Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
US–China health exchange and collaboration following COVID-19

Liming Li, Kean Wang, Zhuo Chen, Jeffrey P Koplan

Strong US–China collaboration on health and medicine is a crucial element of the global effort against COVID-19. We review the history of health collaboration and exchanges between the public and private sectors in the USA and China, including the long-lasting collaboration between governmental public health agencies of the two countries. Academic and scientific exchanges should be reinvigorated and the increasing valuable role of non-profit foundations acknowledged. The shared interests of the two countries and the magnitude of the pandemic necessitate both countries to collaborate and cooperate. We provide recommendations to the two governments and the global health community to control the ongoing COVID-19 pandemic and prepare for future threats.

Introduction
Over the past 4 years, trade, tariff, and other economic and security issues have created tensions between China and the USA. The relationship between these two countries has been exacerbated by the COVID-19 pandemic, including issues over original knowledge of the source of SARS-CoV-2, disagreements on transparency and data sharing, and increased public disputes between the two countries. In this Viewpoint, we argue for the viability of the US–China health exchange, highlight what has already been achieved through this collaboration, point to the urgency of such collaboration after turbulent years rife with distrust and disagreements, and outline key factors that will benefit both countries.

History of US–China health collaboration
The US–China relationship regarding health and medicine has fared better than the political interface. Since 1972, when President Richard Nixon visited China, scientific exchange and partnering efforts have flourished between China and the USA. The relationship between these two countries has been exacerbated by the COVID-19 pandemic, including issues over original knowledge of the source of SARS-CoV-2, disagreements on transparency and data sharing, and increased public disputes between the two countries. In this Viewpoint, we argue for the viability of the US–China health exchange, highlight what has already been achieved through this collaboration, point to the urgency of such collaboration after turbulent years rife with distrust and disagreements, and outline key factors that will benefit both countries.

The US–China Joint Committee for Cooperation in Medicine and Public Health—Public Health and Health Services Research Subject Area, was formed. This taskforce was co-chaired by John Bryant (1980–82), Jeffrey P Koplan (1982–92), and Prof Yang Ming-Ding (1980–1992) of Shanghai Medical University.

This taskforce promptly led to substantive collaboration between the USA and China, as documented in a supplemental issue of the American Journal of Public Health on public health in China, with each paper coauthored by Chinese and US scholars. Over the next four decades, ties flourished between US and Chinese health research institutions. Hundreds of memoranda of understanding between educational institutions, health science centres, and hospitals have been established and there are many examples of substantive and sustained relationships between the two countries (table).1

There are many examples of productive health and medicine collaborations between the two governments. During the 1990s, the US–China Collaborative Project for Neural Tube Defect Prevention, a partnership between the US CDC and Chinese institutions, produced landmark findings on the efficacy of folic acid and contributed to the evidence base for mandatory folic acid fortification policies in the USA.2,3 In January, 2002, the Chinese Academy of Preventive Medicine was reorganised into the Chinese CDC, which was established as the main public health agency in China. The US CDC worked closely with the newly founded China CDC; the two sister agencies signed a memorandum of understanding and, until 2017, held annual director meetings to report on progress and exchange views on global health and collaborations.

The US CDC helped China establish programmes, including the China Field Epidemiology Training Program and the Tuberculosis Prevention and Control Cooperation Project. These collaborations have played a crucial role in China’s responses to emerging infectious diseases, such as SARS-CoV, avian influenza, and COVID-19, and are crucial to global health security. The national scientific funding agencies, the US NIH and the National Natural Science Foundation of China, have partnered to encourage collaborative biomedical research even as the bilateral relationship has soured.6

Since the Carter Administration pioneered the US–China student exchange, there are many Chinese students at every stage of academia in the USA; it is estimated that more than 350 000 Chinese students have studied in the USA since 2015.4,5 In 2018, there were 6182 Chinese students who received a doctoral degree in the USA.6 Many students with biomedical training have returned to China, and other students have taken leadership roles, such as department chairs and deanships, in both the USA and China. Misuse of data, challenges to intellectual property, and frayed
partner relationships have occurred. However, these unfortunate events have been few by comparison with the tens of thousands of trainees, faculty exchanges, and successful research collaborations in biomedical and public health. Yale University (CT, USA) and Harvard University (MA, USA) are two of the many US educational institutions that have long-lasting collaborations with Chinese counterparts on topics related to health and medicine.

Non-profit foundations have played an instrumental role in US–China health exchange and collaboration. For over 100 years, the China Medical Board has collaborated with medical universities and schools of public health and nursing in China to train health-care professionals, provide incentives for doctors to stay in areas of need, and develop capacities in global health, health policy, and health system sciences in China. The Bill & Melinda Gates Foundation has funded initiatives in China directly and through other agencies, including the Emory Global Health Institute (GA, USA) and Resolve to Save Lives (NY, USA), to promote health in China and harness the manufacturing capability in China to develop innovative and low-cost means to benefit people in need elsewhere.

To benefit the health of people in both countries, we need to maintain and support our productive, mutually beneficial medical and scientific exchanges and collaborations in every sector of the two societies.
Challenges and opportunities in US–China health collaboration

Challenges to the US–China health collaboration exist, including deeply rooted political and economic differences, acute stresses related to the COVID-19 pandemic, and other global concerns such as mental health disorders, non-communicable diseases, ageing, urbanisation, and climate change. The political and economic differences need to be acknowledged and might require a long-term solution involving continuing dialogues between US and Chinese health leaders.

Over the past 4 years, even before COVID-19, steps have been taken by both countries that hinder bonds of scientific inquiry, friendship, and productivity. The US CDC China Office has had a substantial reduction of its staff, compromising collaborative efforts. The past 4 years have been stressful for Chinese scholars in the USA, particularly those who have close collaborations with Chinese institutions because of increasing scrutiny, often by law enforcement, funding agencies, and employers. The intensity of these stresses has increased because of the COVID-19 pandemic. The tension has been initiated and has intensified more at the higher political levels (ie, senior elected and appointed officials in health and diplomatic sectors) than at the scientific or technical levels (ie, scientists and researchers).

As the ongoing COVID-19 pandemic continues to disrupt livelihoods, international travel will be compromised for the near future and there will be less face-to-face interactions. Collaboration will continue virtually, with the eventual return to common practice of in-person travel and face-to-face meetings. Anticipation of one or more effective and safe vaccines can be promising but not assured. Strong US and Chinese collaboration in vaccine development and distribution would benefit both countries and the world.

There are also many inherent long-term societal and health challenges for both nations, alluding to collaborative opportunities in health and medicine. These challenges include: urban health as China experiences dramatic urban growth and develops its megacities, ageing populations in both countries with expanded demands for medical and social services for older adults, environmental degradation, climate change, energy needs and approaches, policy and economic issues in which health has a major stake, and non-communicable diseases and their risk factors (eg, including tobacco use, smoking, diet or overnutrition, salt intake, fat intake, physical activity, diabetes, heart disease and stroke, mental health and substance abuse, arthritis and mobility and injuries).

Besides the ongoing COVID-19 pandemic, long-running global health challenges include fragile health systems in the low-income and middle-income countries that can be overwhelmed by an emerging infectious disease or chronic diseases. The USA and China can complement each other in their global health aid and engagement despite differences in objectives, approaches, and where they succeed and fail. The USA has extensive experience in evaluating health aid programmes and can offer lessons learned. China could operate with more security and efficiency in particular geopolitical settings that are out of reach for the USA. China could also complement the US prowess in technology and management with its strengths in manpower and logistics, as shown by the US–China collaboration in controlling Ebola. The USA also has a much larger global health workforce and more global health academic programmes, supporting the scale of operation of the US global health engagement. By comparison with the USA, China has fewer and less extensive global health programmes. Global health science and knowledge will be enriched from a bi-directional exchange between the USA and China.

The immediate future, following COVID-19, will be challenging. However, we have so much to learn from and offer to each other that our biomedical and public health ties must be maintained and strengthened. It makes sense for US and Chinese scientists to work together on elements of the pandemic response and best practices for future pandemics.

Recommendations for US–China health collaboration following COVID-19

The health and medicine collaborations between the USA and China have been fruitful. We refer to the USA and China, but in reality, it is global because every nation is relevant as long as COVID-19 is circulating. Although elimination of transmission in one country is excellent for that individual nation, it must prepare for the reintroduction of the virus and its rapid propagation. There is great value in addressing the pandemic in partnerships, collegially, sharing information, being transparent, improving communications in accuracy and timeliness. The collaboration must be maintained and nurtured to support our common interests and address health challenges and threats.

In the era of the COVID-19 pandemic there are heightened political tensions. We hope the Biden administration can help resolve our political and economic differences. There are many areas of real or potential conflict. However, health and medicine are areas where we have shown we can work together productively for mutual benefits because we live in an interconnected world. Collaborations and exchanges will be more important than ever following COVID-19. We need to learn together and appreciate our similarities and differences. We are intellectually enhanced and socially challenged by both and hereby offer three immediate recommendations.

First, to control and rebuild from the COVID-19 pandemic and prepare for future outbreaks and pandemics, we need to restore partnership and collaboration on health and medicine between US and Chinese government agencies that has been hampered by
The collaboration could be between the US and Chinese CDCs, the US Food and Drug Administration and the China Drug Administration, the US Agency for International Development and the China International Development Cooperation Agency, and the Chinese Academy of Medical Sciences and NIH. We welcome the announcement from the Biden Administration that the USA will not withdraw from WHO and will participate in the COVID-19 Vaccine Global Access (COVAX) facility, providing an opportunity where the USA can collaborate with WHO and China to provide funds for countries that do not have ample financial resources. The two countries should go beyond the COVAX initiative to increase access to COVID-19 vaccines in low-income and middle-income countries. For example, with the country’s successful history of mass testing, China could team up with the USA to assist African countries in testing and screening of COVID-19. The USA and China should work with WHO and other nations to expand the Yellow Card (also referred to as a vaccine passport, which documents an individual’s vaccination history) vaccination record to address needs generated by the COVID-19 pandemic.

Second, to enable the collaboration and exchange between the academic and scientific communities that has been hindered by politics and the COVID-19 pandemic. Scholarly exchanges continue to exist amid the tensions and the pandemic; however, the momentum could be dampened if the set course continues. Collaboration and exchange in health and medicine between academic institutions should be encouraged rather than held back. Previous missteps, such as the discontinuation of the Fulbright Program in China, should be reversed. Both sides should invest in earnest efforts to improve bilateral exchanges in science and cultural perspectives.

Finally, the business case for US–China collaboration on health and medicine is evident. The USA and China should collaborate in investing in innovations for health, expanding market access for pharmaceuticals and providing regulatory control for synthetic opioids, which has benefits to both the USA and China. There are ample opportunities for the private sector, including businesses and non-profit organisations, to work with the governments in both countries to improve US–China collaboration on health and medicine.

Contributors
All authors contributed equally to the conception and writing of the manuscript. All authors have approved the final version of this viewpoint.

Declaration of interests
LL served as the founding Director-General of the Chinese Center for Disease Control and Prevention (2002–04) and Vice President of the Chinese Academy of Medical Sciences (2004–06). KW served as the third President of the Chinese Academy of Preventive Medicine (1996–2000). JPK was Director of the US Centers for Disease Control and Prevention (1998–2002), the Founding Director of the Emory Global Health Institute (2006–11), and is the co-founder of the International Association of National Public Health Institutes (since 2006). JPK was part of the first US government team of health leaders that visited China and co-chaired the long-term taskforce called the US–China Joint Committee for Cooperation in Medicine and Public Health—Public Health and Health Services Research Subject Area. ZC declares no competing interests.

Acknowledgments
Some information in this viewpoint was based on JPK’s keynote speech at the China and the World in the Post-COVID-19 Era Symposium on Nov 12, 2020, organised by Harvard University Fairbanks Center for Chinese Studies and Wuhan University Faculty of Medical Sciences.

References
1. Yang MD, Bryant JH, Henry P. Background of US–PRC government cooperation in health: descriptive study and workshop on health services research in Shanghai County. Am J Public Health 1982; 72 (suppl 9): 9–11.
2. Seligsohn D. The rise and fall of the US–China health relationship. Asian Perspect 2020; 45: 1
3. Yang MD, Koplan JP, Bryant JH. Health services in Shanghai County: the future of US–PRC governmental collaboration in health services research. Am J Public Health 1982; 72 (suppl 9): 92–93.
4. Potter W, Ko G, Zhang L, Yan W. Clozapine in China: a review and preview of US/PRC collaboration. Psychopharmacology 1989; 99 (suppl): 85–91.
5. Shu Y, Song Y, Wang D, et al. A ten-year China–US laboratory collaboration: improving response to influenza threats in China and the world, 2004–2014. BMC Public Health 2019; 19: 520.
6. Gao GF. Foreword from editor-in-chief George F Gao—China’s Outreach to the World: public health goes global. China CDC Weekly 2019; 1: 1–2.
7. US Department of State. US–China strategic and economic dialogue VIII strategic track select outcomes. June 7, 2016. https://2009-2017.state.gov/c/nea/rls/hs/251915.htm (accessed Nov 14, 2020).
8. The Carter Center. US–China collaboration in combating the 2014 Ebola outbreak in West Africa. 2014. https://www.thecartercenter.org/resources/pdfs/peace/china/trs-03-combating-ebola-breakout.pdf (accessed Nov 14, 2020).
9. Berry RJ, Li Z, Erickson JD, et al. Prevention of neural-tube defects with folic acid in China. N Engl J Med 1999; 341: 1485–90.
10. Collins FS, Morgan M, Patrinos A. The Human Genome Project: lessons from large-scale biology. Science 2003; 300: 286–90.
11. Redmon P, Koplan J, Eriksen M, Li S, Wang K. The role of cities in reducing smoking in China. Int J Environ Res Public Health 2014; 11: 1006–72.
12. Salovey P. Summary of Yale University’s collaborations and history with China. 2014. https://world.yale.edu/sites/default/files/files/ChinaBlueBook_eng_2014.pdf (accessed Jan 19, 2021).
13. Harvard School of Public Health. About us: history of Harvard and health in China. Sept 20, 2012. https://sites.sph.harvard.edu/about-us-and-contact/ (accessed Jan 19, 2021).
14. China Medical Board. What we do. 2016. https://chinamedicalboard.org/what_we_do (accessed Jan 19, 2021).
15. Resolve to Save Lives. Where we work: China. 2020. https://resolvetosavelives.org/where-we-work#china (accessed Jan 19, 2021).
16. Bill and Melinda Gates Foundation. China. 2001. https://www.gatesfoundation.org/Where-We-Work/China-Office/Case-Highlights (accessed Jan 19, 2021).
17. Wald NJ. Commentary: a brief history of folic acid in the prevention of neural tube defects. Int J Epidemiol 2011; 40: 1154–56.
18. National Science Foundation. Dear colleague letter: NSF/NSFC joint research on environmental sustainability challenges. July 20, 2018. https://www.nsf.gov/pubs/2018/nsf18096/nsf18096.jsp (accessed Jan 19, 2021).
19. Press F, Smith PM. Science and technology in the Carter Presidency. In: Pielke R, Klein RA, eds. Presidential science advisors. Dordrecht: Springer; 2010: 37–56.
20. Snyder TD, Dillow SA. Digest of education statistics 2018. December, 2019. https://nces.ed.gov/pubs2020/2020009.pdf (accessed Jan 19, 2021).
Siu L, Chun C. Yellow peril and techno-orientalism in the time of COVID-19: racialised contagion, scientific espionage, and techno-economic warfare. J Asian Am Stud 2020; 23: 421–40.

Palmer J. Lincoln Chen: fostering health collaboration with Asia. Lancet 2010; 375: 1073.

Lewis MK. Criminalizing China. J Crim Law Criminol 2021; 111: 149–225.

Crisp LN. Global health capacity and workforce development: turning the world upside Down. Infect Dis Clin North Am 2011; 25: 359–67.

Li Z, Gao GF. Strengthening public health at the community-level in China. Lancet Public Health 2020; 5: e629–30.

Koplan JP, Butler-Jones D, Tsang T, Wang Y. Public health lessons from severe acute respiratory syndrome a decade later. Emerg Infect Dis 2013; 19: 861–63.

Bouey J. China’s health system reform and global health strategy in the context of COVID-19. May 7, 2020. https://www.rand.org/pubs/testimonies/CTA321-1.html (accessed March 18, 2021).

Anderson BD, Ma M-J, Wang G-L, et al. Prospective surveillance for influenza A virus in Chinese swine farms. Emerg Microbes Infect 2018; 7: 87.

Gao G, Nkengasong J. Public health priorities for China-Africa cooperation. Lancet Public Health 2019; 4: e177–78.

China International Development Cooperation Agency. What we do. http://en.cidca.gov.cn/2018-08/01/c_259525.htm (accessed Jan 19, 2021).

Gostin LO, Shalala DE, Hamburg MA, et al. A global health action agenda for the Biden administration. Lancet 2021; 397: 5–8.

The Lancet. Access to COVID-19 vaccines: looking beyond COVAX. Lancet 2021; 397: 941.

Lee JJ, Haupt JP. Scientific collaboration on COVID-19 amidst geopolitical tensions between the US and China. J Higher Educ 2020; 92: 303–29.

Yuan Y. Unique role of think tank exchange in promoting the China–US relationship. China Q Int Strateg Stud 2019; 5: 143–59.

© 2021 Elsevier Ltd. All rights reserved.