific development, and justice and equity—and outlines 13 core indicators to be reported this year and 2030.

China has achieved considerable progress in many of these arenas. As shown in Figure 1, life expectancy at birth compares favorably with other upper-middle income countries and even with some OECD countries (76.5 in China in 2018 according to OECD data, compared to 78.6 in US), while child vaccination rates surpass those of the US and many other wealthier countries (Figure 2). There remain several issues of concern, such as high male smoking rates (Figure 3), which contribute to the gap in

⁴ See the "Outline of Healthy China 2030 Plan" (The State Council, 2016). The “Healthy People” plans in the United States “provide science-based, 10-year national objectives for improving the health of all Americans. For 3 decades, Healthy People has established benchmarks and monitored progress over time in order to: Encourage collaborations across communities and sectors; Empower individuals toward making informed health decisions; Measure the impact of prevention activities.” (<https://www.healthypeople.gov/2020/About-Healthy-People>).

life expectancy between men and women (see Figure 1) and is the leading cause of premature mortality.

The Healthy China goals also seek to redress the health disparities within China, which remain wide despite laudable progress in lifting millions out of poverty. For example, as I emphasize in the introduction to *Healthy Aging in Asia* (Eggleston 2020), residents of the most developed provinces (megacities) enjoy first-world health outcomes, virtually a different country from that of their compatriots in the lowest-developed provinces, as illustrated by the 10-plus-year gap in life expectancy between the lowest and highest provinces -- equivalent to the gap in life expectancy between high-income and middle-income countries.

China's goals include building a stronger, more comprehensive and higher quality health insurance and health service delivery system. Having achieved universal health coverage through a network of basic social insurance schemes, China's health system now is moving on to harder steps that confront most health systems: implementing evidence-based policy to make new technologies available broadly; investing in and monitoring quality and responsiveness; providing greater financial protection and access for those most vulnerable, to ameliorate disparities in access and health outcomes; keeping up investment in pandemic preparedness even when other priorities come to the fore. Below sections of the testimony address the progress towards these goals and remaining challenges for China's health system.

- What is the extent of healthcare coverage (e.g., doctors per thousand people, hospital beds per thousand, etc.), and what is the quality of the coverage across different population segments?

China's healthcare infrastructure, or health service delivery system, includes its clinics and hospitals as well as the healthcare professionals that provide services within them. All these aspects of medical care in China have developed substantially since the turn of the 21st century, with policy goals to continue to improve both access and quality. This section provides an overview of that healthcare service delivery system, starting with arguably the most important aspect: the healthcare workforce, the human capital undergirding the health service delivery system.

As shown in Figure 4, skilled health professionals per 1000 population in China have increased substantially from 2.85 per thousand in 1980 to 7.04 per thousand in 2019, with noticeably accelerated growth after 2005 (correlated with the post-SARS health system investments). Within healthcare professions, the number of doctors per 1000 population increased from 1.2 in 2000 to 2 in 2017, comparable to the average for upper middle-income countries globally, and similar to Brazil (2.2), and far higher than India, South Africa, or Indonesia – each with less than one doctor per thousand, according to World Bank data. China's relatively low doctors or nurses per capita

relative to OECD countries (Figures 5 and 6) contrast with China's 4.3 hospital beds per 1000 residents, which exceeds that of the US (2.8) and falls about in the middle of the OECD country range (Figure 7). Figure 8 shows China's substantial increase in doctors per capita since 2000, with China shown in comparison with the average for upper middle-income countries and the average for high income countries, as well as specific comparison middle-income economies (India, Brazil, South Africa Indonesia, Vietnam) and OECD countries (Japan, South Korea, and the US). These figures all illustrate that China is catching up but behind the average for OECD countries and its neighbors Korea and Japan in terms of doctors per capita.

To be more specific and in depth, consider data on the skilled healthcare workforce from the World Health Organization (WHO) *Global Health Workforce Statistics*, focusing on China (compiled by Jinlin Liu and drawing from our joint paper on the association between healthcare professionals and health outcomes across countries, Liu and Eggleston 2020). The WHO *Global Health Workforce Statistics* data aggregates skilled health workers in three categories: medical doctors, nurses, and midwives. The data we present is the most recent year available between 2007 to 2017 in each country.

China's density of skilled health workers per 1000 population rose from 2.87 in 2002 (right before the SARS crisis) to 4.63 in 2015 (the latest available figure), a 60% increase in a dozen years. Among the 178 countries for which 2017 data is available, the density of skilled health workers in China is 3 times the average of low-income countries, and 1.5 times that of lower-middle income countries (using the World Bank's classification), but less than half (37%) of that of high-income countries, which enjoy about 11 skilled health workers per 1000 population.

Unsurprisingly, China's significant increase in skilled healthcare workforce over the past couple decades is correlated with its well-documented improvements in multiple population health outcomes, such as infant mortality rates. As the density of healthcare workforce increases, health outcomes have also improved, with a significant decrease in maternal mortality (see Figure 9) and in under-five mortality over time (Figure 10). Of course, this relationship is partly driven by the overall improvement in living standards in China over the past two decades, which has improved health outcomes from the non-medical determinants or health as well as the resources available for investment in training and employing a larger healthcare workforce to serve China's 1.4 billion.

Medical Education

As noted, China has made significant strides in increasing the skilled healthcare workforce serving both rural and urban areas, although vast disparities remain. The heterogeneity of China's health providers arises early in the pipeline, in terms of who receives college education and who goes on to which levels of medical education. The

vaunted barefoot doctors of Mao-era China had minimal training beyond middle school. In today's China, doctors usually receive at least four years of medical training in earning an MD as an undergraduate degree, and many have deeper and longer training. To increase the level of standardized medical education and train more high-level general practitioners to work in the rural areas and primary care institutions, China launched the "5+3" model of medical education in 2015, with a degree program and residency training. Starting this year, residency training in an accredited program is required for all new medical graduates looking for work in a clinical capacity.

Medical curricula have also evolved. Since the last decade, the Chinese government's aggressive push to expand the number of General Practitioners (GPs) has opened new paths for individuals with varying backgrounds to obtain certification (Lian et. al, 2019). While five years of a Bachelor of Science education plus three years of required residency (standardized nationwide in 2014-15, as noted above) are often required for GPs who wish to operate in both urban and rural areas, assistant GP candidates can obtain certification with significant flexibility, some of which require only a 2-year technical degree (Lian et. al, 2019; Lio et. al, 2018). According to a study conducted in Henan (Wang, Fu, Liu et al. 2018), most undergraduate medical students do not choose a general practitioner career, and factors such as gender, family income and hometown location influence choice of specialty significantly.

Despite the rapid growth of GPs in the past decade, China's medical education still suffers from inconsistency in quality and teaching resources across different geographical areas (Lio et. al, 2018). Some analysts argue that the lack of competency and skill-focused curricula, and the lack of training in outpatient and palliative care, contribute to low public trust in practitioners' competency and effectiveness (Xu et. al, 2010; Jiang et. al, 2016).

To mitigate these problems, China has incrementally undertaken several measures to standardize its curricula, such as releasing new standards for the internal medicine curricula in 2014, strengthening residency programs, and launching the National Clinical Skills Competition in 2010 (Lio et. al, 2018; Jiang et. al, 2016). Some argue that the simulation-based competition in particular not only created incentives for institutions to improve practical training and dedicate more resources, but also enhanced inter-school communication between medical institutions (Jiang et. al, 2016).

As noted, rural areas are especially likely to lack robust numbers of skilled healthcare professionals. Like many large countries, China has tried many policies to address the relative lack of doctors in rural areas. In 2010, China launched a program to recruit and retain doctors in rural areas called the "rural-oriented tuition-waived medical education program." While relatively new, some empirical evidence about the program suggests it holds promise but is unlikely at the current scale to close the

urban-rural skill gaps any time soon. Jinlin Liu (2020), in his systematic review, discusses the features of this national RTME program, which has been implemented in 22 provinces in central and western China (along with 8 provinces in eastern China which have implemented provincial RTME programs on their own). From 2010 to 2019, over 56 thousand rural-oriented tuition-waived medical students (RTMSs) have enrolled in the national 5-year program, so that the program provides a steady source for increasing the rural health workforce in China. The majority of students enrolled in the 5-year and 3-year programs do start by fulfilling their obligations for rural service under the terms of the program, but it appears “impossible to completely improve the shortage of health workforce in rural China only relying on this single program. More efforts need to be taken to enlarge the enrollment number of RTMSs, improve intrinsic motivation of RTMSs to work in rural areas, improve the retention of RTMSs after work contracts expire, attract more medical graduates to work and stay in rural areas, and develop and implement more rural health worker programs in China” (Liu 2020).

Having discussed the development of the PRC healthcare system infrastructure and healthcare workforce, I now turn to health system financing, including the investments made by the government, social health insurance coverage, and households’ remaining financial burdens.

- Assess the government’s progress to achieving these objectives. What is the cost burden on the Chinese government? What is the cost burden on citizens?

During the health reform era since the beginning of the 21st century, China has attained universal health coverage and put in place a series of policies to enhance access to effective medical care while decreasing households’ out-of-pocket spending burden.⁵

China’s health spending has grown considerably as its economy has experienced unprecedentedly rapid growth and investments funded the expansion of healthcare documented in the previous sections. Nevertheless, China’s health spending per capita is much smaller than that in the US or even most other OECD countries (Figure 11). Total health expenditures represent 5-6% of GDP (depending on how one aggregates spending), amounting to an expenditure per person about average for upper middle-income countries but well below that for high-income countries (Figure 12b). Over the past two decades, the government share of spending has expanded considerably, by 2017 representing slightly over 9% of overall government expenditures (Figure 13). These investments, into and alongside subsidized social health insurance programs, improved risk pooling and brought down the financial burden on patients and their families. Out-of-pocket spending (“tax on the sick”) declined from about 60% in 2000 to about 36% in 2017 (Figure 14). This government spending—both directly on

⁵ This summary draws from Eggleston 2019 and the sources cited therein.

healthcare infrastructure and subsidizing social health insurance for the rural and urban non-employee populations—substantially reduces the burden on families, although many lower-income groups still face the risk of catastrophic health spending from hospitalizations or other very large expenses.

Utilization has greatly increased for healthcare services, especially hospital outpatient department visits and inpatient admissions. The relative decline in utilization at the village or community level has been an unintended consequence, although relatively straightforward to predict: with less of an out-of-pocket burden, patients self-refer to more trusted providers at higher levels, and swell the ranks of those crowding into secondary and tertiary hospitals. However, because the insurance coverage of the rural insurance program, the New Cooperative Medical Scheme (NCMS), is less generous than for urban residents and especially relative to insurance for urban employees, the risk of catastrophic medical spending and illness-induced poverty remains higher for rural than urban residents.

Recent mergers of insurance risk pools—such as raising NCMS benefit levels to those of the urban resident basic medical insurance—and implementation of catastrophic supplementary insurance within local social health insurance systems are encouraging trends for closing gaps in risk protection. As of the end of 2018, 316.7 million were enrolled in Urban Employees' Basic Medical Insurance, 897.4 million in Urban-Rural Residents' Basic Medical Insurance, and 130.4 million in “remaining NCMS,” according to the National Medical Security Administration. Per capita spending per enrollee ranged from 3,316.7 RMB per urban employee to only 700.3 RMB per person in urban-rural residents' insurance and 627.6 RMB per NCMS enrollee.⁶ Thus, urban formal sector employees enjoyed health insurance benefits worth more than 5 times those of rural residents. Closing this gap while continuing to cover new life-saving therapies for all will confront China's medical system with financing challenges for years to come. Ongoing integration of urban residents' insurance with remaining NCMS has led to coverage under the “Urban-Rural Residents' Basic Medical Insurance” for the vast majority of Chinese. However, the level of risk pooling remains local to a given county or municipality, and the level of risk protection they entail still varies widely across localities.

Study of NCMS and other health programs provide suggestive but not definitive evidence that they may have contributed to closing the mortality gap between rural and urban China, although the true impact is difficult to untangle from all the other changes affecting survival trends in China; see Zhou, Liu, Bundorf et al. 2017.

Expanding and equalizing catastrophic insurance coverage will be ever more important as medical care technology continues to advance. Breakthrough therapies draw upon increasing biomedical knowledge and “precision medicine” or

⁶ This summary draws from Eggleston 2019 and the sources cited therein.

“personalized therapy” using genetic and other information, especially for cancers but also other major killers. These therapies can be extremely expensive. Providing equitable access to these new treatments poses a challenge for health system financing not only in China, but around the world. Financing experts recommend China explore policies utilized in other middle- and high-income economies, such as expanding the taxation base to assets for health insurance contributions as done in the health systems of South Korea and Taiwan.

In addition to expanding insurance coverage, China has put in place multiple policies to address health inequalities. Perhaps most salient was equalization of essential population health services as part of the 2009 national health reforms. As noted, addressing disparities has also been highlighted at the 2016 first national health meeting, in the Healthy China 2030 goals, and in other leadership statements. Such high-level attention is an important first step to continuing progress in reducing disparities. In China’s system of governance, attention from leadership matters greatly for translating policy rhetoric into effective implementation. Qingyue Meng and colleagues recommend that local officials’ performance evaluations be based in part on local health indicators, among other suggestions (Meng et al. 2019).

Health expenditures have increased rapidly as China has developed its system of universal health coverage. Double-digit health spending growth surpassed the rate of economic growth, and as a result, health spending absorbs an increasingly larger share of the total economy. Most recent policies seek to make sure additional spending on health and elderly care is efficient and effective, while also attempting to address the nonmedical determinants of health and promoting healthy aging.⁷ More will need to be done. The health system needs to be reengineered to emphasize prevention, provide coordinated health care for people with multiple chronic diseases, assure equitable access to rapidly changing medical technologies, and ensure long-term care for frail elderly, all without unsustainable increases in opportunity costs for China’s future generations.

COVID-19 and cost of care

During the period of containing the spread of SAR-CoV-2 and the pneumonia it causes, COVID-19, new policies were put in place to attempt to allay fears about payment for care, to assure that all patients sought and received treatment regardless of their potential out-of-pocket burden, and that providers would feel assured of revenue to cover their treatment costs. Whether the announced policies were successful, to what extent, will only be evident in the coming months or year, but in this section I lay out the basic aspects of the health coverage policies as announced in early 2020 and how they relate to what was just described in terms of health insurance coverage for different population segments in China.

⁷ Eggleston chapter in Fingar and Oi, *Fateful Choices* 2020.

January 22nd, the National Healthcare Security Administration (*Guojia Yiliao Baozhang Ju*) and the Ministry of Finance announced two principles: patients should not worry about payment for COVID-19 care, and providers should not worry about covering their costs of providing care.⁸ How exactly those promises would be met was not initially spelled out, and a full accounting will not be possible until at least a year from now probably, but authorities claim that this financing policy played an important role in control of COVID-19.

Basically, it comes down to a question of trust: did patients during the intense pandemic phase believe that the government would pick up the tab for their testing and treatment? We know early on there were reports of tragic cases: patients self-discharging for fear of inability to pay—a common phenomenon in China before universal coverage, and for those facing catastrophic health spending for services not covered or beyond the ceiling of spending allowed by the basic insurance program--then dying at home. Did patients and their families believe that they would not be asked later to settle the bill? Did healthcare providers believe that the government would allocate new funds to cover those treatments, not reduce already budgeted amounts or take these funds out of global budgets for the year, and so on? Extra government subsidies are supposed to cover both the care received before confirmed as COVID-19, as well as treatment received outside the home locality (e.g. by migrant workers in lockdown outside their hometown or home province). Ultimately there is supposed to be a national reconciliation of insurance claims, where each locality first covers treatment for everyone seeking treatment there, and then receives payment from other localities, net of what they owe. Announced estimates suggest about 170,000 RMB spent per confirmed case, two-thirds of which was covered by social insurance and the remainder by “support from MOF” – not clear if this *Bu Zhu* (assistance/support) means they completely cover the remainder, or if households are assisted based on some other measure of their ability to pay.

China also adjusted insurance coverage criteria during the pandemic – for example, ECMO (ventilator) treatment is expensive and frequently not covered by China’s social insurance programs, but was covered by insurance for COVID-19 treatment. Moreover, policymakers took steps to try to address the care needs of other patients, such as allowing or encouraging longer-term prescriptions of anti-hypertensive and anti-diabetic medications, renewal of prescriptions and internet-based consultations that avoid physical contact. Only in the future will it be clear to what extent these steps mitigated the impact of delayed care.

⁸ For news and policy announcements related to coverage of COVID-19 treatment spending, see for example the NHSA website (e.g. http://www.nhsa.gov.cn/art/2020/4/26/art_14_3054.html) or http://www.xinhuanet.com/politics/2020-03/29/c_1125784154.htm; http://www.gov.cn/xinwen/2020-04/12/content_5501508.htm.

One element of the COVID-19 response is relatively certain: the pandemic quite likely will give a significant and long-lasting boost to telemedicine and other tech-enabled, non-direct-contact forms of care in China, as has also been the case in much of the middle- and high-income world.

Regional and urban/rural disparities

In a country as populous, expansive, and diverse as China, it is not surprising that there are wide disparities in health and healthcare between different population sub-groups distinguished by wealth, education, urban-rural *hukou*, inland-coastal residence, and so on.⁹ Health disparities can be assessed in multiple ways, and most tell consistent stories: China has achieved impressive improvements in health and longevity, including for the low-income residents in rural areas; however, significant gaps between the most- and least-privileged Chinese citizens persist, and in some cases are growing. Some of the best estimates of average life expectancy across different regions suggest gaps of 11·8 years for men and 12·8 years for women in 2013, and more recent Global Burden of Disease estimates for 2017 continue to underscore large regional differences.

Figures 15 and 16 illustrate China's significant regional disparities in skilled healthcare professionals per capita. Figure 17a shows urban areas, clearly much better endowed with doctors per capita than their brethren in rural areas (Figure 17b). Figure 18 shows the urban-rural gap in doctors per capita: rural areas were catching up 1980-2000, but the gap began widening again starting in 2005. Similar trends are evident for nurses per capita: although rural areas gradually enjoyed more nurses per capita, the pace of growth was faster for urban areas, increasing the urban-rural gap especially after 2005 (Figure 19).

Thus, despite progress, sizable healthcare disparities remain in China, contributing to and correlated with disparities in health. Health outcomes differ not only between urban and rural areas, but also and along other dimensions, such as between urban regions of higher or lower per capita income, or across individuals with more or fewer years of schooling. The burden of chronic disease is a case in point. For example, diabetes is associated with greater excess mortality in rural China, although prevalence is higher in urban areas (Bragg et al.) Lei et al. (2014) document strong educational gradients in self-assessed health, presence of any disability, and in survival expectations (respondents' self-report of possibility of surviving to age 75), using the China Health and Retirement Longitudinal Study (CHARLS) baseline survey, and controlling for per capita expenditures and other economic and location variables.

⁹ This section of my testimony draws from Eggleston (2019).

Figure 20 shows the persistent urban advantage over rural areas in terms of hospital beds per 1000 population, 2010-2018, with rural areas in 2018 having fewer than urban areas enjoyed back in 2010. Figure 21 shows regional disparities in beds per capita, and Figure 22 contrasts urban and rural areas within each province. Of course, the nature of infrastructure investments, development of urban referral hospitals, and low density of population in rural areas suggests that perfect parity in beds per capita between urban and rural areas should not be expected. Rural residents of most large countries face more constraints on physical access to healthcare than their urban counterparts. Nevertheless, it is important to keep in mind that China continues to have very large regional and urban-rural differences in health system capacity, almost inevitably compounded by the differences in skills of their healthcare professionals as well (although the latter is less readily documented).

One attempt to measure quality, combined with effective access, is the Healthcare Access and Quality (HAQ) Index proposed by the Global Burden of Disease 2016 Healthcare Access and Quality Collaborators (2018). This index is based on measuring premature mortality from causes that should not occur if the individual had access to high-quality healthcare (GBD 2016 Healthcare Access and Quality Collaborators, Fullman et al. 2018). According to this index, China stands out for striking regional disparities. The 43-point regional disparity *within* China is the equivalent of the difference between Iceland (the highest in the world) and North Korea. China truly entails “multiple countries within one.” By pulling up the lagging regions even other developed coastal areas leap ahead, China has been able to steadily improve nationally. China’s rapid national improvement in access and quality as proxied by this HAQ Index is evident from the fact that even China’s lowest region in 2016 was above the 1990 national median. Among 195 countries and territories, China shows the highest absolute change in the HAQ Index between 2000 and 2016; and China’s HAQ index in 2016 was the highest among all countries with same or lower medical spending per capita.

China's primary health care system¹⁰

China has tried to strengthen primary care and develop a family doctor system, as described for example in Rize Jing and Hai Fang’s chapter within *Healthy Aging in Asia* (2020). These represent the latest efforts to re-orient China’s health service delivery system away from crowding at tertiary hospitals and establish reliable systems for community-based care. Jia, Du and Fan (2019) discuss the factors associated with residents' willingness to a contract with the family doctor, especially information; and Gao (2019) discusses how the family doctor contract service appear to have a significant effect on the community management of chronic hypertension

¹⁰ This section draws from Eggleston 2019 and Eggleston, Donahue and Zeckhauser 2020 chapter on healthcare.

and chronic disease, and may be able to help patients better control blood pressure levels.

China's health policies have long supported prevention and primary care, yet during the last two decades many reforms had the unintended consequence of promoting hospital-based care rather than primary care. As Professor Meng Qingyue emphasized in his keynote address at a conference on the family doctor system (June 26th, 2018 at the Stanford Center at Peking University), increased demand for hospital-based services is an almost inevitable outcome of rising living standards and purchasing power of China's consumers, and their interest in high-quality medical services. Patients' suspicion of the quality of primary care is certainly not without foundation; as noted earlier, well-trained physicians are in short supply in many areas, especially for primary care. Despite efforts to train more general practitioners and enhance primary care, by 2017 only one in ten rural doctors at township health centers had at least five years of medical school (up from 5.6% in 2010; Meng et al. 2019). System reforms are needed to put in place the financing and incentives to attract, retain, and motivate qualified physicians, nurses, and other health providers at the primary care level. As highlighted in a recent World Bank report, patient-centered integrated care is one such approach.

Some areas such as Shanghai have implemented a decade or more of variations of the family doctor system and primary-care-based model, gradually gaining the trust and confidence of residents. Xiamen has developed a well-known team-based model that includes a health manager ("*jiankang guanli shi*") working with a general practitioner (GP) and any specialists the patients may need. Such team-based approaches may expand as the tasks more appropriate for physician assistants (including recordkeeping and basic population health service delivery, follow-up health education and care coordination) are taken over and leave the increasingly well-training primary care physicians with more time to focus on their comparative advantage in clinical management.

Offering a quick and convenient channel for upward referrals to the best urban specialists is one service that patients value. Referral back down to primary care after inpatient treatment has been less systematic, although new forms of provider integration linked to global budgets have given incentives for hospitals to partner with community health centers in follow-up care and rehabilitation. In fact, one of the metrics used by some integrated care systems is whether the number of downward transfers to primary care from hospitals is similar to or greater than the number of upward referrals for hospitalization. Whether improved dual-referrals systematically improve health outcomes while reducing expenditures and out-of-pocket burdens, however, remains unclear.

China's vibrant e-commerce and digital payment sectors have also been harnessed in preliminary ways to support population health and convenient medical care. In

addition to the aforementioned WeDoctor, many local health authorities are also experimenting with iPhone apps to promote healthy lifestyles, self-management of chronic disease, or adherence to clinical recommendations. And many are thinking of ways to enrich the benefit package associated with signing up for the family doctor system, to attract patients into first-contact care at the primary care level. Such services include not only access to specialist referrals when needed but also easier prescription refills, home-based care for the disabled, and so on. Ultimately it will be important to assess whether such programs do achieve better convenience and lower cost without sacrificing quality of care.

Health data platforms and application of AI to healthcare offer many possibilities for deploying big data to support increasing “healthspan” in China (e.g. through appropriate analysis and decision support tools); but they also must navigate patient privacy and data security issues, assuring that they not exploited for commercial purposes without individuals’ consent or official oversight. Here again progress had been rapid, but many issues remain to be addressed.

Unfortunately, there is not yet much rigorous evidence about the impact of improving primary care. Nevertheless, programs such as management of patients with hypertension and diabetes under the essential population health services package may provide a promising way forward. In a recent study with Yiwei Chen and Zhejiang colleagues, we analyze the impact of such a program that gives primary care physicians financial and reputational incentives to identify patients and enroll them in primary care management for their condition (Yiwei Chen et al. 2019). We assemble a unique dataset linking administrative and health data at the individual level for all registered residents of a county in Zhejiang province. The data include health insurance claims between 2011 and 2015 and primary care service records for over 70,000 rural Chinese diagnosed with hypertension or diabetes. Our study design utilizes variations in management intensity generated by administrative and geographic boundaries. Utilizing this plausibly exogenous variation, we find that patients residing in a village within a township with more intensive primary care management of chronic disease, compared to neighbors with less intensive management, had more primary care visits, fewer specialist visits, fewer hospital admissions, and lower inpatient spending. No such effects are evident in a placebo treatment year. Exploring the mechanism for reduced specialist and hospital utilization, we find that patients with more intensive primary care management exhibited better drug adherence as measured by medication-in-possession (e.g., the percentage of days in which the patient had a filled anti-hypertensive prescription in 2015).

These results suggest that physician incentives for improved primary care management led to better adherence to medications and primary care visits, and through that pathway reduced inpatient spending. A back-of-the-envelope estimate of welfare suggests that the resource savings from avoided inpatient admissions

substantially outweigh the public subsidy costs of the program, even if we ignore the value of any associated improvements in quality of life and survival.

Evidence from other programs would be valuable.

Incentives, organization, competition and market power

One tantalizing set of policy experiments in China involves health alliances or local integrated healthcare organizations based on formal mergers of local government-owned hospitals and primary care providers. Such integration initiatives may provide health benefits while slowing the rate of expenditure growth, although rigorous evaluation will be needed to see if that is the case. Such integrated care organizations usually unify the drug formulary for different levels of provider, so that patients do not have to go to tertiary hospitals to be prescribed specific medications or renew prescriptions (as had been an unfortunate consequence of the essential medication list policy as implemented in some areas). The next frontier may be in expanding coordination of health services with long-term care services for the elderly and disabled.

In these integrated care system experiments, one challenge will be to find the correct regulatory balance: strict, transparent oversight and regulation can be critical to uphold budget constraints and patient rights as well as to deter malfeasance; but on the other hand, flexibility and autonomy are needed for institutional innovation, and can be well justified as long as the organization is accountable for results. Sometimes the oversight and regulatory structures—such as the personnel employment system (*bianzhi*) or fragmented financing streams—stand in the way of innovations of considerable social value. Some well-intentioned policies lead to unfortunate distortions. For example, controlling spending by constraining per-visit expenditures and per-admission spending may seem intuitive and well designed, but it has unintended consequences: it gives incentive for providers to require more frequent, low-spending visits, with shorter drug prescriptions (and inability to substitute towards treatments that might promote longer-term treatment adherence and health). To avoid undue pressure to distort treatments for the more seriously ill, some places exclude chronic disease patients when reporting per-visit spending, removing the distorted incentives but leaving an incomplete picture of the resource use and effectiveness of cost control. Thus, simple metrics of per-visit or per-admission expenditures are no substitute for rigorous evaluations of whether reforms actually reduce the growth rate of overall medical expenditures.

Healthcare alliances appear promising in some respects, but it is not clear yet what their impact will be overall health outcomes and on disparities. Moving toward prepayment – such as adopting a global budget and/or capitation – does give incentive for prevention and investment in cost-effective settings for management, such as primary care. Yet there is need for balance and careful monitoring, because strong incentives to control medical expenditures also have important unintended effects,

including risk selection (turning away expensive-to-treat patients) and/or under-provision (stinting on care or withholding innovative treatments even when appropriate). The most vulnerable and disadvantaged could be most susceptible to these adverse impacts. Social tensions will also increase if only the rich can afford to “buy out” of under-provision by paying extra for better care. The hard-won trust in primary care could be soon undermined from the opposite direction: rather than (or in addition to) doubting the technical competence of community health centers or village clinics, patients may start to wonder if, in pursuit of lower spending, primary care providers will purposefully withhold referrals up to specialists (or accept a discharge back from a hospital too early). Therefore, reforms toward alternative payment systems and organization forms should be rigorously monitored and evaluated for impact on quality of care and access, especially for the most vulnerable patients.

Moreover, integration of all government-owned providers in a given district or county in effect creates a local monopoly. Although the role of competition in healthcare is controversial, relatively robust evidence suggests that patient choice (provider competition) in a well-regulated system can lead to improvements in quality (e.g. Bloom et al. 2015). Policymakers should be cautious in endorsing claims that local monopoly care organizations can better coordinate care and improve outcomes while controlling spending.

An integrated provider may excel by streamlining services, better coordinating care and investing in efficiency improvements – such as through centralizing procurement, logistics, human resources, and other operations—as well as promoting the appropriate site of care. However, new monitoring and evaluation systems will need to be put into place to make sure these local monopolies live up to social expectations. Those involved may call for mandatory within-network treatment, forced gatekeeping, and not making the local integrated care organization responsible if the empaneled patients seek care elsewhere. While it is true that many health systems have this feature, they also have substantial safeguards in place. There is a social value of allowing patients to “vote with their feet”, even if that means providers cater to patient-observable dimensions of care and not technical quality of care. Evidence from the UK, for example, clearly links competition for patients to hospital management quality (Bloom et al. 2015). When integrated networks or primary care providers must compete to attract patients with the services they provide, this offers a counterbalance to under-provision, and gives policymakers a key feedback loop for monitoring whether providers are truly meeting people’s needs. Moreover, private providers may be squeezed from the market, and without any regulatory structure on ownership and competition or anti-trust, the negative sides of this organizational structure may come to outweigh the benefits if not managed carefully. The success of integrated networks in China will depend on how well policymakers achieve this balance. Moreover, these policy initiatives may achieve few lasting results unless they are subject to rigorous evaluations.

Continuing tensions within the system also need to be addressed. For example, physician-patient conflicts have erupted into violence, and it remains unclear whether after COVID-19 these tensions will resume at similar, mitigated, or potentially even worse levels (especially if many young people are discouraged by the crisis from seeking careers in medicine). Consider, as one illustration, a recent study by Jinlin Liu about workplace violence against healthcare workers in tertiary public hospitals in west China (Liu 2020). Analyzing survey data from over 3000 healthcare workers in 2018-19 from six tertiary public hospitals in west China, he finds workplace violence against healthcare workers increased (from 23.3% to 45.0%) and was significantly associated with job burnout, higher likelihood of turnover, and with discouraging one's own children to go into medical care as a profession. The analysis suggests that patients' lack of trust in healthcare workers, poor communication between patients and healthcare workers, and inadequate laws regarding medical disputes were the top three factors, perceived by healthcare workers, that affected their relationship with patients.

Like in many other health systems, pharmaceutical pricing and distribution in China remain controversial and targets for punishing illegal activities such as price monopoly, price fraud, and unfair competition. China has undertaken significant policy reforms to remove the mark-up on pharmaceuticals that used to generate a large share of hospital and clinic revenues, and policy continues to try to squeeze out drug profit margins as a way to reduce spending growth. While part of the goal is laudable, it will not obviate the need for difficult trade-offs in promoting efficiency and innovation, systematically evaluating new technologies, and prioritizing public health and primary care to reduce disparities.

China's health service delivery system is overwhelmingly government-owned and managed. However, in recent decades authorities have not only allowed but even encouraged investment from non-state sources, both for medical care and for long-term care services. In many regions and segments of the medical services markets, private providers constitute a nontrivial albeit definitely still minority share of service. For more on mixed-ownership health service delivery and engagement of the private sector in China, compared to the US, see Eggleston, Donahue, and Zeckhauser (2020).

For example, the "Law of the People's Republic of China on the Promotion of Basic Medical and Health Care" to go into effect June 1, reiterates promotion of private sector engagement in health services, while strengthening regulation and prohibiting specific kinds of joint ventures.¹¹ The government has previously specifically encouraged private sector investment and public-private partnerships for elderly care (e.g. "PPP prioritizes supporting three major sectors in the field of elderly care

¹¹ "Joint ventures building up new hospital districts or branch hospital models (e.g. "Wei Zexi Event" in 2016, "Ningxia Military Region General Hospital Incident" in 2017) will be prohibited by the Law, and thus such cooperation will face repositioning and adjustment."

services” 2017), encouraging PPP in the construction of elderly care institutions, community care systems, and “integrated development of medical care and health.” For an overview of these policies and examples of “collaborative governance, Chinese style” in long-term care, see the healthcare chapter in Eggleston, Donahue, and Zeckhauser (2020). Others also provide related cases and studies. For example, Zhang (2018) discusses a demonstration project in community elder care illustrating how PPP operation models are being tailored to local conditions.¹²

Public-private engagement in the health sector can be vital for addressing social needs, as perhaps well illustrated by the current pandemic. Development of a health service and research ecosystem can be key to an “all hands on deck” approach to developing a vaccine or innovating in social and economic policy to mitigate the costs of lockdown or physical distancing, without too deeply and permanently scarring our societies in other ways. Private connections also link the global scientific community and its cooperation. Within weeks of the first cluster of cases, Chinese researchers had released the genomic sequence of the virus. Such prompt data sharing enabled vaccine candidates. According to the Coalition for Epidemic Preparedness Innovations (CEPI), there are at least 8 promising vaccine candidates, with some in early clinical trials and some may be ready within a year. None of that would have been possible without international scientists’ culture of data sharing, careful but prompt review of evidence, and collaboration among public and private sectors to get the job done.

Innovations may prove life-saving not only for re-opening global supply chains to support the healthcare response (PPE, ventilators, masks, pharmaceutical ingredients, food, etc), but also innovations that can enhance the ability of societies to leverage civil society and public-private partnerships for the broader social good, to help the poor and vulnerable, to assure that a vaccine once developed is widely and equitably available; and to restore treatment for other urgent health conditions, avoid “deaths of despair” (Case and Deaton) and a devastating mental health toll, or even starvation from the loss of livelihoods in low-resource settings. China’s strengthened health system, compared to SARS or earlier public health crises, along with industry and research capacities, have enabled a more resilient response than would otherwise have been the case.

Turning more directly to the question about technology during the pandemic, let me offer a few brief observations.

¹² Yu and Lu (2015) discuss some case studies. Wang and Zhang (2019) find that Chinese respondents appear generally willing to pay reasonable fees for primary health care services or for improved therapies in private healthcare or PPPs.

Technology and COVID-19 control -- and beyond

China's government and private sector have utilized many technologies in response to the crisis, which, like elsewhere, may continue to play a much larger role in the healthcare system in the future. A prime illustration is telemedicine and "internet-plus" healthcare. For example, China's WeDoctor launched a platform for doctors to provide online consultations, psychological assistance and other services, making it possible for people to consult with a doctor at home during COVID-19.¹³ Others have long observed development of technology-enabled home-care for the elderly (e.g., Cao et al 2016). Recently, Qi Xiaoxia, Director General, Bureau of International Cooperation, Cyberspace Administration of China, has argued that China's leveraging of multiple technologies in the efforts to curb COVID-19 portend broader use of these technologies in the future as well, with examples including the following:

- AI: Baidu Research open-sourced LinearFold (its linear-time AI algorithm), to epidemic prevention centers, gene testing institutions, and global scientific research institutions.
- Big data: Qihoo 360 released "Big Data Migration Map" this past February which users can access through mobile phones or computers to help understand and predict changes in the epidemic situation nationwide.
- Cloud computing: Alibaba Cloud made its AI computing power available to public research institutions around the world for free to accelerate the development of new pneumonia drugs and vaccines.
- Blockchain: Lianfei Technology launched the nation's first blockchain epidemic monitoring platform, which can track the progress of COVID-19 in all provinces in real time, and register the relevant epidemic data on the chain so that the data can be traced and cannot be tampered with.
- 5G: China Mobile opened 5G base stations at Huoshenshan and Leishenshan hospitals, providing real-time views of the construction.¹⁴

In the future, China as elsewhere (e.g. South Korea, Singapore) will probably continue to roll out and deepen technologies for contact tracing during the remainder of the COVID-19 pandemic, with differing levels of social debate about the trade-offs between civil liberties and intrusiveness on privacy, on the one hand, and benefits of real-time contact tracing and containment of epidemic spread, on the other. China has seen some objection to widespread technology deployment in everyday life – such as a lawsuit against requiring face scanning for park annual passes – but whether the

¹³ People's Daily Online. "Internet plus healthcare' platforms assist fight against COVID-19 at home and abroad." *People's Daily Online* (2020).

<http://en.people.cn/n3/2020/0408/c90000-9677073.html> (accessed April 18, 2020).

¹⁴ Qi, Xiaoxia, "How next-generation information technologies tackled COVID-19 in China," World Economic Forum, <https://www.weforum.org/agenda/2020/04/how-next-generation-information-technologies-tackled-covid-19-in-china> [accessed April 12, 2020].

current crisis will permanently shift that debate remains to be seen. Certainly, the integration of telemedicine and other technologies for healthcare and elderly care will continue to develop, with the potential of either increasing or ameliorating the current disparities within China's health system.

More broadly, the response to COVID-19 in China and its devastating impacts around the globe will leave an indelible mark on health policies for decades to come, not only in terms of technology adoption but also organizational innovation and hopefully, prioritization in resource allocation to safeguard and undergird the rest of the “China Dream” (or “American Dream” for that matter). Clearly this crisis is a test of governance – policymakers have stated as much. Unprecedented measures have been successfully implemented to contain the virus spread, and the PRC health system is much better prepared than during SARS. But China's society and economy are also not the same as at the turn of the century. Dismissal of officials clearly shows that not everyone believes no mistakes were made along the way. Sometimes health systems can only be as strong as their weakest link. Commitment to strengthening the weakest links in the future – that would be a fitting tribute to the victims of the COVID-19 outbreak, from Li Wenliang to the many less well-known others. Perhaps in the future renewed investment and innovation can diagnose and effectively treat health system weaknesses, just like scientific cooperation about the SARS-CoV-2 virus itself. Maybe China will champion renewed commitment to evidence-based, scientific study of health systems – leveraging new technologies to strengthen prevention; address the root causes the patients' ubiquitous lament, “getting healthcare is difficult and expensive” (*Kan bing nan, kan bing gui*) and the sometimes tense physician-patient relationship in China; and invest in cost-effective, high quality primary care and two-way referral systems that can promote healthy lives for every Chinese citizen, including the rural, poor and vulnerable.

- How has China's healthcare system developed in recent years to cope with an aging population?

Through the last four decades, China has benefitted from a demographic dividend caused by the large bulge in the working-age population. To achieve future economic growth, however, it will need to increase investments in health and education -- two sides of human capital — to promote innovation and boost productivity in the Chinese economy. Higher productivity will in turn be the means by which a smaller workforce can support China's large and growing cohort of retirees, for which the health system needs to adapt.

China's current population and demographic trends — including relatively rapid aging — reflect the success of earlier investments in infectious disease control, public health measures, and other contributors to mortality reduction, as I argue in the chapter I contributed to the volume *Fateful Decisions* (Fingar and Oi 2020). China's

total fertility rate declined from approximately 6 in 1950–55 to around 2 in 1990–95. It has been below replacement level for about a generation. The most rapid decline was in the 1970s, prior to adoption of the one-child policy. The dependency ratio declined by more than a third during the past three decades, primarily because of the reduction in youth dependency. Large cohorts in the working ages have contributed substantially to economic growth but are now moving toward retirement. China’s population in the age category of fifteen through sixty-four has begun to decline and is projected to decrease to a little more than eight hundred million by the one hundredth anniversary of the People’s Republic of China in 2049. Over the same period, the sixty-five and older population will likely reach about three hundred and fifty million. By 2050, China’s “oldest old”—those eighty years and older—will represent the same share as the sixty and older population did in the 1960s and an absolute number greater than the current population of France. The proportion of China’s population age sixty and older is projected to more than double over the next three decades, reaching 33 percent in 2050.¹⁵

The lingering effects of family planning policies, historic preferences for sons, and rapid economic development are also major considerations. Together, these factors have produced a shrinking working-age population, a growing number of older adults, a gender imbalance, and hurdles for inclusive urbanization.

Compared to Europe and North America, the demographic transition from high to low fertility and mortality has been more rapid in China, like much of East Asia. That means social institutions, such as retirement, living arrangements, and intergenerational support, have to adapt quickly.¹⁶ For example, extending work-lives will be necessary but *feasible* only if the added years are healthy ones, and *equitable* only if the least advantaged also benefit from healthy aging. The blessings of longevity dim when clouded by pain, disability, and loss of dignity. An urgent question for China’s future is to what extent policies will ameliorate disparities in health, healthcare use, and burden of medical spending.

Retirement also interacts with health insurance policies. Several studies present mixed evidence on the relationship between retirement and healthcare utilization. In Zhou, Eggleston, and Liu (2020), we explore the causal effect of retirement on outpatient and inpatient care utilization among urban workers in a megacity of China, using a fuzzy regression discontinuity design. Our results indicate that retirement significantly increases annual healthcare expenditures due to more intensive use of outpatient care at retirement, especially at the right tail of the distribution of outpatient visits. This increase in outpatient care use appears to stem from a decline in patient cost sharing and the reduced opportunity cost of time upon retirement, not from any sudden impact on health.

¹⁵ Eggleston chapter in Fingar and Oi (2020)

¹⁶ Eggleston 2020, *Healthy Aging in Asia*.

As I argue in Eggleston (2020), raising the retirement age will continue to be controversial – perhaps especially so with the pandemic-caused economic downturn and recovery, giving a ready excuse to avoid older workers (and/or women, seen as primary home care providers). But “nudging” Chinese to embrace longer work-lives for both men and women is urgent. The triumph of longevity threatens the fiscal integrity of pension systems and other social support programs disproportionately used by older adults. Policies are also needed in rural China to ease the transition of families strained by migration and work pressures, and to support the adult children who wish to fulfill roles of filial piety for parents left behind in rural areas or those already relocated to the city with them.

Chronic disease control and healthy aging¹⁷

While strengthening infectious disease control, China’s primary burdens of morbidity and mortality arise from chronic diseases; thus, the focus of much effort to address health inequalities and raise overall population health continues to be enhancing control of chronic disease. China has implemented National Demonstration Areas for Comprehensive Prevention and Control of Non-Communicable Diseases, which include some promising ideas for enhancing collaboration across multiple agencies and sectors. Such intersectoral coordination can be critical to address the social determinants health, reduce risk factors, and integrate health education and promotion with effective screening and management of chronic disease. One important step forward for healthy aging would be a renewal of China’s commitment to tobacco control, the leading preventable cause of premature mortality. For example, using an earmarked increase in tobacco taxation to invest in health promotion for rural and low-income China would be a win-win policy reform, compensating for the regressivity of such taxation, and perhaps help to close the longevity disparity between men and women as well.¹⁸

Moreover, primary care management of chronic disease is especially important for China’s older population, meriting experiments with evidence-based methods for tracking progress. For example, in the *Healthy Aging in Asia* (2020) chapter entitled “Avoidable Admission Rates for Diabetes Patients and Associated Medical Spending in Rural China,” Min Yu of the Zhejiang provincial CDC and co-authors note that diabetes poses a critical public health issue in many countries, especially for health systems ill-prepared to manage chronic disease within primary care. China’s efforts to

¹⁷ This section draws from Eggleston 2019 and Eggleston, Donahue and Zeckhauser 2020 chapter on healthcare.

¹⁸ For more discussion on tobacco taxation and the political economy of this industry in China, see *Poisonous Pandas: Chinese Cigarette Manufacturing in Critical Historical Perspectives*, edited by Matthew Kohrman, Gan Quan, Liu Wennan, and Robert N. Proctor, Stanford University Press, Stanford, California, 2018.

strengthen population health and primary care management for diabetes, especially in rural area, deserve careful study and benchmarking to international experience to inform further progress. Improved prevention and control may not only improve health and quality of life for patients, but also potentially save resources by reducing avoidable hospital admissions. The authors propose age- and sex standardized medical expenditures on avoidable admissions as a useful metric.

Long-term care for the frail elderly

According to the "Thirteenth Five-Year Plan for the Development of Civil Affairs" (2016) and previous precedents, China seeks to develop a robust "multi-level old-age care service system" based on home care for most, supplemented by community-based support and medical care, and with institutional or residential facilities for the most frail individuals in need of regular support with activities of daily living (eating, bathing). Accordingly, policies such as the "Notice on the establishment of a subsidy system for the elderly at the national level" (2016) encouraged all localities to "introduce policies such as old-age allowance, old-age service subsidies, and nursing subsidies as soon as possible in accordance with local conditions, and do a good job in the assessment of the elderly, gradually improve the subsidy standards and coverage."

China's current policies seek to balance individual responsibility, community support, and taxpayer redistribution through safety-net coverage funded by central and local governments. Like many countries, China would benefit from improved coordination across multiple agencies and structure incentives to avoid or mitigate unintended consequences that undermine the goals of its health system. Recent governance reforms, such as the creation of the National Healthcare Security Administration, aim to address these challenges.¹⁹

Most recently, in light of COVID-19 and its severe threat to institutionalized elderly populations, China's authorities have tried to modify policies to support the vulnerable, though it is not clear how successful that has been or will be if there are second and third waves of infection before a vaccine is readily available. According to Xinhua April 28th, "China has urged efforts to resume services of elderly care institutions in an orderly manner while strengthening epidemic prevention and control, according to a recent circular jointly issued by five authorities, including the Ministry of Civil Affairs and the National Health Commission. Safeguarding the life safety and health of elderly people living in elderly care institutions and supporting the normal operation of elderly care institutions have also been stressed by the circular. The establishment of a national rating system for elderly care institutions was underlined, according to the circular. It also emphasized the importance of improving safety management and the nursing service of elderly care institutions."²⁰ The mention of the

¹⁹ Eggleston 2020 in Fingar and Oi.

²⁰ <http://en.people.cn/n3/2020/0428/c90000-9685027.html> [accessed 28 April 2020].

‘national rating system for elderly care institutions’ warrants underscoring, because such a rating system – like Nursing Home Compare in the US,²¹ the Japanese government dataset *Kaigokensaku*,²² and others around the world – represent important efforts in China to standardize and improve the quality of long-term care services.

Similar policies and notices emphasize the “leading role of the government in supporting the development of home and community elderly care services, and ... in implementing preferential policies such as access, finance, taxation, and land.” The link to medical care is recognized in calls for hospitals to establish gerontology departments to improve the diagnosis and treatment of geriatric diseases.

Financing long-term care for China’s aging population remains a critical issue, building upon ongoing pilots that draw funds from the medical insurance schemes and government allocations in different ways.²³ See for example the "Outline of the 13th Five-Year Plan for Human Resources and Social Security" (2017), which called for “explor[ing] the establishment of a long-term care insurance system, and carry[ing] out long-term care insurance pilots.” This critical arena of financing for long-term care is inextricably linked to issues of pensions in China, an important area that largely falls outside the scope of my testimony. However, China’s recent rural pensions merit mention for their impact on old-age support and potentially reducing disparities. Multiple studies have shown the positive impact of improved old-age security for China’s rural elderly by assessing the impact of the rural pension scheme. The new rural pension scheme, although far less generous than urban schemes, enables beneficiaries to take care of own health and medical care and long-term care needs a little better, and to be less dependent on sons and other adult children, perhaps even contributing to reduced mortality.²⁴

While the better-off urban population has several options for in-home and institutional care to supplement family informal care, those in rural areas and/or with few resources have fewer options. Moreover, wealth and educational disparities reinforce health disparities: those achieving greater educational attainment able to command higher wages, achieve higher lifetime wealth, enjoy more security in retirement while

²¹ <https://www.medicare.gov/nursinghomecompare/search.html>

²² <http://www.kaigokensaku.mhlw.go.jp/>.

²³ This summary draws from Eggleston 2019 and the sources cited therein.

²⁴ See for example “The Power of Social Pensions” by Wei Huang, National University of Singapore, and Chuanchuan Zhang, Central University of Finance and Economics, presented at the NBER-SAIF conference on retirement security, Shanghai, PRC, June 30, 2018; Xi Chen, Karen Eggleston, and Ang Sun, 2017. “The Impact of Social Pensions on Intergenerational Relationships: Comparative Evidence from China,” *The Journal of the Economics of Ageing*. <http://dx.doi.org/10.1016/j.jeoa.2017.04.001>; and Karen Eggleston, Ang Sun, and Zhaoguo Zhan, 2016. “The Impact of Rural Pensions in China on Labor Migration.” *World Bank Economic Review* July 2016: DOI: 10.1093/WBER/LHW032.

still investing in their children. Healthy aging enables longer working lives and thus also helps to finance the health services that lead to healthy aging (just as longer working lives lead to more sustainable social security/pension financing as well). Zhang and Ji (2018) document significant differences across cohorts in financial planning, with many relying exclusively on family.

Housing and the built environment are also important for health across the lifespan and in promoting healthy aging. As China continues to urbanize rapidly, affordable housing and linking to accessible community health services and affordable long-term care services remain challenges.

China has developed quickly and population aging is more rapid than in many of the current high-income countries such as the US. One implication is that the current elderly grew up in much poorer circumstances than their children and grandchildren, and may face particular difficulties in remaining healthy into old age and providing for their own care. Future cohorts of elderly in China, similar to Japan, Korea, or Singapore, will benefit from better life circumstances and perhaps a “compression of morbidity” to be healthier as well as live longer. Many demographers have studied these patterns. For example, Zhang, Feldman and Du (2019) find significant cohort differences in change in activities of daily living (ADL) among the oldest-old. Different levels of poverty, childhood experiences and living environments affect ADL change trajectories and contribute to cohort differences.

Recommendations for congress regarding the development of China's healthcare system and its implications for the United States

It is in the interest of Americans and Chinese to have a strong, resilient healthcare system in China. Constructive policies in support of health system improvements in both countries could strengthen the global capacity to control future pandemics and avoid the devastating social and economic effects of future outbreaks on the scale of COVID-19. The US government should also encourage China and its scientists and firms to work collaboratively with multilateral efforts like CEPI to leverage technology to prevent and control future pandemics.

Carefully designed and thoroughly evaluated policies, including those leveraging artificial intelligence and e-health technologies for prevention and accessible medical care, can support the vulnerable and help to close the health gaps that inhibit full realization of China's potential. The US should re-emphasize scientific, evidence-based health policy and regulation, and encourage China to do so as well.

Other recommendations include

- Support and prioritize efforts to **strengthen primary care** and population health interventions with proven cost-effectiveness.
- Share experiences with regional, community-based efforts to address the **social determinants of health** and promote multi-sector policies for healthy aging.
- Support health education and programs specifically **for disadvantaged populations** such as migrant workers and their children, or rural poor and elderly.
- Do not forget **mental health** among chronic diseases and support Chinese scientists, clinicians, and policymakers in efforts to address stigma and support better mental health service access and outcomes.
- Support China's policy efforts to define and regulate the fledgling private sector in service delivery that is categorized as **not-for-profit**, and share experience about how to define and make accountable for "**community benefits**" in exchange for profit exemption.
- Encourage **public-private collaborative governance** arrangements to strengthen the health sector in China, noting that the profit motive should be aligned with social benefits to yield most productive outcomes, and that government-owned and managed providers and insurers are not immune to problems of inefficiency and market power. Work with local and central authorities to fill their demand and encouragement of private sector engagement in healthcare and elderly care, sharing experiences with monitoring and regulating quality – an area where both China and the US wish

to improve (and tragic cases of COVID-19 spread in nursing homes has underscored the need for greater oversight).

- **Technologies** such as AI in health and long-term care should be developed, while taking into account different political and legal contexts in each country for balancing privacy and civil liberties with technology-enabled conveniences of daily life.
- Encourage transparent peer review of research and **international collaboration** between Chinese and American scientists, medical educators, health systems researchers, and technology developers (e.g. for vaccines, low-cost and new medicines such as for Alzheimers or other dementias), while supporting transparent enforcement of intellectual property rights and appropriate human subjects research oversight, and so on.
- Support **Chinese students studying in the US, and encourage US students to study in China and learn Mandarin**, with exchange of talent under transparent and reciprocal policies, including for medical education, clinical training, and related fields such as epidemiology, health economics, biology, and human-centered AI for healthcare and long-term care.
- Promote China's efforts to strengthen **medical education** curricula and residency training programs, especially to scale up GPs and recruit/retain qualified personnel in rural areas, by perhaps offering scholarships for students that commit to working to address disparities.
- Support China's efforts to **upgrade healthcare administration** management, from previous assumption that medical doctors could become managers without extra training, towards what has already been achieved by the top-level MBA and health management attained in some of China's leading (and very large) urban tertiary hospitals.
- Share case studies of US community and health system experiments with **integrated care and fostering patient-centered care**; these may offer useful lessons as Chinese strives to develop "two-way referral" systems and integrated care. Americans should keep an open mind about learning from Chinese experience as well, especially regarding organizational/technological innovations for developing lower-cost approaches to healthcare and long-term care. The time for patronizing assumptions about one-way learning is long behind us.
- **Encourage randomized controlled trials of traditional Chinese medicine**, and other science-based evaluations of herbal remedies.
- Work in conjunction with OECD partners in a **multilateral approach to support China's healthcare ecosystem development**, looking for reciprocity and pushing for openness while accepting that health systems all must be tailored to domestic conditions to some extent.

- Support China’s efforts to develop more robust **systems of malpractice regulation and accountability for quality care**, as well as address physician-patient tensions.
- As China now is implementing alternatives to fee-for-service provider payment, including **DRG** roll-out, US should offer its rich **experience with bundled payment**, managing selection, supporting transparency and accountability. These next five years present a window of opportunity to share business operation experience without advocating the dysfunction that has gripped parts of the US health system. If DRG roll-out in China further undercuts patient trust in physicians and quality, then it could exacerbate physician-patient tensions and undermine the substantial progress with increasing access to care and raising quality in China’s health system.
- Share American experience with **risk adjustment** and other strategies to try to equitably pay providers and reward them for their “value added,” accounting for the differences in case mix of patients served. China is developing this apparatus, leading to opportunities for mutually beneficial exchange of research, procedures, software, and community feedback.
- Monitor the **quality and transparency of the pharmaceutical supply chain** – do not single out China, but hold to same global standards of inspections etc. as other global suppliers in Europe, India, and elsewhere. Completely “decoupling” supply chains for health and medical products is unrealistic and would be to the detriment of the American people; rather, productive engagement to assure supply and quality, with contingency plans for future pandemics, would be prudent.

The US may promote mutual policy learning in several important areas, such as tobacco control and firearm safety. US authorities can proudly share their experience with recovering the large amount of funds that tobacco causes in terms of higher healthcare expenditures. While specific to the US economic and legal context, the Master Settlement Agreement (MSA)—in which major tobacco companies agreed to compensate most states for Medicaid expenses—could provide a useful basis for experts in both countries to simultaneously improve population health and meet China’s government’s growing need for expenditures to support improved access and quality of healthcare for all Chinese citizens. For example, Cutler et al. (2002) study the MSA economic implications using data from Massachusetts. They find that the financial compensation states received was substantial, yet “dwarfed by the value of the health impacts induced by the settlement.... The value of health benefits (\$65 billion through 2025 in 1999 dollars) from increased longevity is an order of magnitude greater than any other impacts or payments.” (Cutler et al. 2002, p.1). Thus, the scientific and legal case of the MSA in the US could provide a useful basis for helping tobacco control advocates within the government of China and in non-government organizations to achieve the mutually reinforcing benefits of (1) lower

medical spending on tobacco-caused harms and (2) longer, healthier lives as called for in “Healthy China 2030.”

In return, perhaps China and other countries could share their positive experience with firearm safety (aka gun control) as a public health priority for mitigating the harms from firearms in the United States, an international outlier (see Rivara et al. 2018). What can we learn from each other about how to reduce premature mortality from tobacco and guns? China, Japan and Singapore have been relatively successful at the latter, while male smoking remains high. Certainly, the political economy of tobacco control in China and of firearm safety in the US are similarly fraught, with conflicts of interest between the industry and its interest groups on the one hand, and population health and its advocates on the other. Those interests have spilled over into constraints on regulation and research that prevent health researchers and advocates from fully realizing the benefits of tobacco control and firearm safety for reducing premature mortality in both of these great nations. The governments should support each other in breaking through this impasse in the interest of better health of Chinese and Americans alike.

The US should also work collaboratively with their Chinese counterparts to address regional issues of population health importance. These would include, for example, addressing health problems in the DPRK (malnutrition, MDR tuberculosis), working with southeast Asian neighbors on health issues, and integrating public health priorities into China’s Belt and Road Initiative.

Moreover, the US should support Chinese authorities in their laudable efforts to address climate change domestically and in the region, helping to achieve the co-benefits of green growth and better health (e.g. smart cities with green space and excellent public transportation to reduce air pollution, promote exercise, and foster healthy aging). US companies active in developing technologies for sustainability and green growth should actively collaborate with Chinese companies in leveraging those developments for improved health, given the strong link between planetary health and human health.

In all our policies and interactions, we should remember that China is large and diverse, not just the urban metropolises of Beijing and Shanghai; many important decisions in health policies as in other policies are undertaken by local government agencies. The “Chinese people” are not synonymous with any given leader, just as the “American people” are not synonymous with any given leader. Avoid politicizing the COVID-19 pandemic and other health and humanitarian issues. In other geopolitical considerations in bilateral US-China relations, uphold US interests while encouraging the PRC to be active as a globally responsible stakeholder. Be careful not to state or imply that the US seeks to contain or undermine the Chinese people’s aspirations for longer, healthier, thriving lives, with dignity and respect.

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Eggleston USCC Testimony: Figures – China’s health system in international comparison

Overview of health outcomes and health behaviors

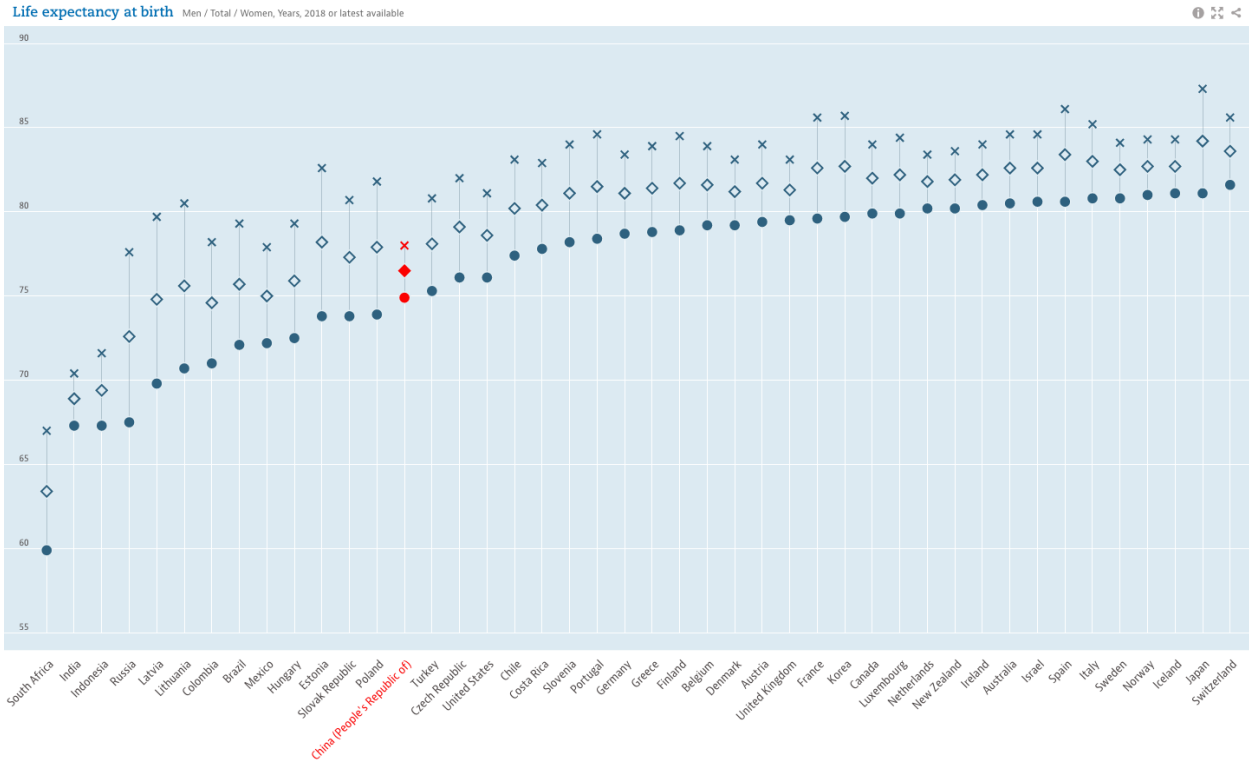


Figure 1. OECD (2020), Life expectancy at birth, 2018. doi: 10.1787/27e0fc9d-en (Accessed on 22 April 2020)

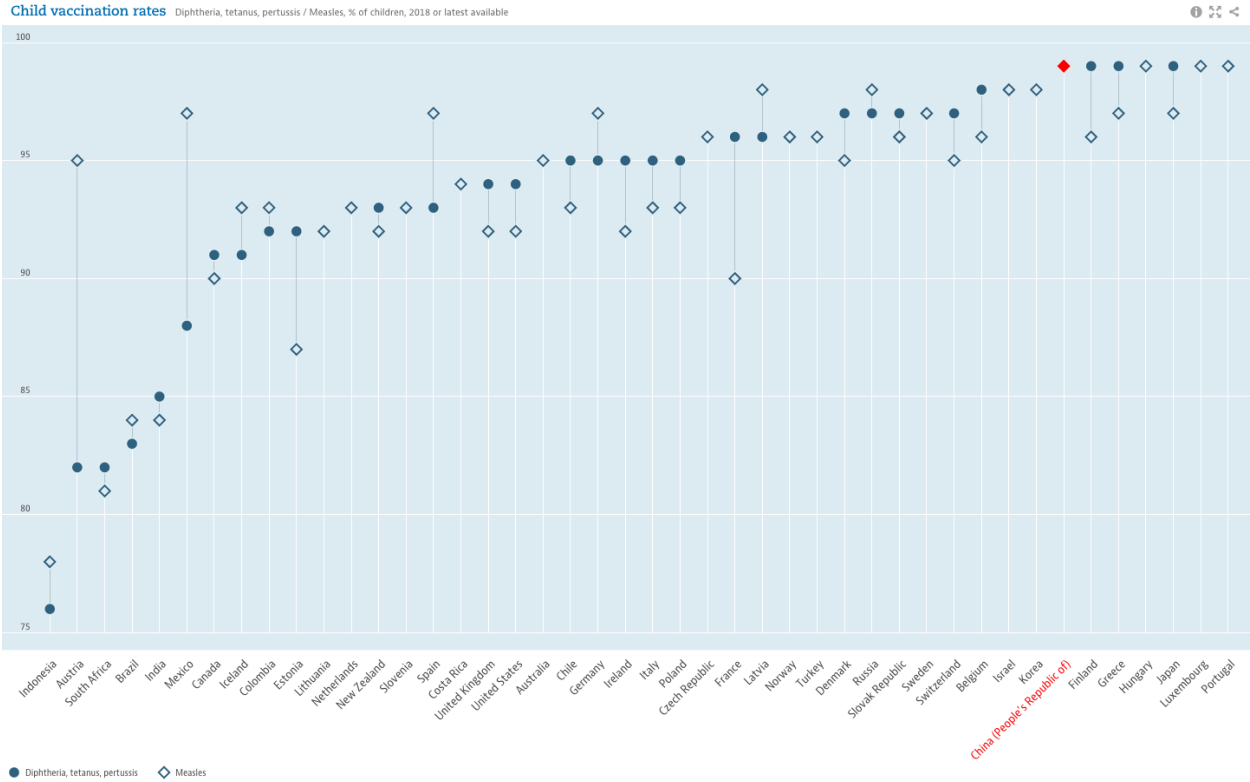


Figure 2. OECD (2020), Child vaccination rates, 2018. doi: 10.1787/b23c7d13-en (Accessed on 22 April 2020)

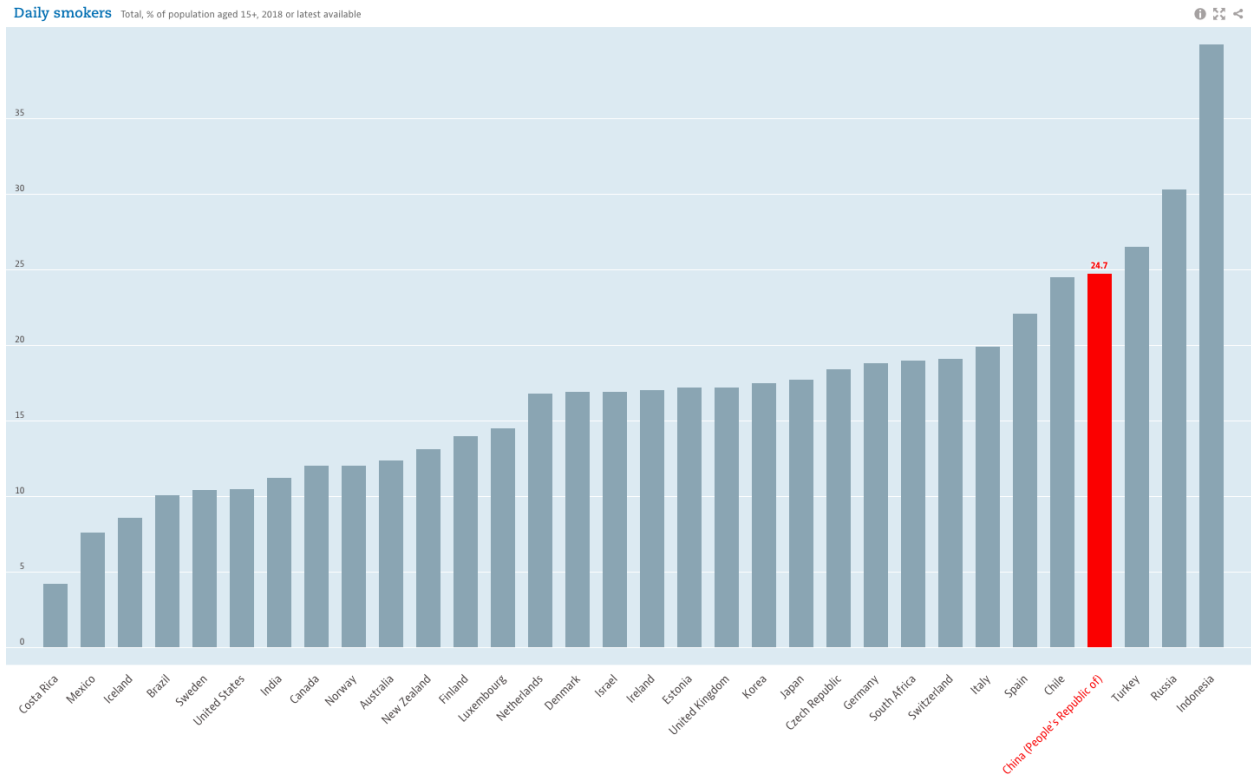
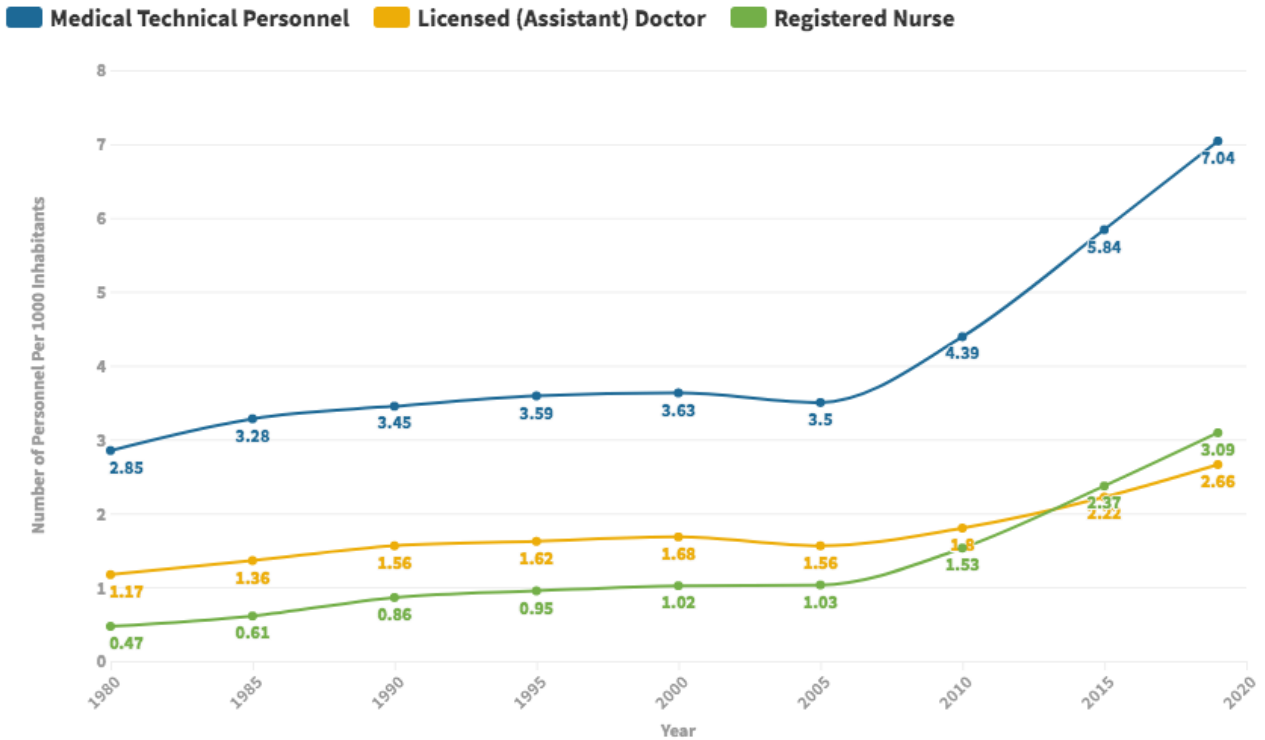


Figure 3. OECD (2020), Daily smokers, 2018. doi: 10.1787/1ff488c2-en (Accessed on 22 April 2020)

Health service delivery system

Medical Technical Personnel per 1000 Inhabitants in China, 1980-2019



Source: China Statistical Yearbook 2019. National Bureau of Statistics of China

Figure 4. Skilled health professionals per 1000 population in China, 1980-2019. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China, accessed April 22, 2020. <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

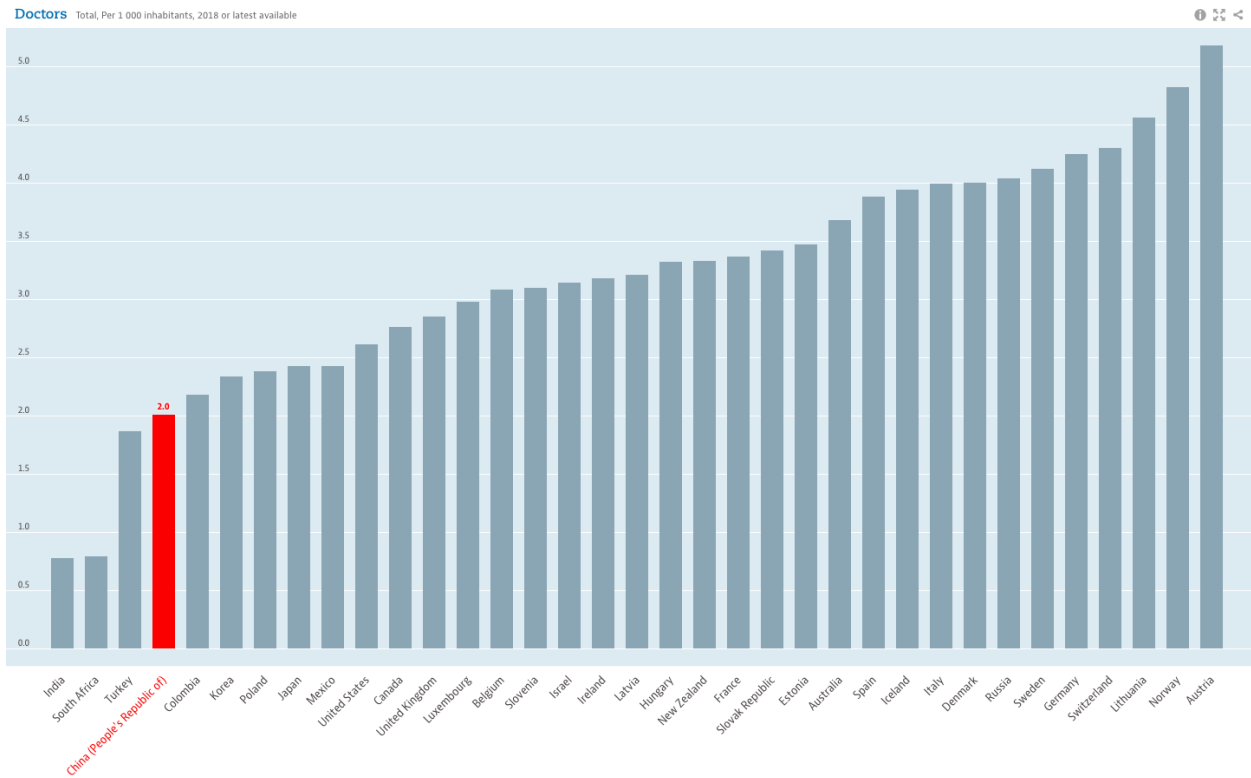


Figure 5. OECD, Doctors per 1000 residents, 2018. doi: 10.1787/4355e1ec-en (Accessed on 22 April 2020)

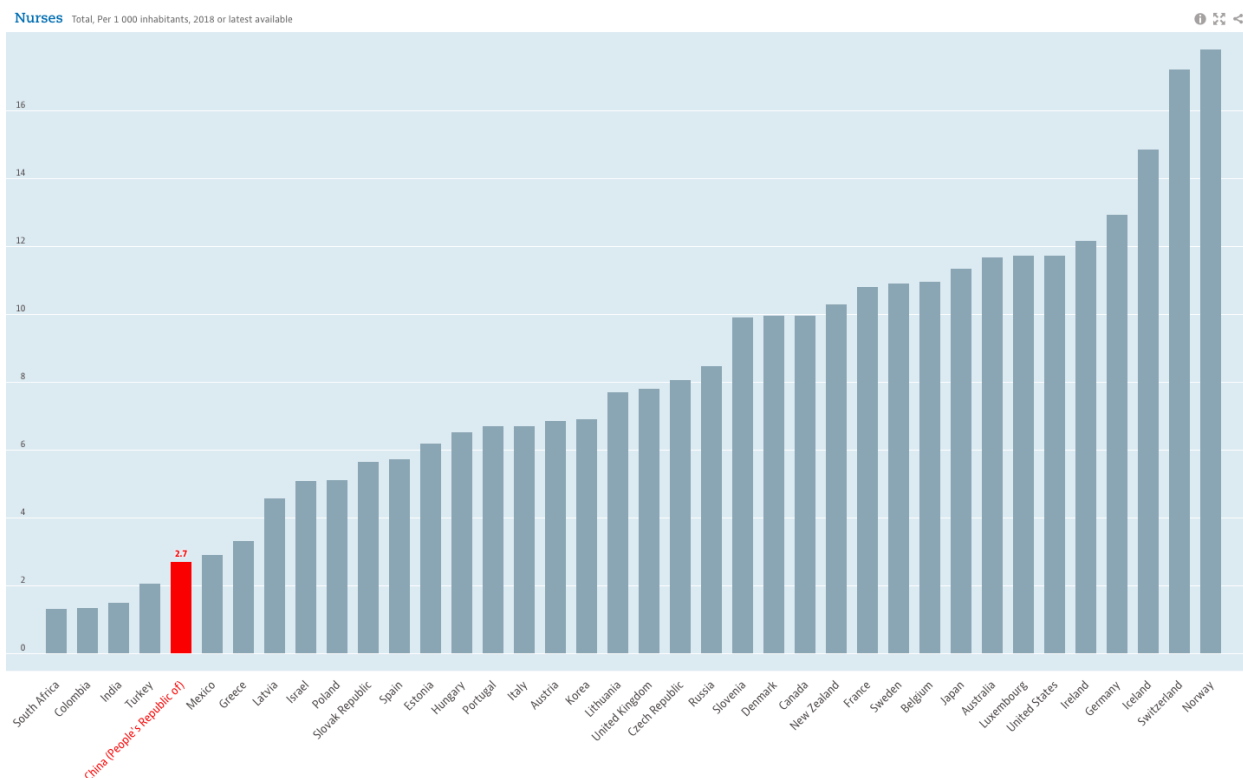


Figure 6. OECD, Nurses per 1000 residents, 2018. doi: 10.1787/283e64de-en (Accessed on 22 April 2020)

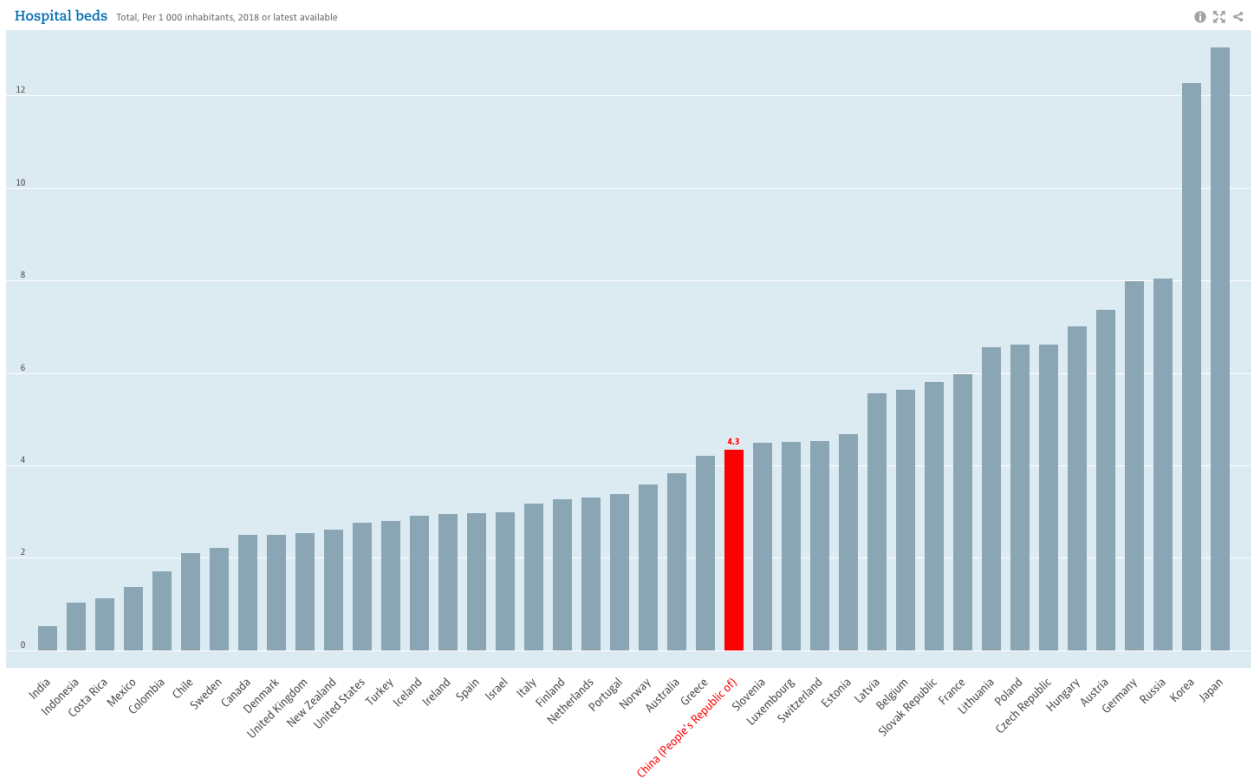
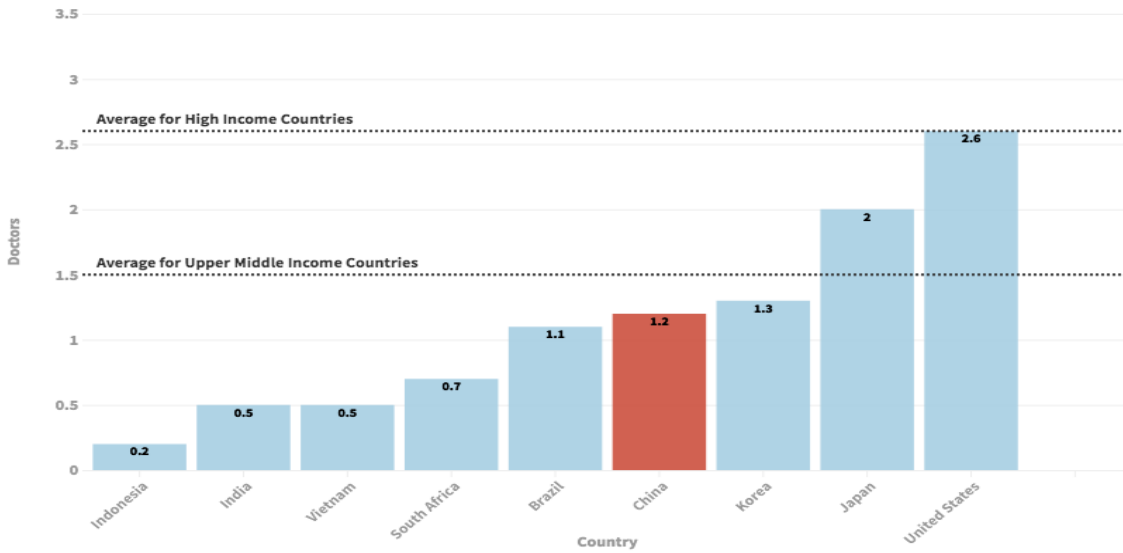


Figure 7. OECD, Hospital beds per 1000 residents, 2018. doi: 10.1787/0191328e-en (Accessed on 22 April 2020)

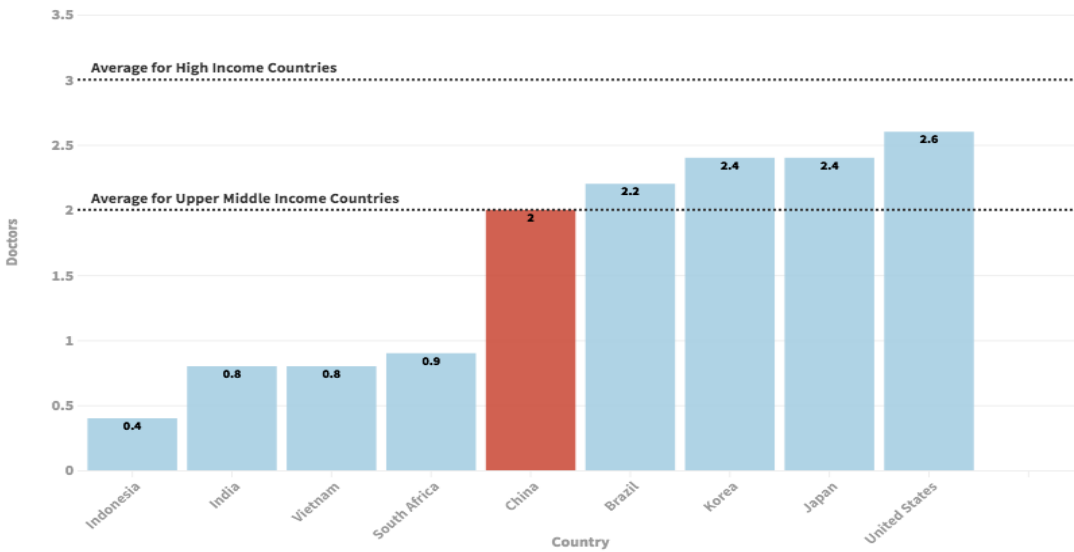
Doctors per 1000 Inhabitants, 2000



Source: The World Bank, World Development Indicators

Figure 8a. Doctors per 1000 residents, 2000. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020.

Doctors per 1000 Inhabitants, 2017



Source: The World Bank, World Development Indicators

Figure 8b. Doctors per 1000 residents, 2017. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020.

China's Skilled Healthcare Workforce (Doctors, Nurses, Midwives): Liu and Eggleston (2020)

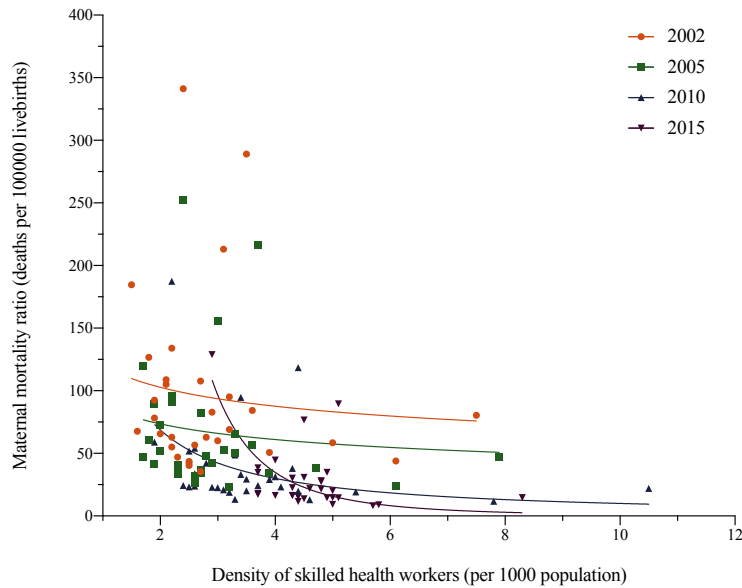


Figure 9a. Scatter plot of maternal mortality ratio and density of skilled health workers in China (2002, 2005, 2010, 2015) (log-log curve)
 Sources: Liu and Eggleston (2020) analysis of data from China Health Statistical Yearbook (2003~2016) and the Global Burden of Disease estimates

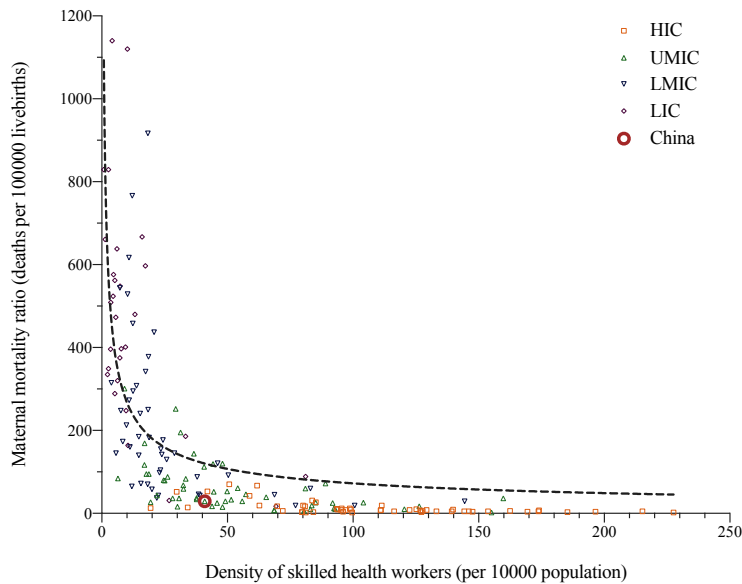


Figure 9b. Scatter plot of maternal mortality ratio and density of skilled health workers for 178 countries in 2017 (log-log curve)
 Sources: Liu and Eggleston (2020) analysis of data from Global Health Workforce Statistics and World Health Organization

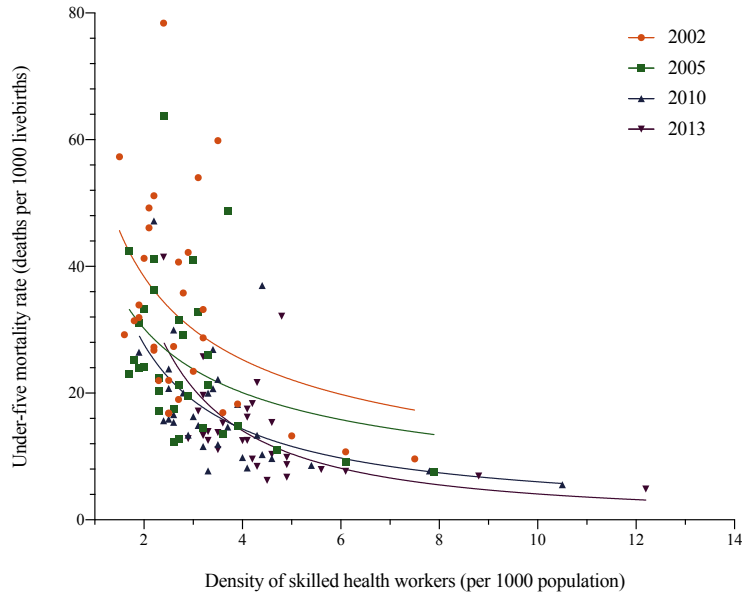


Figure 10a. Scatter plot of under-five mortality rate and density of skilled health workers in China (2002, 2005, 2010, 2013) (log-log curve)

Sources: Liu and Eggleston (2020) analysis of data from China Health Statistical Yearbook (2003~2016) and the Global Burden of Disease estimates

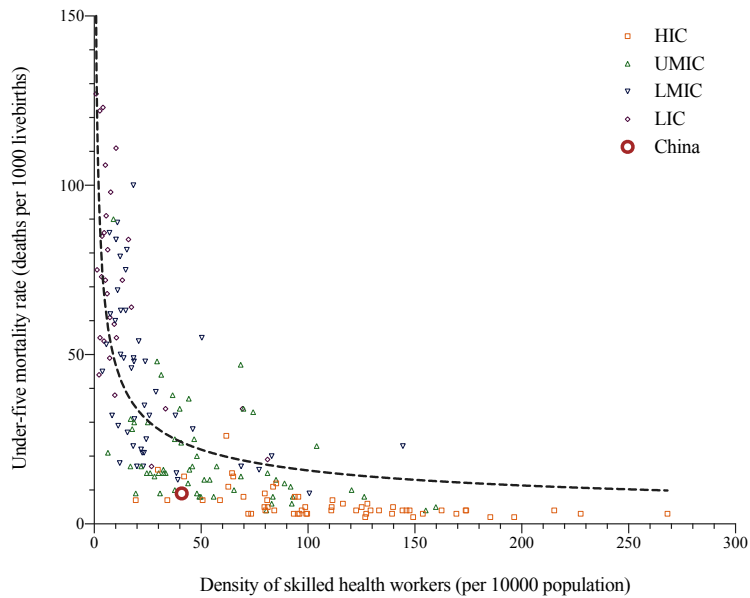


Figure 10b. Scatter plot of under-five mortality rate and density of skilled health workers for 189 countries in 2017 (log-log curve)

Sources: Liu and Eggleston (2020) analysis of data from Global Health Workforce Statistics and UN Inter-agency Group for Child Mortality Estimation

Health spending

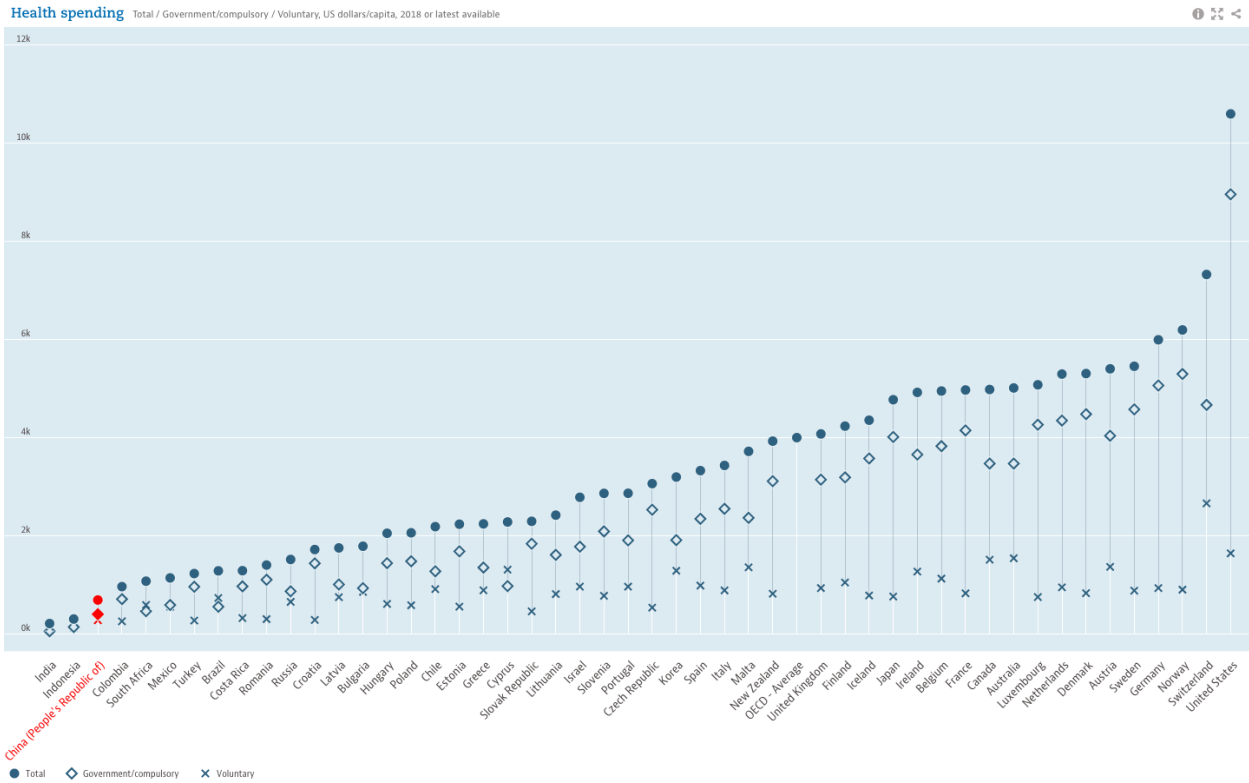
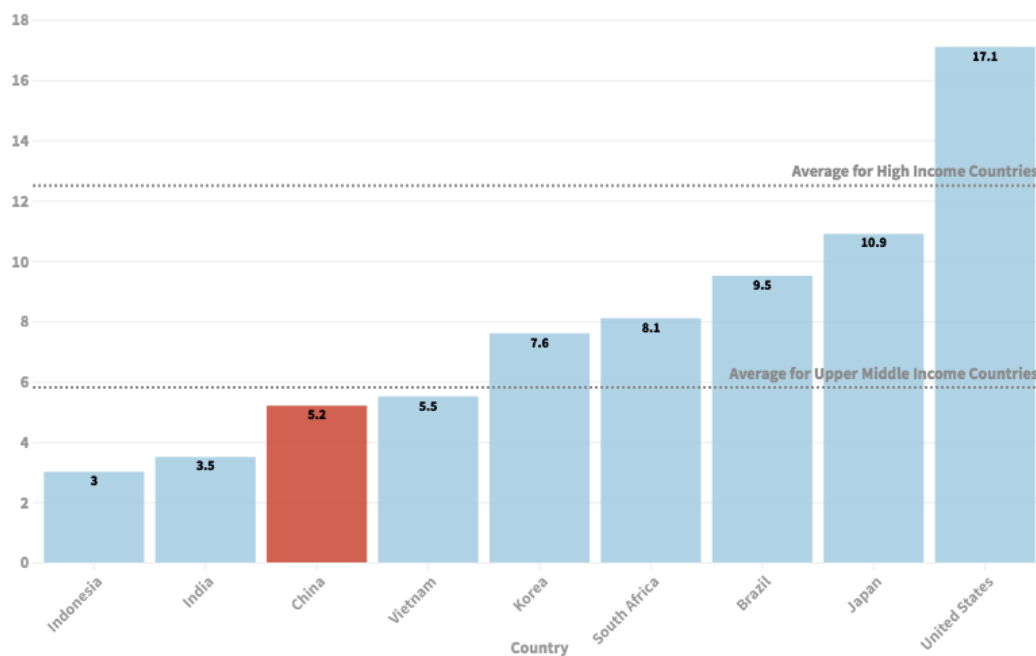


Figure 11. OECD (2020), Health spending, 2018. doi: 10.1787/8643de7e-en (Accessed on 22 April 2020)

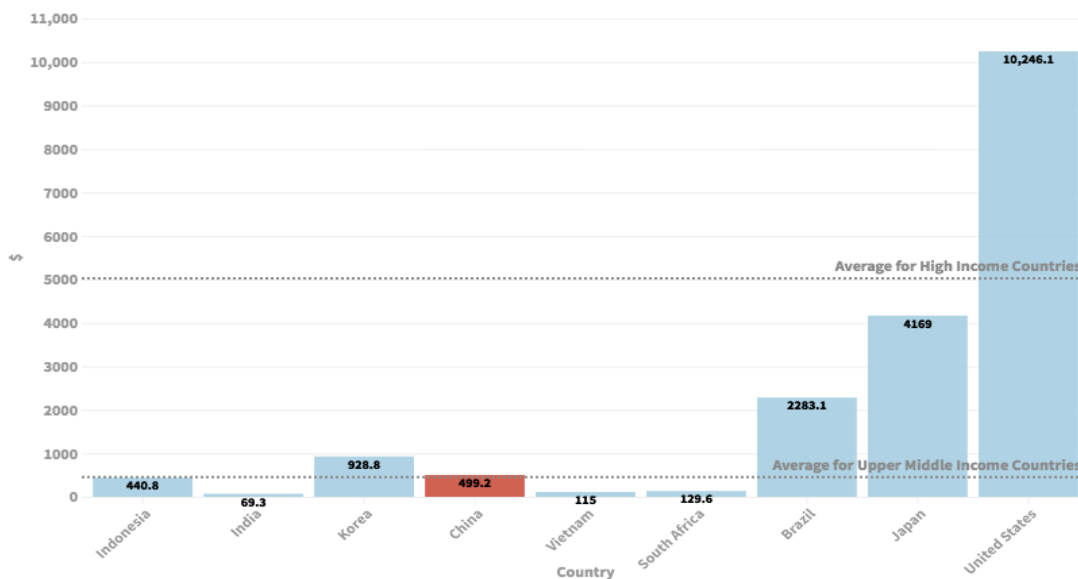
Current Health Expenditure (% GDP), 2017



Source: The World Bank, World Development Indicators

Figure 12a. Health spending, % of GDP, 2017. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020.

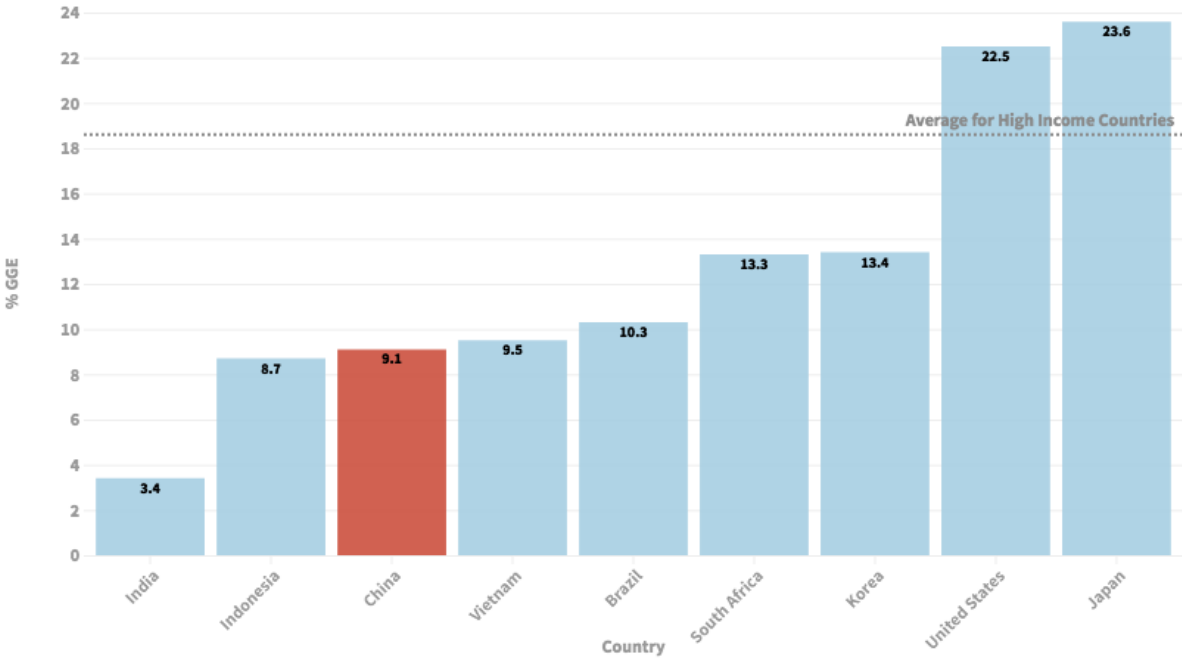
Current Health Expenditure (Per Capita), 2017



Source: The World Bank, World Development Indicators

Figure 12b. Health spending per capita, 2017. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020.

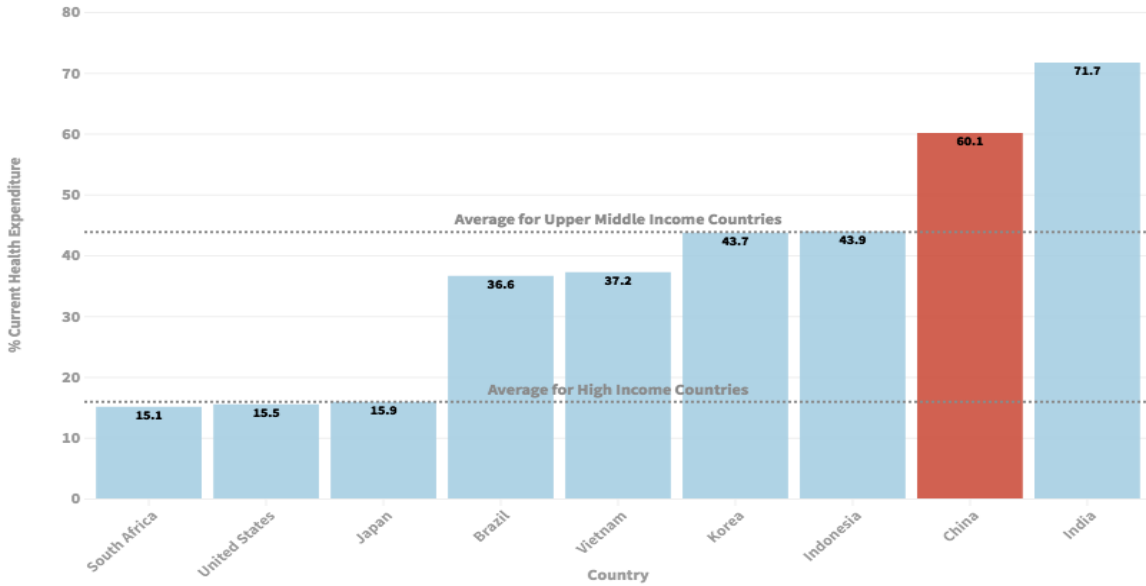
Domestic General Government Health Expenditure (% of General Government Expenditure), 2017



Source: The World Bank, World Development Indicators

Figure 13. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020. <https://datacatalog.worldbank.org/dataset/world-development-indicators>

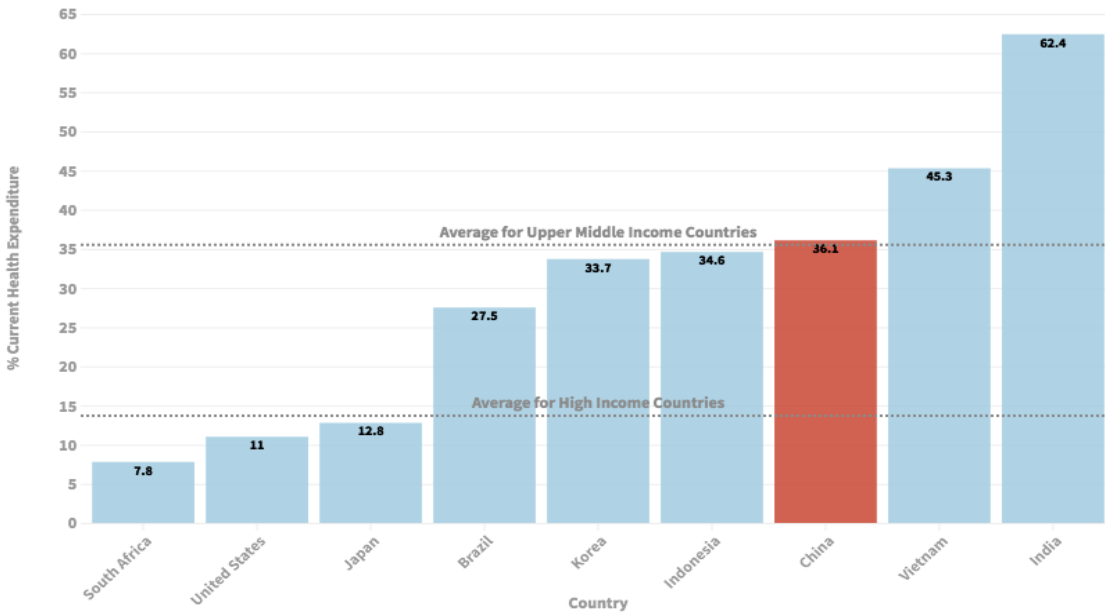
Out of Pocket Expenditure (% of Current Health Expenditure), 2000



Source: The World Bank, World Development Indicators

Figure 14a. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020. <https://datacatalog.worldbank.org/dataset/world-development-indicators>

Out of Pocket Expenditure (% of Current Health Expenditure), 2017

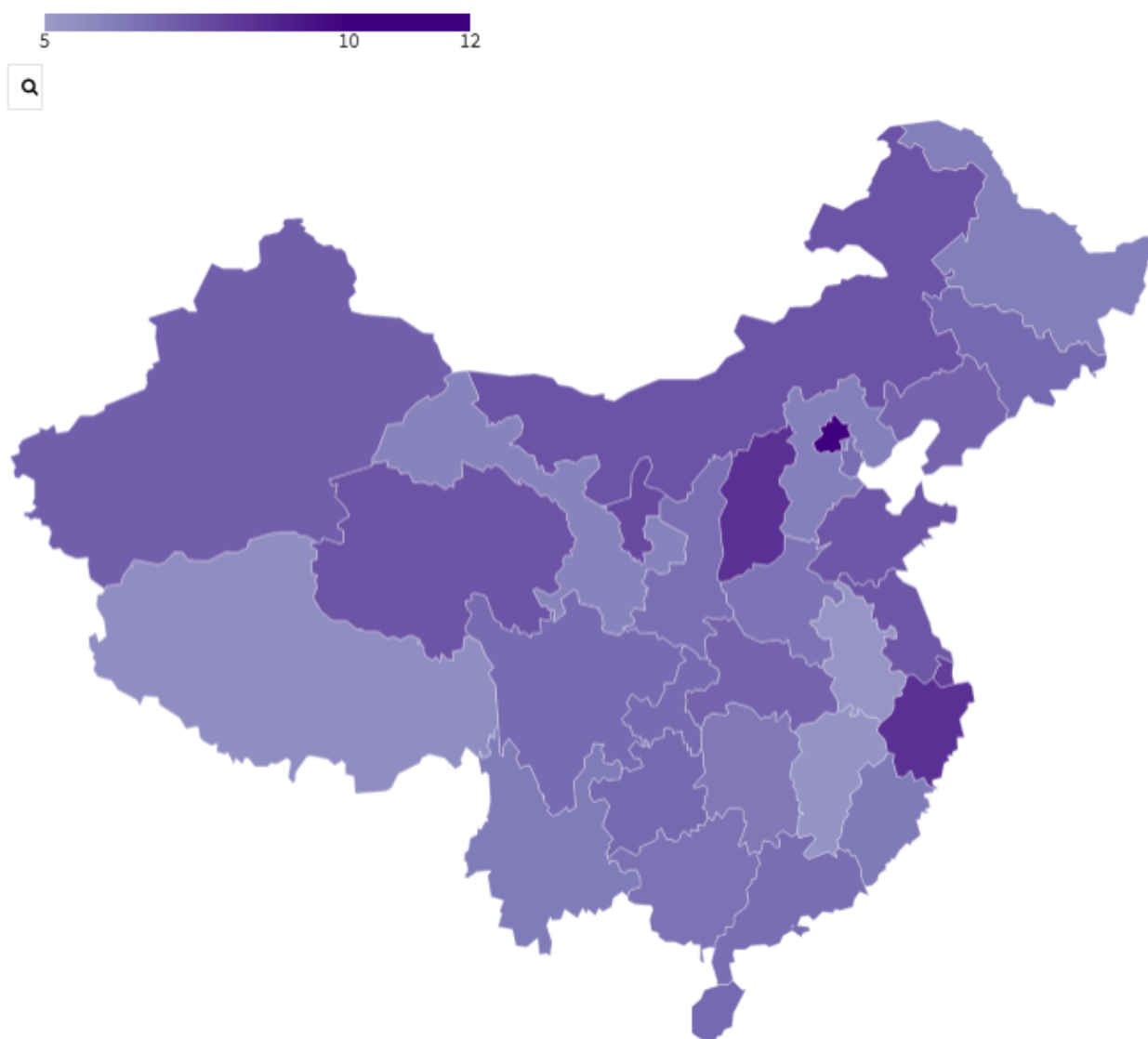


Source: The World Bank, World Development Indicators

Figure 14b. Prepared by the author using data from the World Bank, World Development Indicators, accessed April 22, 2020. <https://datacatalog.worldbank.org/dataset/world-development-indicators>

Regional and Urban-Rural Disparities

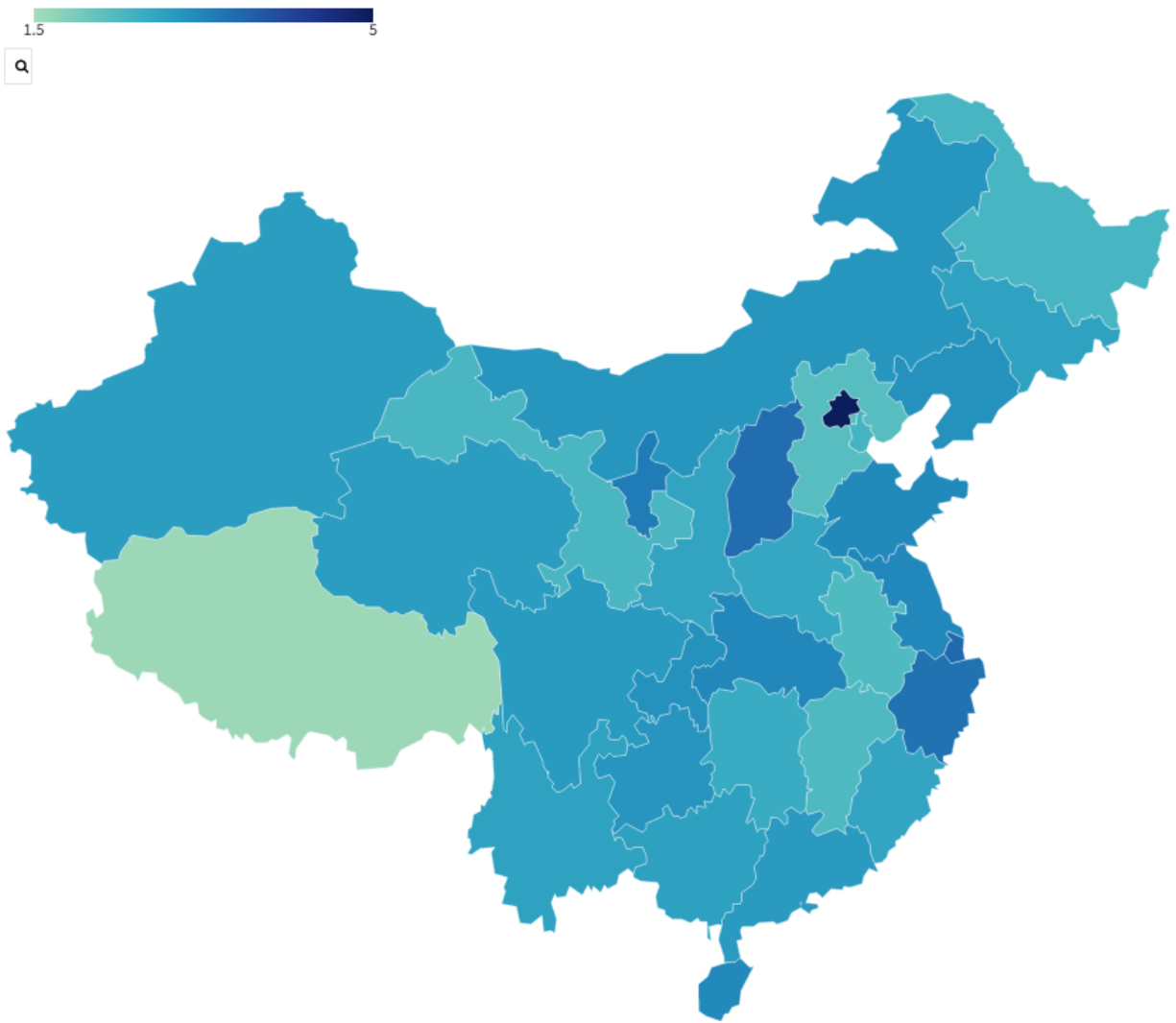
Medical Technical Personnel per 1000 Persons, 2018



Source: China Statistical Yearbook 2019, National Bureau of Statistics of China

Figure 15. Prepared by the author using data from the National Bureau of Statistics of China, accessed April 22, 2020. <http://data.stats.gov.cn/english/easyquery.htm?cn=E0103>

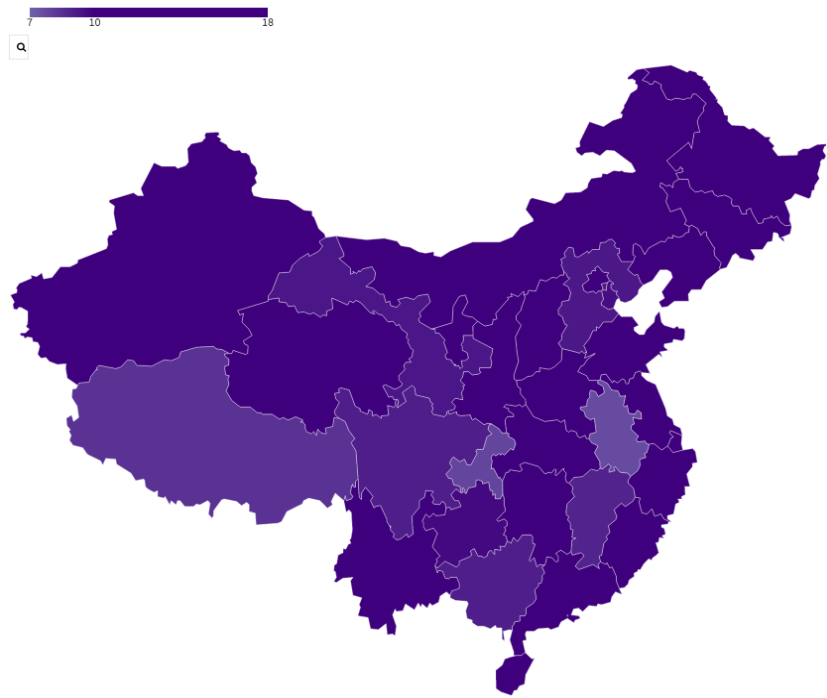
Registered Nurse per 1000 Persons, 2018



Source: National Bureau of Statistics of China

Figure 16. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China, accessed April 22, 2020.

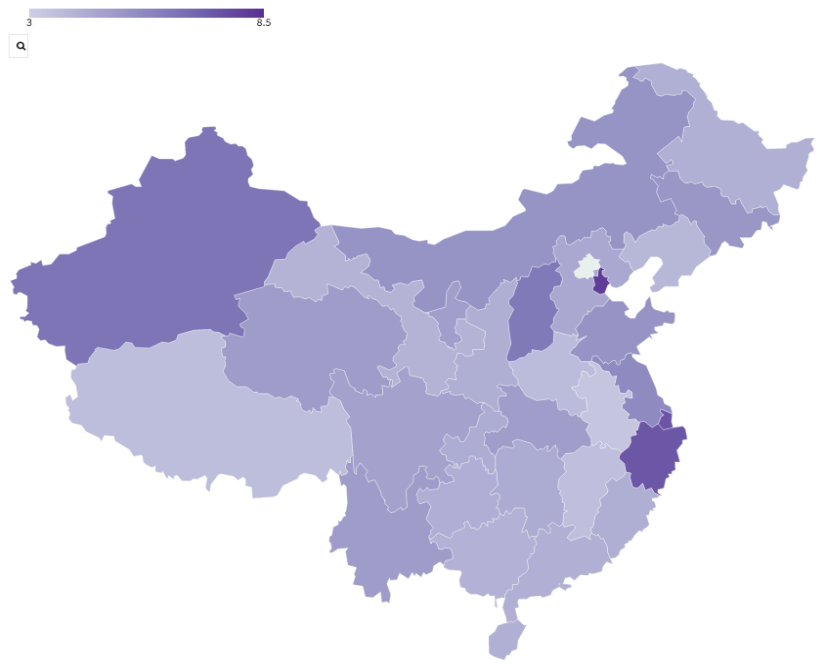
Medical Technical Personnel per 1000 Persons in City, 2018



Source: China Statistical Yearbook 2019, National Bureau of Statistics of China - City includes district of

Figure 17a. Skilled healthcare workers per 1000 in urban areas, 2018. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China.

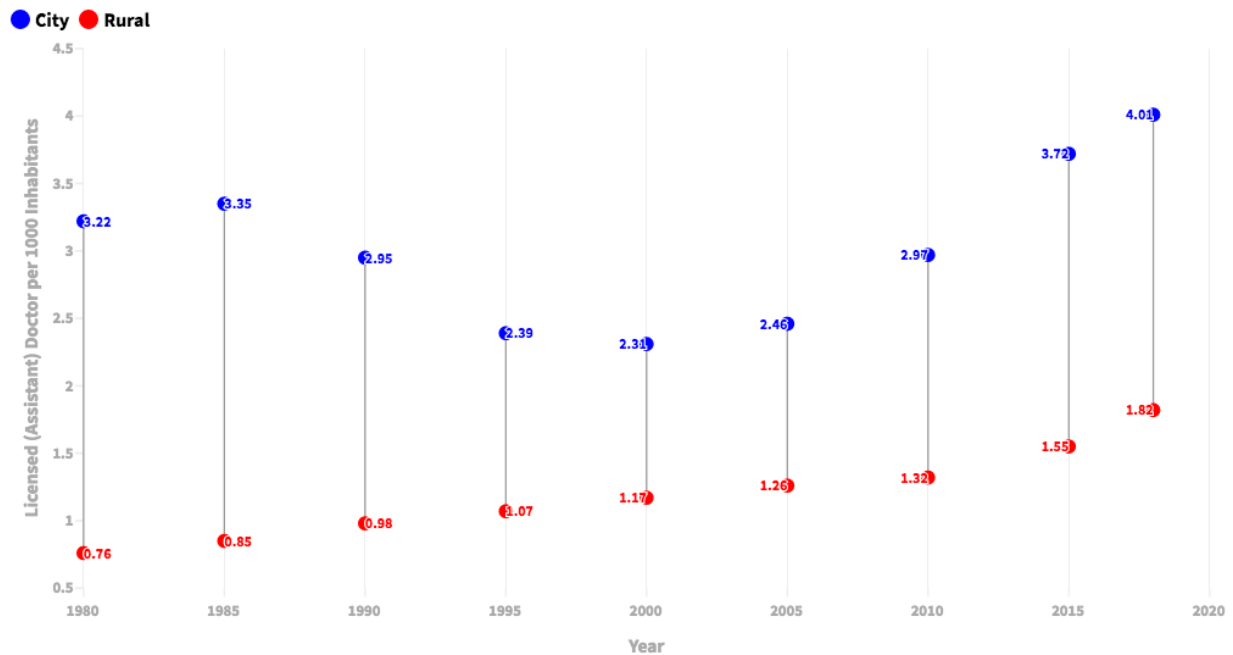
Medical Technical Personnel per 1000 Persons in Rural Areas, 2018



Source: China Statistical Yearbook 2019, National Bureau of Statistics of China - Rural area includes county and city at

Figure 17b. Skilled healthcare workers per 1000 in rural areas, 2018. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China.

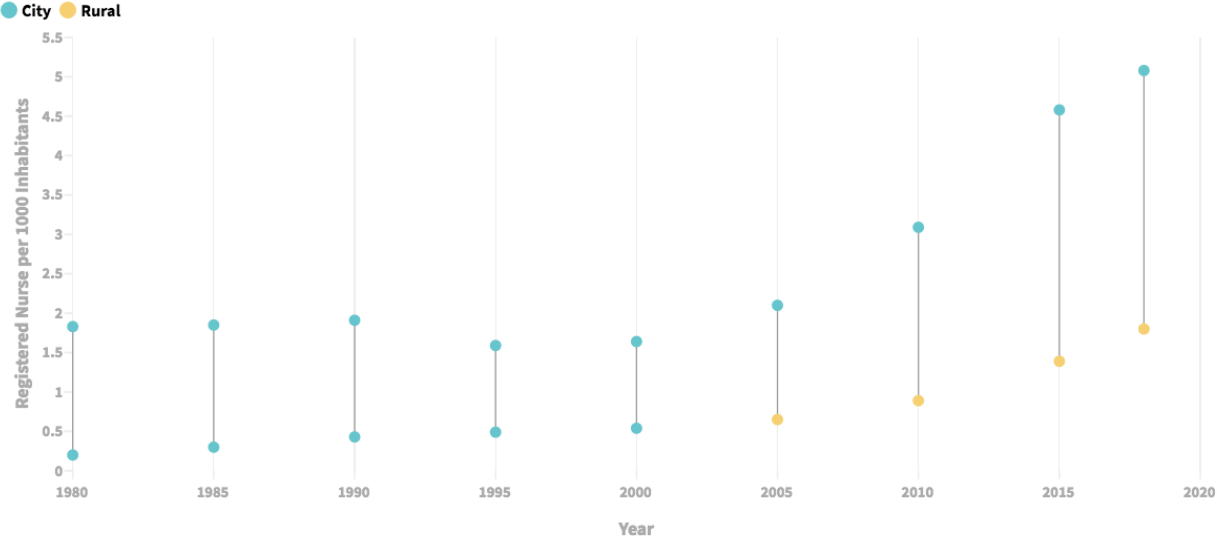
Urban-Rural Comparison: Licensed Doctors Per 1000 Inhabitants, 1980-2018 China



Source: China Statistical Yearbook 2019. National Bureau of Statistics of China

Figure 18. Doctors per 1000 population: Urban-rural comparison, 1980-2018. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China, accessed April 22, 2020. <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

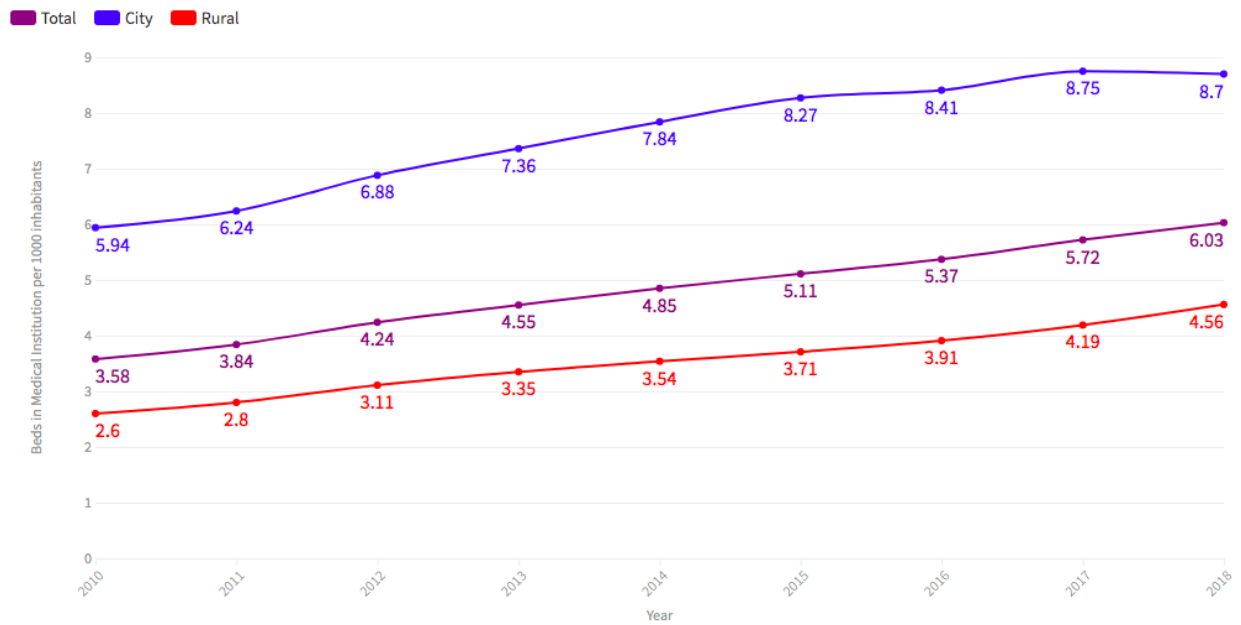
Urban-Rural Comparison: Registered Nurse Per 1000 Inhabitants, 1980-2018
China



Source: China Statistical Yearbook 2019, National Bureau of Statistics of China

Figure 19. Nurses: Urban-rural comparison, 1980-2018. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-3, National Bureau of Statistics of China, accessed April 22, 2020. <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

Beds in Medical Institutions per 1000 Inhabitants in China, 2010-2018
 Urban-Rural Comparison



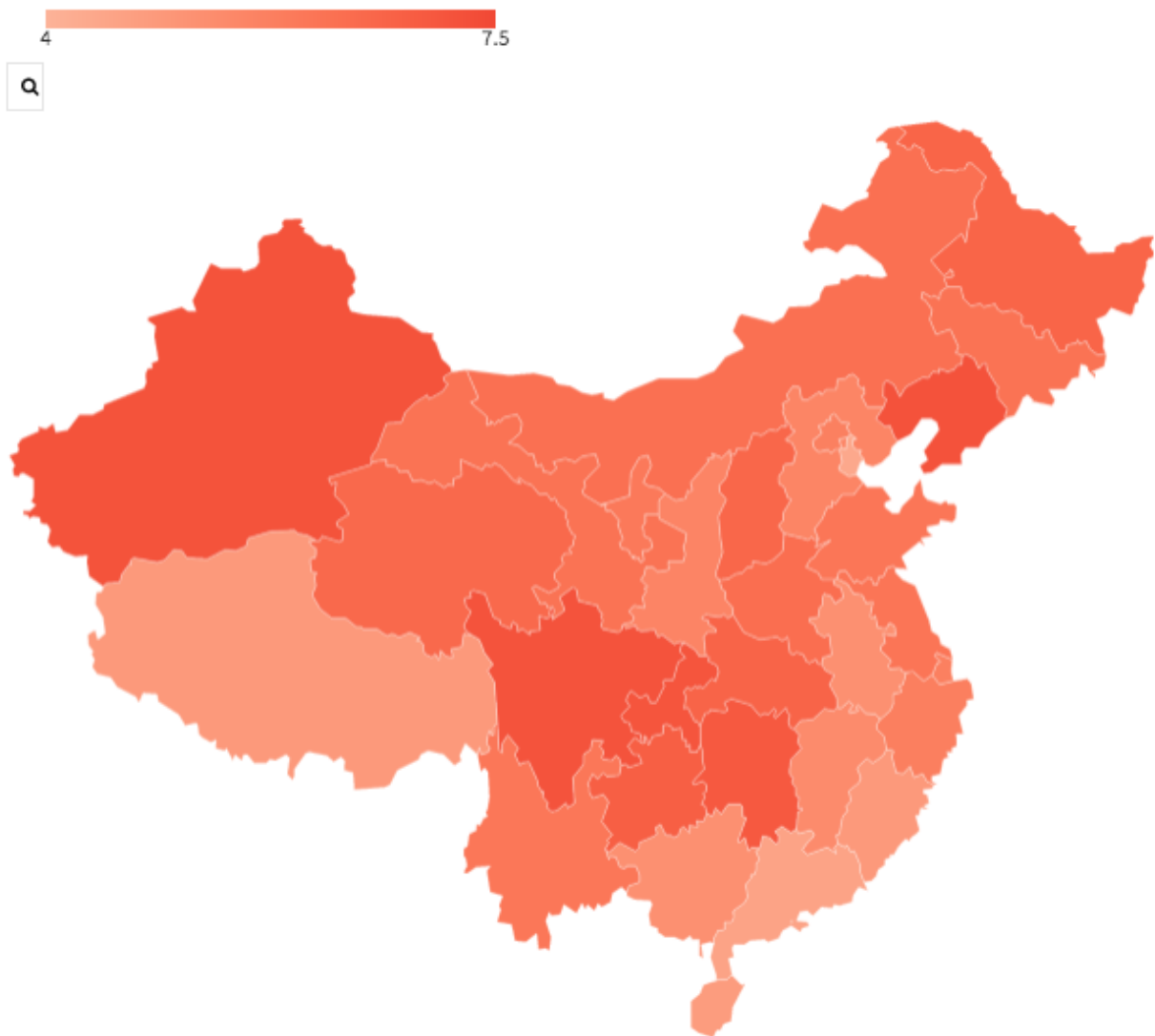
Source: China Statistical Yearbook 2019, National Bureau of Statistics of China

Figure 20. Urban-rural comparison of hospital beds per 1000 population, 2010-2018.

Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-7, National Bureau of Statistics of China, accessed April 22, 2020.

<http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

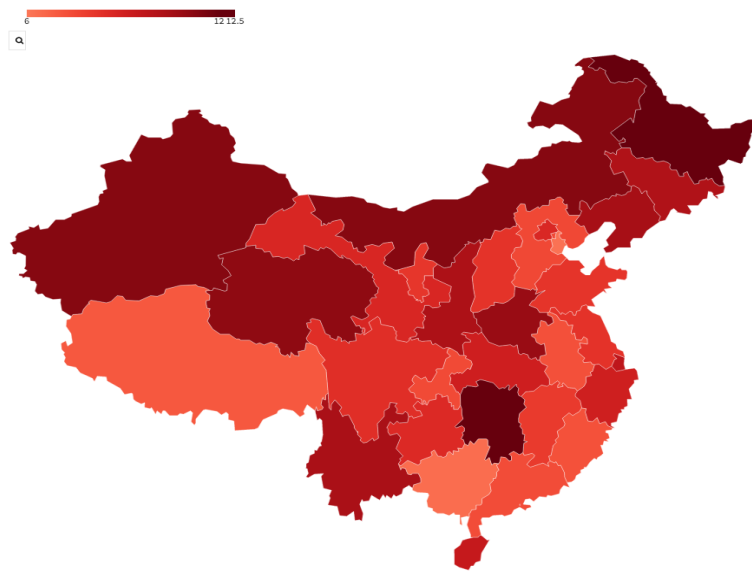
Beds in Medical Institution Per 1000 Population, 2018



Source: National Bureau of Statistics of China

Figure 21. Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-7, National Bureau of Statistics of China, accessed April 22, 2020.
<http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

Beds in Medical Institution Per 1000 Population in City, 2018
China

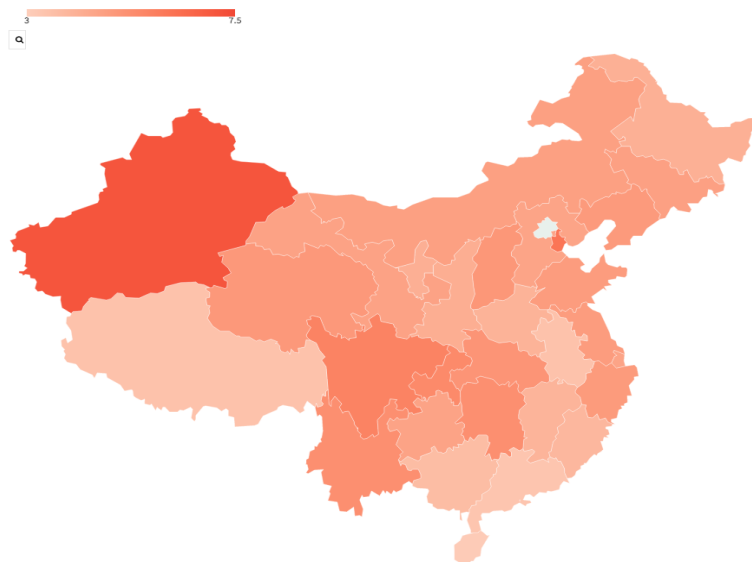


Source: National Bureau of Statistics of China

Figure 22a Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-7, National Bureau of Statistics of China, accessed April 22, 2020.

<http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

Beds in Medical Institution Per 1000 Population in Rural Areas, 2018
China



Source: National Bureau of Statistics of China

Figure 22b Prepared by the author using data from the “China Statistical Yearbook 2019,” 22-7, National Bureau of Statistics of China, accessed April 22, 2020.

<http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>

OPENING STATEMENT OF TARA O'TOOLE, SENIOR FELLOW AND EXECUTIVE VICE PRESIDENT, IN-Q-TEL

COMMISSIONER LEE: Thank you, Dr. Eggleston. Next, we will hear from Dr. Tara O'Toole.

DR. O'TOOLE: Thank you. Unlike some of the other speakers here, I am not a China scholar. I am a physician who spent most of my career studying public health and epidemics, and I have gone back and forth between government and academia.

In the last five years at In-Q-Tel, which is a nonprofit, nongovernmental organization focused on using venture capital practices to bring innovative technologies to the national security community, I have concentrated on what technologies might be used to help us detect, manage, and respond to epidemics, whether they're natural or deliberate. And in the course of that work, China's avid appetite for biotechnologies and related technologies became very obvious.

So my remarks stem from our observation about China's technology strategy. As Dr. Eggleston alluded to, China has urgent and extensive healthcare needs and deficits, and its plans to transform its healthcare deficiencies are certainly propelled by domestic political necessities. The imperative to do better has certainly been illuminated by its COVID-19 response.

But it's important to understand that its healthcare strategies are also tightly bound to its geopolitical ambitions. And in particular, it is integrating its technological strengths and accomplishments, particularly in digital technologies, genomics, and artificial intelligence, with its economic ambitions to create its own innovative biopharma sector and to dominate biotechnologies, particularly genomics in its quest for healthcare.

I won't repeat Dr. Eggleston's review of China's formidable challenges in bringing modern healthcare to its 1.4 billion people. It has a grossly inadequate healthcare infrastructure. Inequitable access to healthcare is rampant, particularly in urban areas. It's got a huge burden of chronic disease; the highest incidence of cancer in the world, for example. Over 100 million diabetics are in China today, and it also suffers from a demographic crisis and may well get old before it gets rich given its rapidly aging population.

China's Healthy China 2030 strategy is very holistic. It wants to increase the number of physicians and hospitals, reduce patient cost, and increase life expectancy. And the three technology thrusts it is relying on to achieve this are as follows.

It is making a very strong play to use what we call digital health apps, applications as in algorithms to be loaded mostly on smartphones, to some extent on computers, in order to increase access to healthcare, create a force multiplier for physicians who can see a lot more patients using telemedicine than they can visiting in offices, and to start directing routine care away from the limited number of specialty hospitals, where most people prefer to go because they're clearly of higher quality and which daily see thousands of people lining up to get care.

These digital health apps are a reasonable way to go in China because of the extensive use of mobile devices for everyday functions in China. Chinese use their phones to bank, to pay bills, to make appointments. They basically live on their smartphones.

So using these applications to figure out what your symptoms mean or to book an appointment with a doctor or to consult with a doctor seems very normal. And one survey found that 81 percent of those surveyed had contacted a physician within the past three months through a digital app. And 94 percent of physicians themselves had used them.

As was alluded to, there's a lot of startup companies in China trying to develop these

apps. More than 800 such startups existed about a year ago. Foreign companies, such as Sanofi, are setting up digital hubs and are going into partnership with some of China's big companies, such as Ping An, which is a large insurer that created Good Doctor, which is a medical consultation service that already has 300 million users. And they're beginning to explore more analytic algorithms that would, for example, help manage diabetes digitally and from afar.

Over time as these companies develop a database of patients that includes perhaps their vital signs, lab results, and just a history of their disease, that database will become very valuable in figuring out what works, what doesn't work, how one patient differs from another and so on and so forth. And of course, China's prowess in artificial intelligence will be put to use here, which is why the big Chinese internet giants such as Tencent and Alibaba are very interested in getting into the digital health game.

The second technology strategy, which China is pursuing very aggressively, is their ambition to dominate biotechnologies. And there's two parts to this strategy. I will start by saying that China has announced this strategy publicly, repeatedly in policy documents. They're using all the means at the hands of an authoritarian state, including policy, financial rule changes, regulatory changes, and the Chinese FDA, et cetera, et cetera, to fuel their ambitions in biotech.

And again, some of them are completely legitimate and necessary for them to deliver healthcare to their people. Their FDA changes, for example, were such that they became more aligned with the American FDA regulations. On the other hand, this is also part of their geopolitical strategy.

Firstly, they are clearly intent on developing a domestic pharmaceutical industry that can not only manufacture and export generic drugs that were invented by companies elsewhere and in-license (telephonic interference) drugs, such as biological drugs used in cancer treatment. But they want to now generate their own innovative medicines for sale domestically and abroad, thereby moving up the financial value chain, holding down domestic prices. And some of their policies, as was noted, force foreign firms to develop Chinese partners or build facilities in China in order to gain access to the huge Chinese drug market, which is now the second largest in the world, soon to be number one.

COMMISSIONER LEE: Dr. O'Toole, can I ask you to wrap up quickly? We're trying to be at seven minutes. Thank you.

DR. O'TOOLE: Their third strategy is in genomics and precision medicine, which I'm happy to discuss in detail.

My recommendations are, first of all, that we recognize the national security implications of China's ambitions in digital health and biotech, particularly in combination with AI, that we make America much more competitive in these areas and in technological leadership in the life sciences generally, and that we get serious about health data in the United States, collecting it, protecting it, and making use of it. Thank you.

**PREPARED STATEMENT TARA O'TOOLE, SENIOR FELLOW AND EXECUTIVE
VICE PRESIDENT, IN-Q-TEL**

U.S. – China Economic and Security Review Commission

Testimony of Tara O’Toole, MD, MPH

May 7, 2020

China’s Evolving Healthcare Ecosystem

Good afternoon, Chairman Cleveland and Vice Chair Bartholomew, distinguished members of the committee. Thank you for the opportunity to appear before you today to discuss “China’s Evolving Ecosystem: Challenges and Opportunities.”

I am an internal medicine physician, and have spent much of my career in academia and government. In 2014, I became executive vice president and senior fellow at In-Q-Tel (IQT), a non-profit investor for nine United States national security agencies, accelerating and shaping commercial startup technologies for the U.S. national security community. For the past five years, I have led a team of medical and scientific professionals who focus on technologies that could improve epidemic detection and response. Prior to joining IQT, I served as Under Secretary of Science and Technology at the Department of Homeland Security. In the decade before that I was a Professor of Medicine and Public Health and Director of the academic think tank now known as the Johns Hopkins Center for Health Security. From 1993-97, I served as Assistant Secretary of Energy for Environment Safety and Health. I was a senior analyst and program manager at the Congressional Office of Technology Assessment from 1989-93.

I appreciate the opportunity to come before you. My intent is to provide a picture of how China is trying to improve its beleaguered health care system, and in particular to describe its efforts in the diverse field of “digital health.” It is clear that China faces daunting problems in its effort to provide decent health care to its huge and aging population. It is also evident that the government recognizes the humanitarian, political, and economic necessity of improving health care access and quality. There are many open-source examples of companies, projects, and commercial products employing digital health approaches to accomplish these goals. What is less clear is how pervasive or successful these efforts have been, what the intended milestones and metrics for success might be (as viewed by the Chinese government), and to what extent the strategy articulated in “Healthy China 2030” is being funded and achieved.

Background – China is facing extensive unmet health care needs, inadequate medical infrastructure, and a large and growing disease burden.

China faces significant structural, social and technological challenges as it seeks to bring better health care to its 1.4 billion people. These challenges include inadequate and inequitable access to health care; insufficient numbers of medical professionals, many of whom are poorly trained; limited access to advanced medical technologies, including drugs; and an extraordinary burden of disease which will grow as China’s population ages.

Insufficient medical infrastructure - China's medical infrastructure is insufficient, unevenly distributed, and not well prepared to deliver access to modern health care, which the rising middle class has come to expect and demand. Almost all of China's best hospitals are in cities. Even in urban centers, advanced medical technologies are available in only a few top hospitals where thousands of people daily wait in line to be seen.

Inadequate numbers of well-trained health care professionals - China lacks sufficient numbers of health care professionals, who often work long hours with limited resources and little pay. According to the OECD, China has only 1.8 doctors per 1000 patients, compared to 2.6 per 1000 in the U.S. and 4.3 per 1000 in Sweden. Specialists in referral hospitals may see 200 patients per day. General practitioners are often minimally trained and shoulder huge workloads. Violent attacks on doctors are so common there is a term for these attacks: "yi nao" or "common medical disturbance". The hostility comes in part from widespread expectation that seeing a physician requires a "gift" from the patient, other forms of corruption, and from patients' dissatisfaction with physicians' low level of competency. In addition, multiple medical scandals – tainted vaccines given to children, false promises of cancer cures promoted by health care product companies, etc. – have eroded confidence in medical professionals.

Geographic inequities in access to care - Although high-quality medical resources are in short supply overall, this is especially true in rural areas. Socialized medicine in the form of minimally trained "barefoot doctors" deployed to rural areas significantly increased life expectancy and decreased infant mortality in China. The 1980s reforms, which cut state subsidies to hospitals and forced hospitals to close, saw the disintegration of rural health systems and the loss of local "township" hospitals.

Extensive, multiyear research found that 400 million children in rural China are so cognitively handicapped that they will be unable to participate in the economy. Left behind in the country while their parents migrated to the cities in search of jobs, these children tend to eat poorly, leave school early, and crucially, lacked intellectual and social stimulation in their first "1000 days" of life. Caring for these individuals as they age will be a monumental task.

Demographic challenges - China's rapidly aging population and the concomitant increase in chronic diseases will place great stress on health systems in coming years. The number of people over 65 is expected to increase at a rate of over six million per year by 2021 and will account for 30% of the population by 2050. As the population ages, chronic diseases such as stroke, cardiovascular disease, diabetes, and cancer become more common. Pervasive and intense levels of air and water pollution, combined with heavy smoking (53% of men smoke) contribute to ill health. China has world's highest incidence of lung cancer, and epidemics of neck and esophageal cancer. China also has over 100 million diabetics, with increased risk of stroke, heart disease, etc.

China is pursuing a multifaceted, technology-based strategy to improve health care access and quality

China's efforts to provide its people with more access to better health care rest on a holistic, long-term plan that includes several inter-related strategies, outlined below. It is difficult, however, to assess how well resourced and financed these plans have been. Given the extraordinary societal and emotional impact of the Covid-19 pandemic, it seems likely that the Chinese state will reemphasize making progress on these ambitions.

- Ambitious state policy goals, articulated in the Healthy China 2030 blueprint, aim at increasing the number of physicians, hospitals, and population life expectancy;
- The development of digital medicine platforms and associated financial incentives are expanding access to care and enabling health professionals to tap into specialist knowledge. One source counts over healthtech 800 startups in China. Large companies such as Ping An, a large Chinese insurer, are also creating digital health enterprises.
- Government policies intended to help Chinese biotech and pharmaceutical companies and to expand the types of drugs available and become the designers of innovative new drugs rather than just manufacturers, are allowing Chinese firms to “move up the value chain” of the pharmaceutical industry and to expand the types of drugs available. This effort is well underway, and is being accomplished via a combination of changes in regulatory and financial policies, public/private investments, and rules that compel multinational pharmaceutical firms to build facilities in China to get access to the growing Chinese market.
- China is also making a big bet on personalized medicine. It seeks to leverage its decade-long investment in genomic sequencing capabilities into knowledge and tools that can identify individual health risks and possibly counter them before disease is manifest; identify effective treatments for chronic disease, cancer particularly; and eventually, enable alteration of genetic traits.

Digital health technologies and telemedicine are a key, rapidly expanding pillar of China's quest to improve health care access and quality.

Digital health technologies are used widely in China by both patients and physicians. Digital health has been defined, somewhat unhelpfully, as “the convergence of health and the internet.” Digital health capabilities, technologies, and applications range widely from individual health inquiries and diagnosis to population-based monitoring and messaging. In this paper, “digital health” will be used in the broadest sense to include cellphone-based, direct-to-consumer information and advice; telemedicine services involving remote contact with physicians or interactive services with intelligent algorithms, computer-based triage and diagnostic services; remote patient monitoring and management, and much else.

The ubiquity of smartphones, faster 5G networks, and the Chinese practice of using smartphones for a wide range of functions – banking, paying bills, etc. – has placed China in the forefront of digital health. Ninety-four percent of Chinese health professionals and 81% of

Chinese people report using digital health technologies or mobile applications, compared to 47% of patients in 15 other surveyed countries. Indeed, it is difficult to function in China without using these social media applications, which allow Chinese citizens real-time access to official health information (e.g. Covid-19 developments) and also serve as a feedback mechanism to government.

For example, WeChat, a messaging app created by Tencent in 2011, and often referred to as the Chinese Facebook, has 900 million users daily. WeChat is typically used for communications, banking and shopping and, increasingly, for booking doctor appointments, paying medical bills and accessing medical reports. Tencent has a network of over 30,000 participating hospitals. WeChat is being integrated with China's electronic ID system and it is anticipated that individuals will soon be able to access their entire medical record via WeChat.

Telemedicine allows patients to remotely access a physician via smart phone or computer who can use other technologies to examine the patient, gather vital signs, and even perform remote procedures such as ultrasounds, EKGs, etc. Telemedicine services also make it possible for patients and doctors to access specialty care. Numerous startup companies have developed mobile applications designed to diagnose and triage symptoms, assist in managing chronic diseases such as diabetes, or monitor signs of worsening illness. For example, "chatbots" aim to help people diagnose relatively simple medical problems. Such apps can lessen the load on physicians, and when combined with more extensive telemedicine services, can act as force multipliers for health care professionals.

Ping An Insurance, one of China's major insurers, offers on-line medical consults and saw a tenfold increase in telemedicine use during the coronavirus outbreak in January 2020. Ping An is advocating the creation of a national telemedicine network. Ping An already offers apps to order non-prescription medicines and wellness products. Users complete a quick, AI-driven questionnaire to determine their health needs and then the products ordered are delivered to their home within an hour. Ping An has also piloted a project called Good Doctor, which features unstaffed, "one minute clinics." These use AI-driven algorithms to assess patients' symptoms and, if necessary, to connect patients with Good Doctor's in house clinicians. Such clinics are now located in 8 provinces and cities, providing services to 3 million users. In rural areas, general practitioners are being trained to upload patient records electronically so they can be reviewed by distant specialists.

China's giant internet companies, such as Alibaba and Tencent, etc. are actively engaged in applying their expertise in Artificial Intelligence (AI) methods to digital health technologies. AI is already in use in China (as well as in the US and Europe) for such tasks as interpreting medical imaging, determining possible patient diagnoses, aiding in drug development, etc. As more patients use these digital platforms, companies and the government acquire growing "big data" caches that can be used to improve diagnostic algorithms and provide population-level insights into disease patterns.

China aims to become the predominant developer of innovative medicines to address rising health challenges, and to improve economic competitiveness

China is aggressively pursuing global dominance in biotechnology. As documented in numerous government policy documents, changes in regulatory and financial rules, and state and private investments, China recognizes biotech as both an enabler of its quest for better health care, and as a “critical strategic technology” essential to 21st century economic competitiveness. These two pursuits – progress in health care technologies and dominance in biotechnologies, including genomics, drug development and human augmentation – will reinforce each other.

China sees biology and biotech as a route to expand its global power. China has long recognized biotechnology as one of the most important strategic technology areas and identified it as such in the thirteenth 5-year Research and Development Plan, declaring the goal of the biotechnology sector producing 4% of China’s GDP by 2020.

China is investing heavily in bioresearch, building new scientific facilities, recruiting talent from within and abroad, reforming drug approval regulations, establishing financial rules that favor Chinese companies, and linking its giant internet firms like Tencent and Alibaba to biotech development.

China has urgent and compelling humanitarian reasons to aggressively pursue advances in biomedicine and biotechnology. Its huge and aging population, suffering from a growing burden of chronic disease, will require access to the most innovative pharmacological remedies. Cancer treatments, especially the newer “biological” medicines, are particularly needed.

Until recently, China has been a low cost manufacturer of drugs invented elsewhere. In the past few years, China has become a major source of contract research organizations (CROs) for testing new drugs and contract manufacturing facilities (CMOs). But increasingly, Chinese companies are creating their own innovative products. For example, Beigene recently received U.S. FDA approval for a new, first-in-class oncology drug – the first approval for a China discovered drug. China has become a peer competitor in pharmacological development and manufacturing.

Genomics and Personalized Medicine:

Over the past decade, China has invested aggressively in DNA sequencing and genomics. Chinese companies are world leaders in commercial sequencing services and have accrued a huge database of genomic information. Since much of the science of genomics is comparative, these large libraries of genetic coding sequences hold great advantage. Here too, making sense of these enormous data bases requires application of AI expertise, and Tencent, Alibaba, etc. are strongly engaged in helping to decipher the genetic code of human health and disease. Genomic sequencing and synthesis technologies are increasingly integral to drug development and to understanding, treating and preventing adverse health conditions caused or influenced by genetics. China’s interest and investments in “personalized medicine” suggest that the

government is trying to get ahead of the curve and to develop ways to detect, treat, or even prevent genetically driven diseases such as cancer. Personalized medicine can also help predict which patients are likely to benefit from new (and expensive) cancer therapies.

China is investing heavily in biological research (particularly “translational” research, which is intended to transform basic research insights into products), building new science facilities and biomedical incubators, high-containment laboratories, recruiting biomed research talent from abroad and at home, and establishing financial rules that favor Chinese biotech companies, even as it insists that multinational pharmaceutical corporations establish large footprints in China. Increasingly, biomedicine will depend on genomics and synthetic biology approaches.

In 2016, the *Economist* magazine noted that “biology will be to the 21st century what physics was to the 20th,” reflecting the growing power of the life sciences and biotechnology to read, write, and edit the genetic code, and in so doing, to transform manufacturing processes, materials design, and practices across multiple industries. Leadership in biotechnology is not just a matter of improving biomedicine. It will be key to global economic competitiveness.

Recommendations

China is aggressively pursuing an integrated, technology-based strategy to improve health care access and quality. Interactive digital health platforms that allow individuals immediate access to useful, personalized health information are an important aspect of this strategy.

Digital health technologies are increasingly available in the U.S., and have become more widely used during the Covid-19 pandemic. In spite of their usefulness, significant barriers to their use exist, including payment restrictions, state-based limits on telemedicine use and geographic restrictions on medical licensure. The Covid-19 pandemic has loosened some of these constraints. CMS, for example, agreed to pay for Medicare recipients’ use of telemedicine services. Commercial digital health apps have assisted the Centers for Disease Control and Prevention, as well as many municipalities, in understanding the geographic spread of coronavirus. The U.S. should consider ways to permanently remove such barriers and to expand telemedicine and digital health apps, under appropriate oversight, to expand health care access, cost-effectiveness and patient convenience.

Public health practice could also be enhanced by digital health technologies, without impeding individuals’ privacy. For example, trends in the number of people in a geographic area or in a particular demographic category who access digital triaging services could be even more useful than people calling 911 with respiratory symptoms.

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OPENING STATEMENT OF JENNIFER BOUEY, SENIOR POLICY RESEARCHER AND TANG CHAIR IN CHINA POLICY STUDIES, RAND CORPORATION

COMMISSIONER LEE: Thank you so much, Dr. O'Toole. And next, we will hear from Dr. Jennifer Bouey.

DR. BOUEY: Thank you. I hope you can hear me clear. If there's an interruption, I'll switch to the phone. But thank you for the Committee to inviting me back. In this testimony, I will focus on reviewing the reforms of China's three healthcare systems, the public health system, healthcare system, and global health. I will also discuss the implications of these developments in China on China's response to the COVID-19 pandemic. This testimony will end with my recommendations to the U.S. government on how to engage China in global pandemic response and where investments in China's healthcare market can be mutually beneficial.

I will start with the public health system. China restructured its CDC 18 years ago after SARS. The new China CDC absorbed all the epidemic prevention stations at the local levels. It also follows the U.S. CDC's practice of prioritizing the epidemiology and the lab science.

Meanwhile, China also set up a new National Influenza Center, revised its notifiable disease diagnostic criteria and the reporting law, and built two reporting systems for the existing infectious diseases and two new surveillance system on emerging pathogens. China CDC's role is mainly maintaining these data systems, providing technical consultants to the local and central government, and providing training and technology support for the lower level CDCs.

COVID-19 however revealed three problems in the system. First, the CDC system has been underfunded for years. This funding shortage is partly due to the competing needs for healthcare reform and biomedical technology development, and partly due to the dwindling income and increasing debts at a provincial government level as the economy slows down.

Secondly, despite a sophisticated system set up, the performance of the surveillance system varies. The pneumonia surveillance system in particular was reported to be insensitive to new and emerging pathogens, as frontline clinicians lack incentives and the training to use the system and the follow-up investigations are considered burdensome.

Finally, China's CDC lack of legal and administrative power made it impossible for CDC to announce the public health alert or implement public health interventions. These actions will have to be initiated by the central or the local government. And as the local government may have different concerns and priorities at the beginning of the public health crisis, such system can easily lead to delays in actions.

As for the healthcare system as my fellow panelists have talked about, China's latest reform has been quite successful providing most of the Chinese citizens with sustainable basic healthcare coverage. The hospital infrastructure also strengthened. The overall government health spending quadrupled from 2008 to 2017.

As a consequence, the medical resources in large cities in China has often seen that's better than that of the other developed countries. For example, even before COVID-19, Wuhan had a higher physician density and twice the number of hospital beds per 1,000 people compared to that of the U.S. And during the COVID-19, China's central government mobilized the 41,000 healthcare workers from outside Wuhan to support Wuhan in about two weeks.

Certainly, there are lots of room to improve in quality and efficiency of the healthcare in China as mentioned earlier. As the country's wealth increases, more demands and expectations of healthcare may drive up the cost. A fast-aging population, the surge of chronic disease, the

urbanization, and pollution also threaten the sustainability of this system. The government is hoping to answer these challenges by using the system reforms by supplementing the national insurance system with private insurance.

COMMISSIONER LEE: Sorry, Dr. Bouey.

(Simultaneous speaking.)

DR. BOUEY: China's investment in biomedical research and technology also -- okay, sorry.

China's investment in biomedical research and technology also grew at an annual rate of 32 percent from 2008 to 2013, higher than that of many other countries. COVID-19 has demonstrated that China's capacity to conduct research on a novel virus, from genomic sequencing to vaccine development. At this time, China has more COVID-19 vaccine candidates approved for human phase testing than other countries.

And finally, China is also revamping its global health ambitions and strategies. On the tradition that can trace back a half century, China has continued to send medical teams, medical supplies to developing countries and help with the infrastructure building. They also train health professionals in these countries and provide humanitarian aid when necessary.

What is relatively new, what we have seen with COVID, is increasing visibility of the private donor from China and a closer tie with the multilateral health organizations at a time when U.S. is backing away. So far, China's medical aid and assistance has received mixed reactions. Some of the efforts were met with enthusiasm and a recognition, while others with skepticism and suspicion.

I have three main recommendations to the U.S. government. First, restore research partnership and collaborations on public health between U.S. and China CDC. Second, restart a bilateral dialogues between U.S. and China to strengthen the global health strategy. And finally, consider a U.S.-China combined investment in innovations for health when the intellectual property practice improves in China.

Strengthening public health, global health, and innovations in medicine may well be the key to both countries in this quest for affordable, accessible, and high-quality healthcare. And these collaborations will certainly pave the foundation for sound strategy as we are all facing the COVID-19 pandemic. Thank you.

**PREPARED STATEMENT OF JENNIFER BOUEY, SENIOR POLICY RESEARCHER
AND TANG CHAIR IN CHINA POLICY STUDIES, RAND CORPORATION**

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

Jennifer Bouey

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

Testimony of Jennifer Bouey¹
The RAND Corporation²

Before the U.S.-China Economic and Security Review Commission

May 7, 2020

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

¹ The opinions and conclusions expressed in this testimony are the author's alone and should not be interpreted as representing those of the RAND Corporation or any of the sponsors of its research.

² The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest.

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.

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,

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

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.

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 Automate-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

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 benefitted 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

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),

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

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 Advancine 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

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 goggles, 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

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

⁵¹ Liu Yimeng, "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.

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.

OPENING STATEMENT OF JOHN BALZANO, PARTNER, COVINGTON & BURLING LLP

COMMISSIONER LEE: Thank you very much, Dr. Bouey. And last, we will hear from Mr. John Balzano.

MR. BALZANO: Thank you very much, Commissioner. I'll be brief. First of all, thank you very much for having me here today to offer the legal and regulatory viewpoint on some of this. I have been an observer of China's healthcare and life sciences regulatory system for the last 16 years, both as an academic and as a practitioner.

The other panelists have talked in great length about China's healthcare policy as an area, and so I will just say that I sort of consider there to be sort of two policy pillars that will frame my remarks today. One is China's increasing desire to expand coverage and accessibility of both high-quality healthcare services and medicine. And the second is the desire to increase innovation in life sciences area for both drugs and medical devices, but also as a separate category for digital health solutions.

In 2018, the government embarked on -- enacted a forward-thinking regulation in the area of digital health that provided a process and structure for entities to apply -- or hospitals to apply to provide e-diagnosis services, to establish internet hospitals, to expand their telemedicine operation. This is also linked to a policy trend that we've seen in the medical device and drug regulatory area to increase the speed to market for medicine that China considers to be of a higher technology and a greater level of innovation, the first of their kind in the world, and ones that it considers to be more clinically valuable to China in terms of facilitating clinical needs in the area of oncology, medicines that are for diseases that are prevalent among the elderly, medicines for diseases that are prevalent among children, and infectious disease treatment.

I'd like to, as requested, in terms of discussing the opportunities and challenges for foreign companies in China, I divide my remarks into three different areas.

The first are the opportunities and challenges in engaging with the healthcare system. The second being the opportunities and challenges for registering medical device technology that works in the digital health area and provision of information about that technology via the internet in China. And the third being intellectual property and data flow challenges.

In the area of the healthcare -- interacting with the healthcare system, I see two main challenges that we commonly see when we see companies going to China. One is in China's healthcare services by law are provided by licensed medical institutions that are both public and private. The bulk of the population receives their medical treatment via public state-run healthcare institution.

There is not a great deal of guidance on what constitutes a medical service, and so companies seeking to embark in this area and provide, for example, health and wellness information or provision of healthcare information have to determine with less than optimal guidance whether they cross that line into the medical service area, or be conservative and partner with healthcare institution. Foreign investment in the healthcare area is also limited. It's required to be in a joint venture or cooperative venture with a Chinese company, and foreign companies in practice are not allowed to own more than 70 percent of the venture. Despite this, companies do indeed invest in the healthcare sector in China.

The second area I'd like to talk about is the medical device area, and these are the instruments or tools, the apps, the software that has been mentioned by other panelists that provide disease diagnosis, treatment, and monitoring functions. China does allow foreign

companies to participate very, very vigorously in the medical device area. But to date, it has continued to divide the area into imported devices and domestic devices.

And the opportunities available to those devices that are made in China are more than they are for the imported devices. Imported devices have more restrictions on them in terms of what is required, in terms of documentation proving that they were registered abroad. And the domestic devices, in some cases, are eligible for more priority programs and pilot programs than imported devices.

I'd like, since I'm watching the time, go a little bit faster. And I'd like to venture into the intellectual property and data flow area. And here, in the interest of time, I'd like to focus on one regulation in particular that's been an impediment, that is the Human Genetic Resources Regulation.

The Human Genetic Resources Regulation was promulgated in 1998, but it wasn't vigorously enforced in 2015. In 2015, it was expanded to cover all clinical trials being conducted in China by foreign or foreign invested companies. It provides that any company that would like to -- any foreign company that would like to collect, use, analyze, or transfer biospecimens containing Chinese DNA must do so in a collaboration with the Chinese party, and that means that the collaboration must be approved prior to initiation of a study.

As part of that approval process, the company must articulate their plan for using the biospecimen, including where they will be stored, who will store them, whether they will leave China, and the data associated with those biospecimens including where it will be stored and who it will be passed to. If they would like to export samples from the country, they have to apply for separate export permit. If they would like to transfer data to a party that is not part of the collaboration, they must submit a record filing and upload a copy of the data to a government database where they can do so.

Also as part of the approval process, they have to articulate how they will divide the intellectual property related to the collaboration in the event there are results that are patentable from the collaboration and the use of the human genetic resources. This requirement in China is not a default rule. It is a rule that the parties to the collaboration divide -- jointly own, excuse me, the patent rights to any patentable inventions that arise from the collaboration.

This results in difficult negotiations during the start of a study, and it can sometimes delay the study in China by up to three or four months while these negotiations happen, including negotiations with the entity within the Chinese government to approve these collaborations, which is called the Office of Human Genetic Resources Administration within the Ministry of Science and Technology. To be clear, most in OHGRA do not seek to obtain intellectual property over the drug or the device, the background IP, nor do they seek to obtain control over the registration of that product in China. They interpret this requirement of joint patentability and ownership to cover exploratory resource, but that's a concept that they have not designed.

In the interest of time, I will just say that in terms of recommendations and a path forward, we hope to see China continue with the progress that it has made on many fronts in terms of merging the -- for example, the imported and domestic medical device pathway, in terms of freeing the restraints on research and on data flow, providing more guidance to companies so that they understand the restrictions and they can obtain approvals that they need to do the research, and to own the results of the research within a reasonable period of time. Thank you very much for having me today.

**PREPARED STATEMENT OF JOHN BALZANO, PARTNER, COVINGTON &
BURLING LLP**

**Testimony before the U.S.-China Economic and Security Review Commission:
China's Evolving Healthcare Ecosystem: Challenges and Opportunities**
May 7, 2020

John Balzano, Partner, Covington & Burling, LLP¹

I. Introduction

I would like to thank the U.S.-China Economic and Security Commission for this opportunity to testify at this hearing on China's Evolving Healthcare Ecosystem: Challenges and Opportunities. I have been observing and working with China's system for regulating foods, drugs, and other medical products since 2004, both as a researcher and a practitioner. I worked with U.S. and Chinese government officials on legal reform projects and with companies around the world to understand and interface with China's regulatory system. I read, speak and write Mandarin and follow the new laws, regulations, rules and documents as they emerge daily from China's government, including the State Administration for Market Regulation, the National Medical Products Administration (NMPA), and the National Health Commission—which are some of the key regulators in the digital health area.

As an introductory point, over the last five years China's policies have encouraged development and innovation in the healthcare and drug and device regulatory areas. This development and innovation is a key pillar of the 13th Five Year Plan. For healthcare, the policies have focused on providing affordable healthcare throughout the country to all citizens through the state-run insurance plans.² This includes faster access to innovative drugs available in other countries. It also includes expansion of the regulatory framework for digital health and the ability for citizens to obtain healthcare remotely through telemedicine, e-diagnosis services, and Internet hospitals. China has strongly encouraged the use of other technology, such as artificial intelligence, in healthcare settings.

China released important regulations on digital health in 2018 that created a regulatory structure for specially licensing hospitals that provide e-services.³ And during the Coronavirus outbreak in China, the government emphasized the importance of digital health and telemedicine to ensure treatment for patients.⁴

¹ The viewpoints expressed in this document are entirely my own and do not reflect those of Covington & Burling, LLP.

² Opinion on Deepening Healthcare Security System Reform (CCP, State Council 2020), available at http://www.gov.cn/zhengce/2020-03/05/content_5487407.htm; Outline of "Healthy China 2030" (Central Committee of the CCP and State Council 2016), available at http://www.gov.cn/zhengce/2016-10/25/content_5124174.htm.

³ Notice of the National Health Commission and the Chinese Medicine Bureau Releasing Three Documents including the Interim Administrative Measures on E-Diagnosis (2018), available at http://www.gov.cn/gongbao/content/2019/content_5358684.htm.

⁴ See, e.g., National Health Insurance Commission of the National Healthcare Security Administration, Guiding Opinions on Promoting the "Internet +" Medical Insurance Service During the Prevention

These regulations permitted a variety of follow-up visits through e-diagnosis services provided by brick-and-mortar hospitals and “internet hospitals.”

In terms of regulated products that support digital healthcare solutions, such as medical device technologies, China has similarly encouraged innovation by implementing regulatory measures to more quickly register these device products. These measures include issuing guidance on how to structure applications for medical device software, and strengthening the capacity of NMPA and its Center for Medical Device Evaluation (CMDE) to review and approve products on a compressed timeline, devoting the most resources to products with a particular level of innovation (e.g., the first of their kind globally) or that fill a heightened clinical need (e.g., pediatric, orphan, or geriatric devices).⁵

Both foreign and domestic companies in China have benefitted from these policies. But as I will discuss, there are still structural features of some of these regulations or practices that either (1) restrict foreign investment or (2) tie certain additional burdens to or limit regulatory choices on the basis of the company being a foreign company or using foreign manufacturing operations. As China progresses in developing the healthcare regulatory area, the hope is that these differential burdens will be eliminated.

As requested, this testimony addresses four core legal and regulatory areas in the China life sciences industry: (1) evolving limits on foreign participation in the digital healthcare market, (2) regulatory landscape for foreign participation in the medical device and digital technology market, (3) intellectual property challenges for foreign firms, and (4) current limitations on healthcare cross-border data flow.

II. Participation by Foreign Companies in the Digital Healthcare Market

China allows foreign companies to participate in its digital health market. Companies based outside of China can, and do, invest in the provision of online medical services and the development of mobile medical applications that are registered medical devices in China. China’s laws do not prohibit participation in those markets by foreign companies.

There are, however, features of China’s healthcare regulation that restrict foreign companies in the digital health area. These features pertain to the difficulties with commercial companies generally, and sometimes in particular foreign companies,

and Control of the New Coronary Pneumonia Outbreak (Feb. 28, 2020), available at http://www.gov.cn/zhengce/zhengceku/2020-03/03/content_5486256.htm.

⁵ Opinion on Deepening Reform of the Examination and Approval System to Encourage Drug and Medical Device Innovation, (CCP Gen. Off., State Council Gen. Off. No. 42, 2017), available at http://www.gov.cn/zhengce/2017-10/08/content_5230105.htm.

entering China’s healthcare infrastructure, which is largely based on a system of licensed hospitals.

First, all companies, whether foreign or domestic, face the challenge that, under China law, only licensed “medical institutions”—which is a generic term for hospitals and clinics in China—are permitted to provide medical services to individuals. Those medical institutions are licensed based on having sufficient facilities and personnel to deliver the medical services for which they are registered.⁶ Without such a license, a company cannot deliver or advertise those services.

As medical service is not defined in detail (and there are not sufficient carve-outs, for example, for health and wellness information or disease awareness), it can be difficult for any company to understand the line between providing general health and wellness knowledge and providing actual medical advice. To reduce risk, commercial companies that do not have this license may have to partner with a medical institution, whether state-owned or private, and negotiate terms with them, as opposed to having the option to provide some of these services in-house. Similar restrictions exist in the area of biobanking, which is limited to qualifying entities.⁷ Companies do not have freedom to biobank on their own absent a specific license.

A second restriction applies only to foreign companies, however. If a foreign company decides to invest in or seek to establish its own medical institution, in practice its ownership may not exceed 70 percent under current rules.⁸ In practice this has not prevented overall investment, but it is still a restriction that limits foreign investment independent of partners.

III. Medical Devices and Web Platforms

Use of technology for measuring and monitoring health indicators or assisting in disease diagnosis is another part of digital health.⁹ In China, if the instruments that conduct these functions are marketed as having a diagnostic, treatment, or disease monitoring function then they will likely need to be approved as medical devices¹⁰ by NMPA or one of the provincial medical products administrations, depending on

⁶ Medical Institution Supervision Regulations, Arts. 2, 15 (State Council No. 666, 2016), available at http://www.gov.cn/gongbao/content/2016/content_5139374.htm.

⁷ Human Genetic Resource Regulations, Art. 14-15 (State Council, No.

⁸ Special Management Measures for Foreign Investment Access (Negative List) (“Foreign Investment Negative List”), Item 33 (2019), available at

http://drc.changchun.gov.cn/zcfg/201907/t20190722_1948134.html; Interim Measures on Sino-Foreign Invested and Cooperative Medical Institutions, Art. 7 (Ministry of Foreign Trade & Econ. Collaboration, 2000), available at <http://www.satcm.gov.cn/fajiansi/gongzuodongtai/2018-03-24/2295.html>.

⁹ Medical Device Supervision and Administration Regulation, Art. 76 (State Council No., 685 2017).

¹⁰ Guiding Principles on Technical Registration Review of Mobile Medical Devices (NMPA No. 222, 2017), available at <https://www.cmde.org.cn/CL0112/7812.html>.

the class and the place of manufacture. Domestic and foreign companies can register their products as domestically made or imported devices, depending on where the products are made.

The differences between these two pathways (i.e., domestic and imported) are shrinking in many respects, but there are still disparities. For example, imported medical devices must generally be approved outside of China before they can be registered in China, whereas domestic devices may be registered with no foreign approval.¹¹ The applicant for an imported medical device registration must be the entity that holds the foreign approval in the country of origin; this restricts flexibility in structuring corporate relationships and partnerships in China. For example, foreign companies cannot transfer their marketing licenses to their China affiliates if the medical device is manufactured outside of China. To do that, they would have to transfer manufacturing to China. Also, China has maintained the requirement that foreign companies submit evidence of foreign approval despite the fact that NMPA conducts its own very rigorous review of the device marketing submission and, since 2015,¹² has established a robust inspection program for foreign medical device manufacturing facilities.¹³

China requires that all devices (including software) submit specifications that are based on China's own national and agency-level standards, which it treats as mandatory.¹⁴ This requirement restricts all companies from developing innovative designs. It can restrict any company that has designed their device abroad under more flexible medical device regulatory frameworks and that needs to conform that design to different standards in China, even if they are able to provide data to support the potentially more innovative design.

Also, certain expedited "green channel" pathways, such as the "innovative device pathway," require that intellectual property rights be held or licensed in China (even if the device is made abroad).¹⁵ A pilot marketing authorization program established in 2017 that gave more flexibility in structuring manufacturing relationships to include more than one manufacturing site was only available to entities that made their devices in China, although the China-based affiliates of foreign companies were permitted to participate.¹⁶

¹¹ Medical Device Registration Measures, Art. 13 (NMPA No. 4, 2014), available at http://www.gov.cn/gongbao/content/2014/content_2758500.htm.

¹² China Food and Drug Administration Organizes First Foreign Manufacturing Site Inspection for Medical Devices, available at <http://www.ccpie.org/cn/yjxx/ylqx/webinfo/2015/12/1481297436158390.htm>.

¹³ Regulations on Foreign Inspections for Drugs and Medical Devices (NMPA No. 101, 2018), available at <http://www.nmpa.gov.cn/WS04/CL2138/334163.html>.

¹⁴ Medical Device Supervision and Administration Regulation, Art. 6.

¹⁵ Innovative Medical Device Special Approval Examination Procedures, Art. 2 (NMPA No. 83, 2018), available at <http://www.nmpa.gov.cn/WS04/CL2093/331560.html>.

¹⁶ Notice on the Expansion of the Medical Device Registrant System Pilot Work (NMPA Device Reg. Div., No. 33 2019), available at <http://www.nmpa.gov.cn/WS04/CL2197/339662.html> (program in 21 provinces named therein).

Deployment of digital health technology via the Internet can also be limited. While this is not my area of expertise, China's Internet regulations place restrictions on ownership of servers in China by foreign companies. If the websites on those servers are conducting for-profit activities, they must receive telecommunication licenses—which are difficult generally to obtain—and even then the foreign invested company may only own 50% of the telecommunications venture.¹⁷ To deploy technology online, foreign companies must often partner with Chinese technology or Internet companies to release the applications on websites in China.

Content that is released online is subject to stringent content and advertising restrictions under special rules for drugs, medical device, and medical service advertisements,¹⁸ rules governing drug and medical device informational websites, and rules governing Internet advertisements generally.¹⁹ These restrictions apply to all online content, regardless of whether it comes from a foreign or domestic company.

IV. Intellectual Property Restrictions

Restrictions on intellectual property gathered from research depend on the context. For example, there is a set of laws and regulations that govern when research is funded by the Chinese government. In general, those laws require that there be an agreement between the government and the Chinese party on the allocation of intellectual property obtained from the research.

If a Chinese company takes a grant from the government and later decides to transfer its rights to foreign parties, the law may call for the Chinese company to first obtain permission from the government department supervising the research.²⁰ In practice, however, it is not clear that these provisions have played a serious and limiting role. My understanding is that these restrictions can be navigated, and I am not aware that the government regularly restricts these transfers.

¹⁷ Special Management Measures for Foreign Investment Access (Negative List) ("Foreign Investment Negative List"), Item 20 (2019), available at http://drc.changchun.gov.cn/zcfg/201907/t20190722_1948134.html.

¹⁸ Advertisement Law, Art. 16 (Nat'l People's Cong. Standing Comm. 2018); Medical Device Advertisement Examination Standards (SAMR, NMPA No. 40, 2009), available at <https://www.cmde.org.cn/CL0094/2237.html>; Medical Service Advertisement Rules (NHC No. 26, 2006), available at http://www.gov.cn/ziliao/flfg/2006-11/28/content_455183.htm.

¹⁹ Tentative Measures on Internet Advertisements (SAMR No. 86 2016), available at http://www.cac.gov.cn/2016-07/08/c_1119187555.htm.

²⁰ Law on the Scientific and Technological Progress, Art. 21 (Nat'l People's Cong. Standing Comm. 2007); Law on Promoting the Transformation of Scientific and Technological Achievements, Art. 6 (Nat'l People's Cong. Standing Comm. 2015).

The more serious impediment for foreign companies or foreign invested companies (i.e., companies based in China that have some level of foreign investment) is China's Human Genetic Resources (HGR) Regulations. Those regulations were first issued in 1998, but were largely unenforced or narrowly interpreted until 2015. The HGR Regulations protect biological samples containing the genetic code of Chinese citizens and the information associated with those samples as a national resource.²¹ The HGR Regulations tie the protection of this natural resource not only to public health but also to the national security of China.

Under the HGR Regulations, foreign companies or any company controlled (in some measure) by a foreign company may not independently collect, store, use, transfer, or export human biospecimens obtained in China. These companies may only take some of these actions as part of a collaboration with a Chinese party, and that collaboration must be approved by the Office of Human Genetic Resources Administration (OHGRA), which is an agency under the Ministry of Science and Technology.

This means that for every foreign-sponsored clinical trial in China in which, for example, a blood sample is taken there must be an approval by OHGRA. This approval is in addition to the approval by the drug regulator, NMPA, to conduct the trial and the approval by the local ethics committee(s) in the relevant hospitals. HGR approval occurs at the end of the process and adds several months to the preparation time for a trial.

The HGR Regulations also include an intellectual property restriction that is enforced.²² In order to obtain HGR approval, the Chinese party and the foreign party must agree on how to divide intellectual property associated with the study. The OHGRA has explained that it does not interpret this requirement as applying to the background drug or device itself, or the data generated to assess the endpoints in the protocol.²³ But, the HGR Regulations require that if any patentable inventions arise out of "exploratory research" associated with the collaboration, the Chinese and foreign parties must jointly share the patent rights.²⁴

This joint-patent rule is not a default rule that the parties can contract around. Rather, this sharing is required and OHGRA approval will not occur without an acceptable intellectual property provision in the clinical trial agreement and HGR application. Therefore, the joint-patent rule results in difficult negotiations with the hospital and the OHGRA, sometimes with uncertain conclusions surrounding rights

²¹ Human Genetic Resource ("HGR") Regulations, Art. 8 (State Council No. 717, 2019).

²² HGR Regulations, Art. 24.

²³ The OHGRA has not issued a great deal of explicit guidance but has made these statements in response to inquiries. It may be inferred from their forms, *Compare* application forms for a notification pathway for research to support marketing ([here](#)) with the forms that support approval for broader research ([here](#)). The latter have an intellectual property section, while the former do not.

²⁴ HGR Regulations, Art. 24.

to the data and intellectual property coming from the study centered around an undefined principle of “exploratory research.”

V. Cross-Border Data Flows

The HGR Regulations also have a data flow restriction, meaning they cover not only the biospecimens (or the human genetic materials) of Chinese citizens but also the data associated with those biospecimens (human genetic information). Any time this clinical trial data is transferred to a foreign party, the OHGRA must be notified in some way.²⁵

OHGRA is notified through a two-step process. In the first step, the data must be uploaded to a government website (and kept on file). In the second step, the parties to the collaboration work together with the hospital that hosted the clinical trial to upload a form that describes where the data is going. Once OHGRA accepts both submissions the data may be transferred. Before accepting the application, OHGRA has the option to conduct a national security review to determine if the data is sensitive.²⁶

The implication of this data restriction is that any scientific data that comes from tests on human samples in China requires a potentially cumbersome process to transmit the data from Chinese to foreign parties.

Enforcement in the HGR area is a concern. In 2018, while OHGRA originally focused on cases in which samples were received without permission, recent regulatory changes indicate it can expand to data.²⁷ Penalties could include fines and orders to destroy the samples, as well as disqualification of a company from applying for future studies for several years. Due to the recent amendment to HGR Regulations in 2019, the penalties are more substantial and possibly include hundreds of thousands of dollars in fines and, in serious cases, life time disqualification.²⁸ This includes penalties for a foreign company that exports samples or data abroad in violation of the regulations.

China has other data restrictions. For example, China has a Cybersecurity Law, which it has been slowly implementing and can potentially restrict cross-border data transfers for operators of “critical information infrastructure” (a term that is still being defined). China also has Scientific Data Management Regulations that regulate the flow of scientific data funded by the government, and various

²⁵ HGR Regulations, Art. 28. Collaborators in the approved project are not subject to this restriction, but they are limited to a defined universe of entities, including the sponsor of the study, *Id.*

²⁶ The process is described in Scope and Procedures for Filings of Provision of HGR Information Abroad or Release for Use, available at <https://fuwu.most.gov.cn/r/cms/zwpt/web/assets/pdf/8.rlyczyxxdwtghkfsybafwhcx.pdf>.

²⁷ Penalties from 2018 are listed, [here](#).

²⁸ See, e.g., HGR Regulations, Arts. 41, 43.

provisions in other regulations that prevent healthcare data from being stored outside of China. For example, the Internet hospital regulations prevent healthcare data storage outside China. My understanding, however, is that the HGR restriction has been the most difficult in practice to date.

VI. Conclusions

I would like to thank the Commission again for the opportunity to offer this perspective. China has made considerable progress in building the legal and regulatory infrastructure for its healthcare and life sciences industries, including in particular digital health. There is more to be done, however, to remove problematic restrictions and limitations. For example:

- Restrictions on certain areas of foreign investment and mandates that require Chinese-foreign joint ownership in certain percentages, including in the areas of internet platforms and medical institutions, should be lifted or eased.
- The gap between the imported and domestic pathways for medical devices should be closed to promote innovation and create opportunities to structure valuable partnerships. For example, no evidence of foreign approval should be required regardless of the approval status abroad, if the device can meet the standard for approval.
- Chinese standards and testing laboratories should not be mandatory if the necessary data can be generated in other reliable ways.
- There should be additional flexibility and legal support (i.e., it should be legally permissible) for use of the Internet to offer and promote health and general wellness platforms.
- Parties to scientific and clinical research projects should have the freedom to freely enter into collaborations and contract with respect to intellectual property associated with those endeavors.
- There should be realistic mechanisms and channels to permit and facilitate the transmission of biospecimens and pure scientific and research data out of China, and to allow institutions and companies that generate that data to store it in China and abroad.

PANEL QUESTION AND ANSWER

COMMISSIONER LEE: Thank you very much, Mr. Balzano, and thanks to all four of the witnesses for your excellent testimony and for sticking to our very stringent time limits. But now we will have an opportunity to go back and forth and to ask questions from the Commissioners, and we will try to limit it to five minutes per Commissioner. And if we have time for a second round of questioning, we will go to that.

So I'm going to call on myself first, take the prerogative of the Chair, and start with Dr. O'Toole. You made a provocative statement in your testimony, the Chinese government is aggressively pursuing global dominance in biotechnology, particular genomics, and that this is a route to expand global power. And in your recommendation, you say that the U.S. should recognize the national security implications of China's quest.

I'd like to hear a little more about that, but also whether you think U.S. companies are also being disadvantaged by the Chinese government's biotech policy. And if so, are there policy solutions that the Congress should be pursuing to either offset the Chinese government action, or to challenge any inequitable tactics that are being taken?

You're on mute. Unmute yourself.

DR. O'TOOLE: So I think biotechnology, and many others believe this as well, is going to be the technology of the 21st century. What we have discovered in the last two decades is that biology is essentially programmable. And we are getting increasingly adept at reading, writing, and editing the code of life, which is going to have applications, not just in the biomedical field but across most of the verticals that we think of as industry: agriculture, energy, material science.

And biotech in the guise of synthetic biology is likely to become one of the major manufacturing platforms of this century. Already 20 percent of industrial chemicals are made via biological processes, and that's just the beginning.

So I think China is smart, actually, in prioritizing biotech, which it's done very openly. And as part of its five-year R&D plan, it calls biotech a critical strategic priority and it has moved out smartly and briskly to make those ambitions real, as evidenced by their investments, for example, in genomic sequencing, which they are a powerhouse in, and their investments in precision medicine, which are much more ambitious than those of other countries. Everybody is pursuing precision medicine, but China on a much larger scale and with more money and over a longer period of time.

So I don't fault them for going in that direction. The problem is that the United States, the national security community is not yet plugged in to the strategic importance of biotech. We are the innovation engine of biotech. It's our trillion-dollar investment in NIH since 1950s that generated this explosion of knowledge, but we are not making good on that investment. We have a very good weak translational infrastructure. So we are relatively disadvantaged compared to China, which I'd be happy to talk about more.

I think there's no question that American companies are very interested in investing in China, and China is definitely interested in investing in American startups.

The rules for working in China, I think, as Mr. Balzano pointed out, are complex. They're very difficult to negotiate unless you have a Chinese partner; that's almost essential now. In some cases, it's legally essential.

I don't think that will stop pharma from wanting to invest in China. All of the big pharma companies have giant facilities there. And my caution would be that although I think strengthening CFIUS was a good thing, we need to be careful about turning off Chinese

investments here and thoughtfully go forward on innovative projects.

COMMISSIONER LEE: Thank you very much, Dr. O'Toole. And Mr. Balzano, I'll have a follow-up for you if we get to the second round of questions. But for now, let's move on and we're going to go in this order, Commissioner Borochoff and then Chair Cleveland and then Commissioner Fiedler, and then I'll work down the list. So Commissioner Borochoff?

COMMISSIONER BOROCHOFF: First, let me say thanks to all of you, and I found this fascinating. Dr. O'Toole, if we get to a second round, I'm going to have another question for you. But in the short run, Mr. Balzano, I would like you to expound a little bit in detail as to what the real difference is between the way a company can do business in America versus be able to develop a medical device in China.

If I understood correctly, you have to have a partner and then there's a whole variety of hoops to jump through. And at the end of the day, they want to keep the intellectual ownership. Is that correct?

You have to unmute.

MR. BALZANO: Apologies. I'm not used to the unmute button.

So for a medical device in China, the development -- the regulatory pathway and the development pathway on paper are not terribly dissimilar. You have to generate data to support the safety and efficacy of your device in China. You have to make a determination as to which classification it fits into in China, one, two, or three. The classifications are very similar to United States. You have to potentially conduct a clinical trial or locate, for example, an exemption from the clinical trial, and you're going to have to make choices about the indications and scope of use of your medical device, and then get approval from the government to do that.

Where there are sort of differences, in my view, are when you head into clinical research, as I was talking about, you have this human genetic resources level. That is a separate level from the device regulatory level. That is something that governs all research.

So yes, for that, you have to have a partner. That partner is typically the Chinese hospital where the trial would be conducted anyway. But the uniqueness of the rule is essentially the sort of terms of the partnership and the terms of approval for the study and then potentially the enforcement implications, which I didn't get to talk much about in my testimony.

But not complying with the human genetic resources rule pretty exactly can result in very substantial fines and more threatening disqualification from conducting clinical trials in China. You have to spend a great deal of time and effort to make sure that process is right. And in doing so, you have to think about how to get the data from the study to be potentially transferred abroad.

If you're a collaborator within the human genetic resources study, you can have access to the data pretty freely. But if you're not a collaborator -- because clinical trials are structured in all different ways and there are a variety of different realities in that respect. If you're not a collaborator, then you have to submit record filings, which means notification to the agency before any data goes to any foreign party.

And that requires uploading all the data that you have before you transfer it, and then submitting a form describing where it's going to go and waiting for an okay from the agency before you move forward. That's a significant burden, actually, in a clinical trial where data about injuries and serious adverse events, potentially if it's a global trial, needs to be reported in real time around the world. So that's the significant, I think, difference.

This imported device pathway has always existed, and I think that is different from many other countries, and it does come with different restrictions. China has made some progress

towards merging them, and we can hope that it'll move forward with that progress in the future and merge the imported and domestic pathways that even though a device is made outside of China, they can supervise it equally well.

COMMISSIONER BOROCHOFF: So are you saying that they're working harder to retain the intellectual property they're gaining from the genome research much harder on that than on physically manufacturing devices?

MR. BALZANO: I think the regime is -- the HGR regime, I'll just brand it, is structured to make sure that they have a very clear record of the IP associated with studies and where the data from those studies are going and the ability to intervene if they need to do so. But under the medical device regime, it is still pretty clear that there are a number of regulatory mechanisms to encourage more manufacturing of devices in China. That is also correct too.

COMMISSIONER BOROCHOFF: Thank you.

COMMISSIONER LEE: Thank you. Next, we'll go to Chair Cleveland, and after her, Commissioner Fiedler and Commissioner Goodwin.

CHAIRMAN CLEVELAND: Thank you. I have two questions, but I think I'll start with sort of some nuts and bolts. If I'm hearing Dr. O'Toole and Dr. Eggleston, your testimony, and I think Dr. Bouey, you as well, you talk about the -- you address the level of training. And the average Chinese doctor, as I'm understanding, has four or five years, essentially graduates with what amounts to a bachelor of science degree, in terms our education system. And recently, there have been residency requirements that have been added to the training.

And I think about that level of training and expertise in the context of these ambitions to digitize and use AI to improve diagnosis and treatment. But someone at the end of the day still has to read the x-ray and get the diagnosis right and get essentially a treatment plan right. And I'm trying to reconcile this construct of doctors, with relatively little sort of specialization or education, with these ambitions to create this biotech platform. And so how do you see the current medical -- can you talk about the training and the ability to use some of these sophisticated digital platforms and diagnostic capabilities with the level of training and expertise of doctors in China?

COMMISSIONER LEE: Dr. O'Toole, unmute. There you go.

DR. O'TOOLE: Well, I think they're using digital health to augment the analytical capabilities of their physicians. A lot of these devices are decision trees, if you will, algorithms that put together reported complaints in systems and dive down into what the most likely diagnosis is. And we have digital health devices here that are doing similar things, for example.

So you can go on digital devices and say, I've got a fever. I've got a cough. I'm a grocery store worker. And it will come back and it will say, well, you have an 85 percent chance of having COVID-19, for example. Eighty-five percent of the people with your symptoms would have this disease.

So they are an aid to the doctors in one sense. They also offload the huge number of patients that doctors see. And one of the problems is that because people prefer to go to the more sophisticated hospitals, those hospitals are overrun. And it's hoped, I think, that these digital devices will allow a lot of those patients to kind of take care of themselves by being directed to, you don't need to see a doctor, do this, or you do need to go see a doctor, this kind of doctor, sort of thing.

So they're using their expertise in AI. It's mostly machine learning, I think, to augment the relatively lower educational level of their physicians. It makes good sense.

COMMISSIONER LEE: Thank you, Dr. O'Toole. Any additional thoughts from Dr.

Bouey or Dr. Eggleston? Dr. Bouey?

DR. BOUEY: Yes. Can you hear me? I'm actually talking through my phone. Okay. So this one is a little bit more stable. So I totally agree with Dr. O'Toole. The reason that they adopt more machine learning and AI is, one, to help with the insurance coding system.

With the DRG, most of the DRG coding in this country is coded by hand. But in China, given it's relatively new and the large amount of work, they're basically directly going to the machine learning and AI to do that. Same thing for the medicine. I know at least for global health, they're hoping to use some of the cloud computing to help the remote areas to get basic screenings. Thank you.

COMMISSIONER Lee: Thank you, Dr. Bouey. Dr. Eggleston, anything to add?

DR. EGGLESTON: They pretty much covered it. Just to note that China has changed quite dramatically in just a few decades, the way we've changed over a century, and thus previous generations of training and standardization are quite evolving. So these standards apply to the current doctors, but you have previous village doctors that had very different training. And they're trying to enable these technologies to provide those services in rural areas to leverage those that have more recent and up-to-date training to assist those that have more experience with less training.

COMMISSIONER LEE: Thank you, Dr. Eggleston. Next, we will hear from Commissioner Fiedler.

COMMISSIONER FIEDLER: I have a COVID-19 related question. Some of us don't believe many of the numbers or most of the numbers that are reported out of China on any subject. In this case, the numbers being reported are ostensibly so low, and I'll explain to you why I think they're dubious.

One, we're learning in the United States that the disease was here earlier than anybody thought; number one. Number two, it's attacking communities of people who are underserved and unequal, whether it be migrant workers in China or people of color in the United States. And it is particularly pernicious to people with underlying conditions, and China has a higher percentage of people who die normally from pollution-related problems that it is inconceivable. And by the way, people from Wuhan left -- several million people from Wuhan left early, earlier than the lockdown, when the disease was clearly present. Does anybody believe these numbers, who's testifying here this morning?

DR. BOUEY: This is Jennifer Bouey. Maybe I can say a few words on that. I got quite a lot of questions like that. I think there's a reason to be skeptical on the numbers because we have seen the trend that numbers can change, vary with the political will.

But I sort of believe the number from January 20th to February because I think that's the time when the Chinese government put it as a priority, and they also need those numbers to mobilize the national resources. It's only until February, when the peak is over, that government is hoping to reopen the factories, then we see a very, very small number. But I do believe that overall, China has contained the virus.

And I can say a few -- there's definitely deaths not being counted for COVID, especially in the early days when the testing is not on par, when the healthcare system in the Wuhan area has been overwhelmed. That's a technical issue, I think. But it also happened other places.

But we also have to know that Wuhan has been locked down two days after they announced the emergency, and then most of the patients stayed in Wuhan. And they didn't really have a big fire like Wuhan in any other cities in China and limited in Wuhan. So that, I think, in a way reduced the total number of deaths in China.

COMMISSIONER LEE: Any of the other witnesses like to jump in?

COMMISSIONER FIEDLER: Let me raise the question of their preparedness for a second wave, which everybody expects in the United States and raise the question of what information we are getting about their strain, which apparently according to the papers today, it was -- I mean, there's European strains now and the Chinese strain or the West Coast strain. What information are they sharing with us, or we are getting, on treatment and on a vaccine?

DR. BOUEY: So very quickly, I think for the second wave question, I do think the Chinese government is very -- kept on high alert on that. That's why we see a very slow phase to open up. They had the national guidance and provincial guidance since end of February all the way to April to open up gradually different factories.

And they have the contact tracing app in place. So all of these are to try to discover the clusters as soon as it shows. So we, so far, have seen some of the imported cases, and they have been doing multiple interventions on that.

In terms of vaccine, they have two candidates that's in the Phase II that they have announced and one, I think, may be in Phase I. Treatment, there is a very comprehensive treatment menu in the seventh version at least, the last time I see it, and translated in English. So I'll stop there.

COMMISSIONER LEE: Thank you. And Dr. O'Toole, I didn't know if you had a very quick comment you wanted to make?

DR. O'TOOLE: Yeah, I would agree with all of that. I think we are actually getting quite good numbers on COVID cases from China. They were very clear about the importations from Russia that happened, and they are keeping track through what we would regard as fairly draconian means of the number of cases and who's allowed out.

COMMISSIONER LEE: Great. Thank you very much, Dr. O'Toole. The next three Commissioners, Commissioner Goodwin, Kamphausen, and Lewis in that order. So Commissioner Goodwin?

COMMISSIONER GOODWIN: Thank you, Commissioner Lee, and I want to thank you and Chairwoman Cleveland for putting together such a great and timely panel here today. And I certainly want to thank the witnesses for their time and very thoughtful testimony.

My question is for Dr. Eggleston. In your written testimony, you are discussing the regulatory landscape of the Chinese healthcare system, and you reference one trend, as you've seen it, and that includes a set of policy experiments involving integrated healthcare organizations, including mergers between hospitals and healthcare providers. And then you go on to note that one of the challenges with these integrations and with these models is trying to strike the appropriate and correct regulatory balance, one that provides sufficient oversight while at the same time allowing sufficient flexibility to permit for innovation in the new model.

Obviously, we are familiar with comparable efforts here in the States. I think it's safe to say and to characterize that our regulators here have expressed some interest in similar efforts in integrated care, value-based care, outcome-based care. And there's certainly regulatory provisions that remain in place that affect those efforts, including obviously antitrust, anti-competitive statutes, anti-kickback laws, and the Stark Law, which places some restrictions on the ability of providers to refer patients to one another.

My question is, are there comparable anti-referral -- certainly there are some antitrust laws in China that affect the marketplace. But are there comparable anti-referral, anti-kickback provisions in place that are comparable to our Stark Law? How robust are they, and what impact do you foresee those having on these experiments in integrated care?

DR. EGGLESTON: Thank you for the question. I'll invite other panelists to chime in as well. Just to note that I think there will be a considerable regulatory innovation and development in those areas that haven't been pressed as far forward.

China has not traditionally relied as much on competition between insurance, but it does have considerable patient freedom among providers. And so trying to move toward a more integrated system is also related to, of course, how the providers are paid. So the multiple aspects of the system have to be regulated at the same time.

And licensing has been, traditionally, to a specific hospital. So even allowing doctors to serve at other hospitals or move, say, from a public hospital to a private hospital has encountered many regulatory barriers that they've been trying to reform. If you interview private sector providers in China, as I have, they'll often talk about how it's difficult to approve physicians for many reasons, some regulatory, some having to do with career concerns in their portion of the market.

And so there's a lot of variation across regions about how they interpret even the national laws and how they're implemented. And as China reforms both the payment system and its legal structures, there are questions about whether they're going to also have to think about antitrust and whether it's integration of just the government-owned providers and clinics or whether private providers are included and how that's managed.

That whole area including regulation about malpractice and how that's dealt with will be important because there are very tense physician-patient relations in many places right now in China. So it's a very important area that they'll continue to try to innovate, potentially could be very useful for addressing healthy aging and expenditure control. But there has to be accountability for quality so that patients will believe that primary care is as high quality as the large hospitals. And there's reason for patients to doubt that at the moment.

COMMISSIONER LEE: Thank you very much. Any other panelists care to weigh in? No?

COMMISSIONER GOODWIN: All right. Thank you.

COMMISSIONER LEE: Thank you, Commissioner Goodwin. Commissioner Kamphausen?

COMMISSIONER KAMPHAUSEN: Thank you, Commissioner Lee and our Chair for putting together this terrific hearing. Thanks to our panelists for preparing it so well. I have two questions, one for Dr. Eggleston and one from Dr. O'Toole. And Dr. Eggleston, let me say your prepared testimony really is just a marvelous resource for us, 22 pages of figures following your testimony. So I'm very grateful, and I think it'll be a great resource for us.

A question for you is, you briefly mentioned China's aging demography, and so I want to allow you to talk some more about that. The particular question being, how does the leadership of the Chinese Communist Party think about its aging population? So you can understand I'm really looking at the nexus of public health, national security, domestic policy, and so forth.

For Dr. O'Toole, in your recommendations, you said we need to get serious about collecting and protecting data, and I wanted to allow you an opportunity to talk a little bit more about that. And the materials that were prepared for us by our staff, they talk at some length about the importance of access to U.S. data for China's researchers.

And the implication, I guess, is that it's not just that it's American but that it contributes to the broader accumulation of data which makes the formation of those algorithms and other models more effective. But I just wanted you to -- since you alluded to data in a national security context, I wanted to give you a chance to talk some more about that. Thank you.

DR. EGGLESTON: Thank you for the question. Just to note that China's officials are quite aware that it's aging rapidly and have tried to take steps to address that. In one sense, it's a triumph of longevity in the sense that they're controlling previous infectious diseases and brought mortality down so that people are living longer.

We also know that China's future population structure will be different depending on whether 60 is the new 50, whether there's compression in morbidity. The current elderly in China, of course, grew up in a very different China, even pre the Mao era. And the current generations, when they become older will have benefitted from much higher living standards and education and so on.

So many things are changing in China, and of course, that's affected by family planning and fertility policies as well. So they're well aware of aging and the need to try to support the population in terms of chronic disease control, although it's much easier said than done when you have a very hospital-based health service delivery system. Patients were already lamenting *kan bing nan kan bing gui* (foreign language spoken) which is healthcare is difficult to afford and even to access.

So many policies are trying to address that, but affordable, convenient chronic disease management enabled through technology and competent local providers is certainly a goal that they're going to try to strive toward. And they have other challenges with pensions or thinking about labor force participation, raising their very low retirement ages. Many of these things interact in terms of financing a more robust healthcare system going forward.

And they don't have any system of long-term care insurance, but there are pilots. And it'd be interesting to see how those develop in trying to support Chinese who want to -- filial piety is a tradition that they value. But if young people are migrating or elsewhere, they have a difficulty fulfilling that. And without some kind of support for long-term care, that's a conundrum for many families. So many challenges there.

COMMISSIONER LEE: Dr. O'Toole?

DR. O'TOOLE: So data, of course, has long been the lifeblood of scientific research. But in this century, it has taken on a new importance. In the search for new drugs, for example, it is very important that you test your candidate drug against sufficiently large populations to be statistically meaningful. But also, you want to test them against very biologically heterogeneous populations so that you have a good sense of whether the drug works in people with different kinds of biology, different genetic and ethnic heritage, et cetera, et cetera.

China has a huge population, but it has a genetically fairly homogeneous population if we're talking about the Han Chinese and not the outlying areas. So they are seeking the heterogeneity which is one of the great values of America's health data. We have a very biologically heterogeneous population which is important not just in developing drugs but in genomics particularly which is becoming one of the foundational sciences of the life sciences in biotech.

Genomics is basically a comparative game. If you have enough genomes that specify the sequence of nucleic acids in a particular individual, you can compare them and figure out why this person's genome differs from the other and what a cancerous genome looks like, for example, to oversimplify horribly. So large amounts of data from large heterogeneous populations are extremely valuable.

And as you get more sophisticated in genomics and you try to understand not only what are the genetic signatures of this disease or risks for having this disease and you go beyond that to understanding more subtle traits that are the combination of many different genetic markers as

well as environmental conditions, the bigger the data set is that you need to be able to work on. China has been very adroit in sequencing large numbers of organisms, humans, animals, and plants over the past 20 years.

We have been less aggressive in doing that. Our Precision Medicine Initiative, for example, is much less ambitious than China's. But what everybody wants is a large heterogeneous population of genomic data augmented by what's called metadata.

And the metadata is such things as what is the age of this person, what is the clinical history of this person, did this person work in a mine or work in pristine conditions. That kind of data is also very valuable. And what China is doing, as you heard, is systematically absorbing that data electronically whereas our meta health data is kind of locked in electronic health records that belong to individual hospitals and practices and is much more difficult to get at or interpret.

COMMISSIONER LEE: Thank you very much. We'll next go to Commissioner Lewis and after him, Commissioners Talent, Wessel, and Wortzel. Commissioner Lewis?

COMMISSIONER LEWIS: Thank you all very much for helping educate us on what's happening in China. We've heard today about the Chinese health system, and you've all emphasized the need for collaboration between United States and China in this field. And we've also heard that if American companies want to (telephonic interference) we have to have a Chinese partner, we have to give over to them the secrets that we may have and any patents would be collaborative again.

And now I want to take us back 15 years. And if 15 years ago we knew that China would be the kind of country it is today, would we have been encouraging American companies to go there to help them industrialize the way they have. So the policy question I want to ask you is, given the threats from China wanting to be the dominant world in this field yet us having been a leader in biotech, what policy recommendations would you suggest that we do in this field to prevent China from dominating the field and undercutting us in the field of biomedical?

COMMISSIONER LEE: Dr. O'Toole? Oh, you just muted.

DR. O'TOOLE: We outcompete them. I think we have to get serious about our science and technology policies and understand that we are dramatically underinvesting, particularly in biosciences and the translation of the science into products. I think we have to develop a significant pipeline of talent and rethink how we do graduate research, particularly in the life sciences. It ought not to take seven to nine years to get a PhD as it regularly does in this country.

We need a lot more technical talent in the government than we have now. There's very little biological literacy in the U.S. government, particularly at more senior levels which is why I think we haven't noticed how serious the situation we've gotten ourselves in. And we should probably fund some big biology projects that would get people excited, pull in interested young people, and also demonstrate our own competency and advance our position.

COMMISSIONER LEWIS: Should we be discouraging American companies from investing and building in China?

DR. O'TOOLE: No, but we should warn them and they should have full cognizance of what they're getting into when they go in. We should maintain CFIUS review of Chinese investments in our companies, and we should get busy collaboratively developing the kind of ethical policies and rules that we're going to need to develop internationally as we go forward into this brave new world of genomics.

COMMISSIONER LEWIS: Thank you. I'd like to ask the other panelists the same policy question.

COMMISSIONER LEE: Mr. Balzano, in particular, would you like to weigh in? It seemed like some of that touched on your testimony as well. You're still muted.

MR. BALZANO: All right. So I'm hopefully better now. So thanks very much. I think for companies that are going into China, understanding the landscape and understanding the regulations is critical.

Understanding what compromises do and don't need to be made is very, very important because we often do see times when the communication between foreign companies and their Chinese partners is not very good, and that does lead to difficulties in the decision making process and really understanding the risk. Every regulatory system will have its series of risks and challenges to it. So on that level of understanding is very, very significant.

But I think we should also encourage rules that are fair in China. And so for example, the patent rule that I was talking about where the results of exploratory research must be jointly patented. That could be changed, for example, to a rule where the parties are freely -- permitted to freely contract and negotiate the patent rights arising from a study as opposed to sort of offering it as a default rule.

The data restrictions could be much less than they are. The imported and domestic pathways for products, I think if you look at the reasons in the past why those pathways were separate was very often because China didn't know what was going on abroad and couldn't expect -- inspect, excuse me, and now has a robust foreign inspection program. So the difference is and the needs for those types of pathways that were previously proffered are shrinking, and I think we can point those out in various different dialogues and encourage more of a fair playing field in terms of production.

COMMISSIONER LEWIS: So the government has to get involved in setting some rules for American companies (telephonic interference)

MR. BALZANO: I'm sorry. I might have missed that question. It cut out a bit. Should the government get involved in --

COMMISSIONER LEWIS: Are you suggesting setting rules by which U.S. companies can participate in China?

MR. BALZANO: No, I'm suggesting that the Chinese government should remove some of the restrictions and create more of an even playing field, that if you're going to have -- that China's Human Genetic Resources rules create strict rules that could be turned into situations where the parties are allowed to freely negotiate for the intellectual property as opposed to requiring them to split it. I'm saying that those types of restrictions in China can be lifted.

COMMISSIONER LEWIS: How do we get the Chinese to lift those restrictions unless U.S. government gets involved in this issue?

MR. BALZANO: Well, I think -- I mean, I think certainly the government can be involved in dialogue. That absolutely can be the case. But I think also there needs to be sort of -- hopefully, what we can do is show them that these are rules that have not been necessary in other countries and that the rules that facilitate scientific research and data flow with appropriate protections for privacy, et cetera, have proven to work.

And China is very, very open in some respects to hear about international expertise and to hear the reasoning behind some of these regimes that have worked in other parties. And the more crisp answers that we can give would show how these types of rules have not been necessary in other places can be very, very useful in those policy discussions. So yes, I think the government should be involved and having the dialogue and facilitating them. And I also think that the type of arguments put forward need to be very crisp and comparative.

COMMISSIONER LEE: Thank you, Mr. Balzano. Commissioner Lewis, we're over time for this particular round. We'll have to save more for the second round of questions.

COMMISSIONER LEWIS: I want the other panelists to answer that question when we come back again.

COMMISSIONER LEE: Okay, sure. Thank you. Next, we will go to Commissioner Talent.

COMMISSIONER TALENT: Thank you, Commissioner Lee. I appreciate it, and I want to apologize in advance if anybody hears a dog barking in the background. I'm in a separate office, but the dog is very loud. I want to join the other Commissioners in thanking our witnesses. It was really interesting, all of your testimonies.

I wasn't going to ask a COVID question, but I was very intrigued by Dr. Bouey's narrative about what happened in the history of the epidemic in Hubei Province. And I believe you attributed the issues to a dysfunctional relationship and troubled communications between Beijing and the provincial authorities.

So is it really -- so first question for you, Dr. Bouey, I'll ask all my questions at once, is, is it your view then that the central authorities in China were as misled as the rest of the world really? And if so, why would they have imposed the gag orders that they did impose in early January? I mean, I would think they would want scientific research published by various institutions. So that's question one.

Question two is the last time we had a hearing on the subject of Chinese healthcare, I think it was four or five years ago, there was a lot of testimony and discussion. And I think we reported on it in our report as well on the practice -- the common practice, at the time anyway, of Chinese patients bribing doctors, handing them envelopes of money in order to move up the line in care. None of you mentioned that in your testimony, and so I'm wondering if that practice has been pretty much eliminated and if not, what the government is doing about it.

And then the third question, and Commissioner Lee, I may just need to do this for the record because I'm afraid we're running out of time, I'd love to know how those of you who are consistently investigating national healthcare conditions in China verify your data. I mean, do you have partnerships with other researchers that you look to, to verify data, because I do think there's an issue with how provincial governments are reporting on issues that are sensitive to Beijing. So those are my questions, and thank you all again.

DR. BOUEY: Thank you for your questions. So first one about Hubei Province and central government in terms of COVID-19. So based on what I have learned and seen from different media source, both inside and outside China, I think there was about two weeks' time that has quite a lot of confusion.

The fact that the China CDC sent three investigation teams to Hubei -- to Wuhan within three weeks, probably showing that the tension between the provincial government and the central CDC. And then there were reports that the first two investigation teams agreed with the local colleagues that there's no person-to-person transmission. However, the third team vetoed that and that caused the media to alert to the federal government that opened up the public health emergency.

So I don't think this is a new problem. We have seen in SARS about 18 years ago that there was about three and a half months of delay between the first case to the central government acknowledge the pandemic. This time, it's that duration actually much shortened. I think it's a credit to the, one, social media use, secondly to the genomic technology and Chinese scientists willing to share that information so that we can link the cases outside China to Wuhan. And that

prompt the further investigation, I believe.

So whether there's -- as I said in my testimony, initially all these CDC local office are the local funded stations. So traditionally, there were problems of sending information to the central government. So unfortunately, we see this happen again.

And then in terms of the red pockets issue, that has been knowledge by many people. That was due to, I think, a system that's not very well regulated and also due to the previous health reform that was trying to marketize -- privatize and marketize the health care. And then quickly they reversed that and set up a price tag that cannot be changed. And that prompt this practice of adding more fee from the back door. I'll leave it --

COMMISSIONER LEE: Thank you.

DR. BOUEY: -- to other people.

COMMISSIONER LEE: If one of the other witnesses wants to weigh in quickly, we'll extend a little bit. Any of the other witnesses want to --

COMMISSIONER TALENT: Perhaps on the second question about the -- what do they call it -- red envelopes or red -- I've forgotten the name of them. Dr. Eggleston, do you know whether that practice is still commonplace?

DR. EGGLESTON: Thank you for the question. Yes, hongbao, or under the table payments, for obviously reasons, there's not a lot of transparent data about the prevalence of that. But there have been widespread reforms, for example, bring in social health insurance which is subsidized by the government. So that helps with patients' ability to pay for medical care.

And they don't enforce gatekeeping. So patients, if they can afford it, can directly refer to their preferred provider. And although patients still lament coming, part of that is it's difficult to know where to go for yourself and also to figure out if you have to pay under the table and so on.

But there are a lot of other additional financing from the government and from society that's helped to alleviate that burden and make it more transparent where you go for care. I don't think anybody is assuming that's gone away completely, but there's been a lot of crackdown on corruption in China in general that is also somewhat related to the healthcare system.

COMMISSIONER TALENT: Thank you.

COMMISSIONER LEE: Let's save any additional comments for the second round. And now Commissioner Wessel?

COMMISSIONER WESSEL: Yep, there we go. Thank you all for the testimony and I'm deeply appreciative and appreciative for the prepared testimony as well. I have to say I find this very troubling, the entire subject. One of the few areas that I think most people look to for there to be a global commons, shared aspirations, shared work is in healthcare, medical research and trying to find ways to address some of the critical needs of today's and tomorrow's population.

In preparing for this hearing, I went back. Jim was right. We have worked on this for many years going back to 2011 when we had a hearing on indigenous innovation and what China was doing on its biotech and its biomedical fields all the way through several other events today to today's hearing.

Several of you have talked about collaboration, but it seems that China's desire to collaborate is more a desire to harvest the benefits. Dr. O'Toole, you talked about China's desire to absorb data. I'd argue many times when they can't absorb it, they'll steal it. The Anthem hack was directed at trying to get longitudinal patient data.

We find that U.S. companies are -- pharmaceutical companies are investing more in China than they are here in terms of employment so that they can gain access because they don't

have it from here. And China wants to have the benefits. I believe Chairman Cleveland talked about remdesivir, and we found several months ago that China tried to patent Gilead's prior patented medicine.

Help me through why we should be collaborating, what the benefits are. Aren't they as lopsided as I seem to think they are? Prove me wrong and tell me what the benefits are and why we should continue on the present path. Dr. O'Toole, do you want to start?

DR. O'TOOLE: I don't think we should continue on the present path. But I think as you said at the outset, collaboration in biomed and in improving global health ought to be an aspiration of humankind. And the way we have built our biomedical research and development system is intensely collaborative. Sixty percent of all of the articles published in the top ten life science journals are internationally collaborated.

And I think the scientists themselves in general are very eager to share information and to do science. I think the incentives in China to further its political ambitions skew the search for knowledge and cures and so on and so forth, and we have to -- we being the United States and people doing business in China -- have to understand how the landscape operates. In reality, we should pressure China, I think, as a government and through industry and through our own policies to make things more transparent and fair and so on and so forth.

But essentially, I think we need to get more clear-headed about what's going on here and particularly about what the stakes are. We need more biomed progress. We are going to need biotechnology to solve most of the large global problems we face, whether it's aging populations or the need to feed billions of people under increasingly harsh climate conditions or whether it's the need to deal with climate change generally. So we have got to make advances in biotech and in biomed, and we will do better if we do it in a collaborative way. Figuring out the new rules for collaboration is the challenge.

COMMISSIONER WESSEL: Dr. Eggleston, somewhat quickly if you can, your thoughts?

DR. EGGLESTON: I think the other panelists have been articulate. I would just add that we certainly can't write off the health and well-being of a fifth of humanity just for a given current regime or political conditions. We reach out with humanitarian aid for many countries that we don't necessarily otherwise agree with and sort of investing together and collaborating.

And remember that China is not unitary. There's central. There's local government. There are private actors, 1.4 billion people in China. So they each have different roles, as we Americans do, and we need to have transparent, scientific, productive international collaboration to address some of humanity's greatest challenges.

COMMISSIONER WESSEL: Thank you.

COMMISSIONER LEE: And if Dr. Bouey or Mr. Balzano wanted to make some quick comments?

DR. BOUEY: I agree with my fellow panelists, and I would say that when I had an NIH-supported study in China, I found that China actually learned a lot from the regulations of clinical research and public health research. I think they learned so much on the human subject, the protection process. So I do feel that when we have collaborations that we can standardize some of these basic requirements for research.

COMMISSIONER LEE: Thank you. Mr. Balzano, a quick word?

MR. BALZANO: I'll just say that I think that we can't ignore the data coming out of China. It's one of the most popular destinations for clinical trials in the world. They have access to data sometimes before we do because they have diseases sometimes before we do. And to be

able to get that data to inform our own research here and to be able to inform the global development of drugs, I think, and medical devices is an important thing. And so that's one of the benefits of setting up an atmosphere of collaboration.

COMMISSIONER WESSEL: Thank you.

COMMISSIONER LEE: Thank you all very much. Next, we'll hear from Commissioners Wortzel and Borgeas and after that Vice Chair Bartholomew.

COMMISSIONER WORTZEL: Well, thank you very much, all of you, for some very rich testimony. I have sent in some questions for the record related to your written submissions. But quite frankly, Dr. O'Toole, some of your remarks on genomics and synthetic biology raise a question in my mind here, and perhaps Dr. Bouey would want to respond as well.

A postdoctoral research physicist at Cornell University, Cheng Yangyang, argued in Foreign Policy in April 2018 that China will always be bad at bioethics because the politicized approach to science abets the trampling of ethical boundaries. He said that communism emphasizes the idea of constant struggle not only between classes but against nature.

Meanwhile, People's Liberation Army doctors from the PLA Academy of Military Medical Sciences in Chinese language articles have explored in theory the possibility of targeted synthetic biology and neurology that can target specific racial or ethnic groups. Chen Beibei and He Fushi in PLA Daily, People's Liberation Army Daily, in 2015 argue that modern biotechnology can create pathogens that are resistant to treatment and can be part of the new great power competition. So I guess I have concerns, and I'd like to know what your concerns might be regarding allowing access to the medical data of U.S. citizens to researchers in China. Should U.S. medical data be stored in China?

Given the Communist Party's record on human rights and minorities, could U.S. cooperation with China improve the ability of China's scientific community through synthetic biology to target Uyghurs, perhaps people from India with which China has border disputes or Tibetans or even the U.S. with synthetic biology? And finally, could synthetic biology modify pathogens, as these military people suggest, to attack Americans of African or European descent?

DR. O'TOOLE: So all powerful technologies are dual-use and can be used for good or for evil, including biology. It's important to remember that we had -- the United States had a huge, very powerful biological weapons program until 1969, and we created biological weapons and stockpiled them that were equivalent to nuclear weapons in terms of their large area coverage and their lethality. And many of those organisms used as bioweapons were altered by us using methods much cruder than we would use today.

But biological weapons are not new. They're quite ancient and certainly were not first imagined by the Chinese. Synthetic biology is in its infancy, but it's going to be an extremely powerful platform for all kinds of things, and as I said, certainly has the potential to be turned to malignant purposes.

It is highly unlikely, I think, that in the next 10 or even 15 years, we will find sufficient specific genetic differences among ethnic groups to create a biological weapon targeted at a particular group. We are all 99 percent similar genetically to the great apes. So the difference between different heritages of human beings is really quick minuscule. There are some diseases that travel with ethnicity such as thalassemia, sickle cell disease, et cetera, et cetera. But I don't think that weapons targeted at genetic groups is really our -- or should be our prime concern.

I think we are in a competition -- a geopolitical competition with China. I think the frame for that competition should be thought of as economic competitiveness more generally, and I

would like to see us perform better. But I think an emphasis on biological weapons right now at this point in time is not going to be very fruitful.

COMMISSIONER WORTZEL: I appreciate that. It seems to me that these are aspirational desires by military officers and not necessarily medical people and scientists. And I would note that the PLA is very aware of our programs. And in fact, while the U.S. Army has two chemical, biological, and radiological defense regiments or brigades, the People's Liberation Army has over 220, I think. So they're really worried about it.

(Simultaneous speaking.)

COMMISSIONER LEE: Okay. Go ahead quickly, Dr. O'Toole, and I did want to give the other witnesses a chance to say a few words if they wanted to respond as well. But Dr. O'Toole, go ahead.

DR. O'TOOLE: That's okay.

COMMISSIONER LEE: Okay. Would the other witnesses care to respond?

DR. BOUEY: Just a couple sentences on this. I think the concern probably is real, then all the reason for more dialogue between the two militaries, between the two economic power, and between the two countries' politicians. I think this will not be solved just without the dialogue, and the standard international agreement will be safest for all.

COMMISSIONER LEE: Thank you very much. Now let's move on. Commissioner Borgeas?

COMMISSIONER BERGEAS: Thank you. At the outset, I'd like to pose my questions to Dr. O'Toole and maybe Counselor Balzano but certainly leave it open to the other panelists. I have two questions.

Do you have thoughts and comments on the advancements in artificial intelligence? In particular, do you think that coronavirus has ushered in a period of extraordinary data acquisition and health-related espionage? And the second is, do you agree that we are trending in opposite directions, where China is utilizing all the instruments of data collection and also exporting its data technology, while California, the U.S., and Europe through GDPR and other means are investing in greater data privacy protections? So where are these two trends taking us if you have some thoughts on those, please?

DR. O'TOOLE: Mr. Borgeas (telephonic interference) are going to underlie and turbo-charge genomics in particular and biology in general. You can see the importance of large amounts of data in the epidemiological studies and modeling studies surrounding COVID. I don't see a lot of reasons for espionage around COVID because things are being done in such an extraordinarily open manner because the stakes are so high and affect the group.

Certainly, espionage is a factor in research of all kinds in this country with regard to the Chinese. But again, I think we need to control that. We need to address it. But I don't think that should be our focus. I really do think we have to get serious about outcompeting them in these fields that we deem important.

I think you're completely right. The Chinese have a the-state-owns-all attitude towards data. I think they have correctly and presciently recognized the national security importance of data. I think the first impulse of the West is to protect particularly private health data from intrusion of all sorts by others. But I think we are actually not thinking through the value of data when it is anonymized and aggregated in pursuit of knowledge in such goals as better health care, disease prevention, and so forth.

We need to essentially up our game and get serious about how we are going to both manage our data, how we are going to make it secure enough for our privacy standards. So for

example, we need to think hard and fast about how we're going to secure the data coming out of the increased usage of telemed that's associated with COVID response. But we also have to get much more far-seeing and serious about how valuable this data is and how it needs to be used to further our higher purposes like better health care, et cetera.

COMMISSIONER BORGEAS: Thank you.

COMMISSIONER LEE: Mr. Balzano?

MR. BALZANO: Sure, sorry. I'm experiencing some network difficulties. Let me know if this comes through. On the first question, I don't really have any evidence of heightened security concerns in the coronavirus area -- era, rather.

On the issue that Dr. O'Toole just raised about China's focus on gathering data, I would say I agree. In other words, they have more of a focus on treating data and the results of scientific research and biospecimens as a national resource, and in some cases, connecting that to national security. The Human Genetic Resources Regime that I was discussing before is based around concerns about the public health and national security in China. That's stated as one of the aims in the actual regulation, so that's very clear.

I do think that when we tend to look for analogues or comparisons in other countries, we tend to end up finding more things on the privacy and individual human subject protection front. That doesn't mean that China isn't also pursuing privacy regimes and human subject protections; they are.

But we do see this very strong trend in a number of their regulations and laws in terms of sort of treating data as a commonly shared national resource and then also being very cautious about it like flowing outside of China, not only with the Human Genetic Resource regulations but also there's a regulation called the Scientific Data Management Regulation which I mentioned in my written testimony which also talks about the pooling of different data that's funded by the state. So that is a strong trend in Chinese regulation.

COMMISSIONER LEE: Does anyone want to respond?

DR. BOUEY: I would just add that South Korea is one of the countries that was most successful in containing COVID-19 so far, and they have a public health law that passed after MERS epidemic a few years ago that the public gave the government the right to obtain individual data during a pandemic. That's why we see they have a very sophisticated case tracing system, including those at the location of who test positive. And so far, that has been working in that country. So China, I think has a similar app, tracing the travel and so on, even though I haven't heard of such a law has been passed.

COMMISSIONER LEE: Vice Chair Bartholomew?

VICE CHAIRMAN BARTHOLOMEW: Thank you very much. Thank you to our witnesses. And one of the benefits of asking questions near the end is that I get the benefit of all the questions that my colleagues have asked and the information that they've learned. I think I had some questions about data myself, but I was thinking of data protection, data privacy. I was thinking of Henrietta Lacks and what has happened on genetic data.

But I think what I want to raise in terms of that, and then I have some questions about COVID-19 and the Chinese response, is what's different about China, of course, is it has this social credit system, right? So it's already gathering a massive amount of information on individuals which it's using against individuals. Some people can't buy airplane tickets. If you don't pay a bill, you can be kicked out of where you live.

And so I wonder about, first, the digital health, right, digital technology and digital health, whether there will be people who will not partake of any sort of healthcare because they

have a disease like an STD that would show up in their social credit system and disadvantage them in other parts of their lives. And then I'm going to emphasize just one of the things that Dr. Wortzel said which is we know with Uyghurs that they have been intentionally gathering with no consent DNA in order to be able to continue the oppression of the Uyghurs.

And so I understand that they're developing a regime of protection of data. But I wonder how many loopholes there are going to be or how much they ignore it in order to continue doing what they're doing. That's one question.

A second set of questions, though, has to do with some of the COVID-19, and I wondered if anybody could just talk a little bit about the effectiveness of the Chinese FDA because, of course, hundreds of millions of dollars' worth of faulty PPE and faulty tests have been sent outside of China, and it makes a very big question. Sorry, my dogs and my cats are bothering me. Sort of real questions about the effectiveness of the Chinese FDA in protecting its own population and then protecting the rest of us as it's exporting stuff.

And then one observation and then I'll let you guys answer. And the observation is just in the middle of April, the Chinese government put restrictions on publication of COVID-19 research by Chinese researchers. And so I'd like if anybody has any observation on, how is that going to have an impact on the ability of scientists outside of China to take lessons from Wuhan? A lot of questions, answer whichever ones you want.

COMMISSIONER LEE: Who would like to start?

DR. BOUEY: Maybe I can start with the COVID question since I think it's a repeated question about why China had the gag order at the end of January. I think -- my understanding is it's part of a response to the sentiment inside the country because China, maybe about five or six years ago, all the universities had adopted this point system that's promoting pushing the scientists to publish in high index journals. So that's linked to their salary. That links to their promotion.

So there's a very strong incentive for researchers to publish in English and publish in high index journals. So that's what we see in January. I think it's almost a half or 60 percent. By then, the high impact journals that publish the COVID studies are coming from China with Chinese scientists.

So at the time, I think there were some sentiments in China saying, well, all of these are in English, not in Chinese. It's not helping our own medical society, and we're in this crisis of a pandemic and these researchers just want to publish in high index journals. I think partly due to that public sentiment that the government say, well, now we should focus on combat this crisis rather than publish scientific data.

Later on, I think in March, there was a second gag order. I think that one is probably more due to the fact that there were some publications with data that's not very reliable coming out from China and being detected by the journals. And China, again, has some concerns about the quality of the publication. So again, they issued another warning to say, well, all the publications have to go through some central office for quality assurance and so on.

COMMISSIONER LEE: Thank you. Would any of the other witnesses like to weigh in on the questions that Vice Chair Bartholomew raised? Dr. O'Toole?

DR. O'TOOLE: So I agree with Jennifer. China is trying to increase the reliability of its scientific publications. It's had a lot of problems with fraud due to professional competition within the Chinese scientific community, and the Chinese government has said they're going to try and clamp down on that. So I think there probably is a tension there between getting stuff out fast and making sure it's correct and doesn't have to be retracted which happens a lot with

Chinese publications and hurts China's reputation abroad in scientific arenas where it has great ambitions.

This is an authoritarian communist regime, and powerful technologies, as I said, can be used for very dark purposes. We really do need to lead an international discussion about the ethics of using particularly these biological and these health-based technologies as means of oppression. Collecting and analyzing DNA from people without their permission ought not to be allowed under most circumstances, I would think, let alone for purposes of surveillance as the Chinese are using it, and not just with the Uyghurs by the way.

They are collecting tons of DNA material through the very widespread prenatal testing that the Chinese are engaging in, in order to ensure that they have healthy babies as they are allowed to have a second child. So China is collecting enormous amounts of genetic data on their citizens and their population, and it's not clear what they're allowed to do with it. But we need international rules, and we need rules in this country too on how to govern this kind of thing.

COMMISSIONER LEE: Thank you. Dr. Eggleston or Mr. Balzano, anything to add briefly? Mr. Balzano?

MR. BALZANO: Sure. I'll add something on the Chinese FDA which is the National Medical Products Administration. I will say that they -- so in terms of the fake PPE leaving China, at least what I have found in practice is that a lot of that was made by companies that were not registered as medical device manufacturers in China and that as that was happening, the National Medical Products Administration issued commerce and the customs -- their own customs administration in China to take action, initially pretty severe action, actually restricting all PPE leaving China with medical use labeled on it to ensure products are actually registered as medical devices and requiring a declaration on the part of the distributors to do that.

So they took that action, and then they more recently loosened that up a bit to allow for more that's coming out of China if it meets standards of the destination country which has always been sort of the export rule. So yes, I mean, I think they have distribution rules. They have a rigorous system for licensing medical devices, products in China. But certainly, in the enforcement initially, they needed to correct that course. And a number of companies were placed under criminal investigation and were fined.

COMMISSIONER LEE: Thank you. Dr. Eggleston, a quick word?

DR. EGGLESTON: Thank you. I agree with my other panelists. And just to note my sociologist colleague, Professor Xueguang Zhou, has done a lot of research on those tensions within bureaucracies or central local bureaucracies. If you're interested in how that works in China and how it's played out during the current crisis, he's published some on that.

COMMISSIONER LEE: Thank you very much. So --

VICE CHAIRMAN BARTHOLOMEW: Thank you.

COMMISSIONER LEE: Thank you, Vice Chair. So that completes the first round. We have just -- the hearing is scheduled to go to 4:15, so we have a few more minutes for a couple of quick follow-ups. I'd like to ask the Commissioners if you have a follow-up question that you'd like to ask, raise your hand and then I'll put you in queue. We won't necessarily get to all of you. So I see Cleveland, Fiedler, Lewis, Borochoff, and let me go first to Chair Cleveland and then --

CHAIRMAN CLEVELAND: Thank you.

COMMISSIONER LEE: -- alphabetical order.

CHAIRMAN CLEVELAND: I'd like to actually follow up on what Commissioner Bartholomew asked, and I'm hearing an argument for intensifying collaboration. And I think,

Dr. Bouey, in your written testimony, you talked about the need to expand the U.S. CDC presence in China. I'm wondering if you could talk about freedom of access by U.S. and European CDC, FDA, Ag professionals who are trying to monitor and inspect facilities to ensure safety and reliability of everything from pharmaceutical production to oncology research protocols. So Carolyn asked about the Chinese FDA, but really I'm interested in whether or not you believe there's freedom of access for inspectors or professionals to ensure safety and reliability.

DR. BOUEY: So on that question, I can talk about how U.S. CDC used to work with the China CDC. Since, after SARS when there's a multiple MOU signed by the China MOH and the U.S. counterpart and they set up a specific office in the China CDC where U.S. CDC will have routine staff sitting in there. And then over the years, we see that they are working together on HIV prevention, working on pretty much every epidemic that we've seen in China, especially on avian flu, the swine flu, and with the influence of a surveillance system.

It's not until just recently that that office has been closed -- the Global AIDS Office has been closed. And then due to the security concerns that U.S. government -- I think they require all the U.S. scientists to come back to leave the CDC but rather than to locate their office within the embassy. So that really reduce the contact of the U.S. CDC scientists with their colleagues in China.

They also -- I think the office, the size shrank from 40 to 14 and also the local employees has been reduced dramatically. So this happened to CDC. This happened to FDA and the Agriculture as well as the NSF. So I think the collaboration has been greatly reduced recently, and that disrupt some of the access to data.

In terms of FDA, I know that I think in my testimony in July last year, I talked specifically about the regulations at the pharmaceutical industry in China. Right now, it's still very fragmented. It's very -- the ruling is still very weak, and China realized that. They try to consolidate some of the factories in these sectors and then build stronger regulation.

And I know there were some collaborations between U.S. FDA and the China FDA on how to set up these regulations. But I also learned from my colleague at Rand who work on Sentinel. We know that there's difficulty for the U.S. FDA to send in inspections to China due to diplomatic process that can be long and also the limited manpower at U.S. FDA to go to China to do the inspections. We'll stop there.

COMMISSIONER LEE: Thank you. Any of the other witnesses want to chime in quickly? All right. In that case, let's go to Commissioner Borochoff. And if people could keep their questions and their answers short, we can get through more -- we'll have time more round.

COMMISSIONER BOROCHOFF: I'm interested in intellectual disabilities. About three percent of Americans are intellectually disabled, and about 30 percent of those people have jobs in America. What's the situation in China?

COMMISSIONER LEE: To anybody in particular? Maybe Dr. Eggleston?

DR. EGGLESTON: Intellectual disabilities affect Chinese as well, I defer to some other panelists if you have specific numbers. As in many developing and middle income countries, the services for those individuals has not been completely developed or included within the existing financing system. So a lot of it falls to households, and considerably developing expertise among healthcare providers to support households in supporting those individuals is also in the process of development. I won't give more details at the moment and defer to other panelists. Thank you.

COMMISSIONER LEE: Anybody else like to weigh in, panelists?

COMMISSIONER BOROCHOFF: So basically, there's no formal system in place for IDD, apparently? None of you know of one? Okay. Thank you.

COMMISSIONER LEE: Thank you. Commissioner Fiedler?

COMMISSIONER FIEDLER: I'm going to address this to Dr. O'Toole. So you've repeatedly talked about the need for the United States to compete. So let me be a little more cynical. So the nature of competition, so we don't produce any PPE to sufficiently address the pandemic. We don't produce enough ventilators, and I would argue that the cause of that is an inexorable search for cheaper labor.

And in the case of R&D, we see all sorts of people moving to China. They got smart people who work cheaper. How, without government intervention, do you cause certain things that are desirable in the national interest, because, I mean, I once had a State Department person tell me in a crisis that we were in to get someone out of jail, Jeff, there are no heroes in the business community. So where does the government intervene here?

DR. O'TOOLE: So just to be clear, I am in favor of government intervention in a number of ways. With respect to your supply chain example, I think the United States government dropped the ball and had an inadequately narrow notion of what essential supplies needed to protect the national security was, so shame on us. In terms of talent flowing to China, you're exactly right. There isn't a pharma CEO who hasn't been invited to build in China.

We are in a talent war and the pharma industry for people who know how to make drugs and manage the process of making drugs, and China is winning by all accounts. It's attracting a lot of people who trained here. They may or may not be of Chinese ethnicity. And the saying is, get educated in America and get rich in China.

We need to think about what we are willing to do to make sure that we have the drugs and the ancillary equipment we need to manage major health emergencies. COVID-19 is quite a wake-up call. But I still think that we have some of the best science in the world. I think we have dramatically underinvested in R&D in the past ten years. I think we have a lot to teach China about how we do regulations and what ethical mores would benefit us all the most.

I don't think we have any alternative but to try and secure our own interests by outcompeting with them, not just in the marketplace. The market is almost never fair which is why we have to strive for transparency and a fair deal for everybody. But we've been fat and happy for too long.

COMMISSIONER LEE: Thank you.

COMMISSIONER FIEDLER: Thank you.

COMMISSIONER LEE: Thank you very much, Dr. O'Toole. Thank you, Commissioner Fiedler. Commissioner Lewis, we have just three minutes. So quick short question and quick short answers and then we'll wrap up. Thank you.

COMMISSIONER LEWIS: Can you hear me?

COMMISSIONER LEE: Yes.

COMMISSIONER LEWIS: Fifteen years ago, we never would have thought that 15 years later we would have no pharmaceutical industry in the country. We don't make antibiotics. We don't make penicillin. It's all moved to China. What do we need to do now so that 15 years from now we won't find the same thing with biotech and the subjects we're talking about? What policies should we pursue with Congress?

COMMISSIONER LEE: Dr. O'Toole? You just muted yourself, sorry.

DR. O'TOOLE: We should invest in synthetic biology so that we can make some of these drugs without the polluting infrastructures required in China. We should have a much

broader view of national security that includes the capacity to care for our people particularly during pandemics because we are in an age of epidemics. This will not be the last one and it may not be the big one. And we have to get much more serious about the extent to which technology these days is strategy and have a broader view of the technologies needed for national security.

COMMISSIONER LEE: Thank you very much. Dr. Bouey?

DR. BOUEY: If I can add, I would say 15 years from now, it might not be China to be the largest API producer either because the active pharmaceutical ingredient, these are the chemicals that most polluted and the least in margin in terms of profit. The reason China is doing it now because it's still more profitable in China but not in the U.S. But I can actually see that China is trying to outsource that to other countries because their labor cost is increasing. So as we are changing, China is changing too.

COMMISSIONER LEE: Thank you very much, Dr. Bouey. Thank you, Commissioner Lewis. That concludes our hearing for today. I want to thank all the panelists for their excellent testimony and for their patience and their stamina. I'd like to thank all the Commissioners and especially the other Chair of this hearing with me, Chair Cleveland.

And I especially would also like to thank the staff of the U.S.-China Economic Security and Review Commission who did an amazing job during this remote work period, reaching out to witnesses, vetting witnesses, and really preparing excellent, solid groundwork for today's hearing. And with that, Chair Cleveland, if you had any final remarks.

CHAIRMAN CLEVELAND: No, thank you for handling the whole hearing.

COMMISSIONER LEE: Thank you. You're very welcome. And remember to tune in tomorrow morning, if you want, at 9:30 for the China's Strategic Aims in Africa hearing which will start at 9:30 and will go through to the afternoon. So again, thank you all for joining and have a wonderful afternoon.

(Whereupon, the above-entitled matter went off the record at 4:12 p.m.)