NTS-Asia
CONSORTIUM OF NON-TRADITIONAL SECURITY STUDIES IN ASIA

*NTS-Asia Monograph*

# CORONAVIRUS RESEARCH IN CHINA:

## ORIGINS, INTERNATIONAL NETWORKS AND CONSEQUENCES

*Ryan Clarke and Lam Peng Er*

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# *Table of Contents*

# *Foreword*

The importance of paying close attention to health security has become more urgent than ever as the world continues to deal with the devastating impact of COVID-19 pandemic. Since its outbreak in 2020, the pandemic caused by a novel coronavirus SARS-Cov-2 has already resulted in millions of lives lost and inflicted untold human misery and suffering to people globally.

The Centre for Non-Traditional Security (NTS) Studies of the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University, is one of the leading centres in Asia that highlights the critical linkages between non-traditional security challenges, like climate change and health security, to national and global security. As we have seen, the COVID-19 pandemic is more than a public health emergency of international concern. Its severe impacts cut across economic security, food security, environmental security and personal security, among others.

As the international community continues to grapple with the consequential impact of COVID-19, it is sobering to note that other pandemics are expected to emerge. Thus, the need to advance the global agenda of pandemic preparedness and response cannot be overstated given the evolving nature of emerging infectious diseases. In this regard, knowledge building and sharing of information are among the key pillars in understanding and preparing to respond effectively to global public health crises and promoting global health governance.

Since Asia's experience of the SARS pandemic in 2003, the Centre for NTS Studies has helped to promote the building and sharing of knowledge through its publication of research papers and policy reports written by scholars within and outside Asia. This monograph on Coronavirus Research in China, written by Ryan Clarke and Lam Peng Er, is part of our continuing efforts to advance the building and sharing of knowledge to help our academic and policy communities better understand the complex nature of emerging infectious diseases. We hope that this monograph will not only contribute to better pandemic preparedness and response, but also underscore the imperative of putting health security at the core of national, regional and global security agendas.

**Mely Caballero-Anthony**
Professor and Head of NTS Centre
RSIS, Singapore.

# *About the Authors*

Ryan CLARKE is a Senior Research Fellow at the East Asian Institute, National University of Singapore. He has held leadership positions in defence and intelligence technology companies (full spectrum), investment banking, biodefense, strategic think tanks, emergency response organisations, and specialised law enforcement units. He is the author of three books and over 70 journal articles. He holds a PhD from the University of Cambridge where he was awarded the Salje Medal for the most innovative research. He can be contacted at eairjc@nus.edu.sg.

LAM Peng Er is a Principal Research Fellow at the East Asian Institute, National University of Singapore. He obtained his PhD from Columbia University. Lam is the editor of three academic journals: *International Relations of the Asia-Pacific: A Journal of the Japan Association of International Relations* (Oxford University Press), *Asian Journal of Peacebuilding* (Seoul National University) and *East Asian Policy: An International Quarterly* (East Asian Institute, National University of Singapore).

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# *Introduction*

Arguably, the greatest human security threat on a global scale since the end of World War II is the COVID-19 pandemic. By May 2021, more than 3.4 million lives were lost, and global travel, trade and supply chains were severely disrupted. Millions of jobs were also lost and many people were reduced to penury.

Instead of being drawn closer to mitigate this unprecedented human security crisis since the 1918-20 Spanish flu pandemic, the US and Chinese superpowers were in an acrimonious debate over the origins of COVID-19. The Trump administration alleged that the COVID-19 virus might have leaked from the Wuhan Institute of Virology (WIV), China's first BSL4 (biosafety level 4) laboratory.[1] Chinese Foreign Ministry spokesperson Hua Chungying rejected these allegations and rebuked the United States: "[It] should open the biological lab at Fort Detrick, show more transparency to issues like its 200 plus-overseas bio-labs, invite experts to conduct origin-tracing in the United States …".[2]

Our research, based on open-sourced material in English and Chinese, avoids a speculation on the unknown origins of the COVID-19 pandemic. Its focus is on the dense international links of Chinese civilian virology labs. We note that China and the United States and its allies have cooperated on high-risk viral research for decades. Indeed, the United States and its Canadian, European, Australian and Japanese allies have trained cohorts of Chinese scientists and students on virology research including risky Gain of Function (GoF) research for decades (controversial transnational GoF research will be explained in chapter two).

The outline of the monograph is as follows. In chapter one, we explain why the United States and its allies trained many Chinese virologists in the context of the bi-polar Cold War in the face of a common enemy, the Soviet superpower. While the Founding Fathers of the WIV were trained in the West before the foundation of the People's Republic of China in 1949, what triggered a subsequent huge wave of Chinese virology students in the West was the rejection of Maoist autarky by Chinese paramount leader Deng Xiaoping who adopted the road to reform in 1978 including the opening to the West and Japan for science, technology, trade and investments to transform, modernise and strengthen China. This transnational cooperation in pathogen research continued in the post-Cold War era. The 2003 SARS (Severe Acute Respiratory Syndrome) outbreak was another catalyst to virology research cooperation between China and the West.

The next chapter presents two case studies of the most advanced civilian BSL4 labs in China --- the WIV and the Harbin Veterinary Research Institute (HVRI). There are more than 800 civilian virology labs of varying capability and importance in the Chinese mainland but there are only two BSL4 labs at the apex of the Chinese virology research at the time of writing. The WIV is famous for its bat coronavirus research (amid other types

[1] "Coronavirus: Trump stands by China lab origin theory for virus", *BBC*, 1 May 2020. https://www.bbc.com/news/world-us-canada-52496098

[2] "US Fort Detrick biolab becomes hot topic on Chinese social media", *Global Times,* 22 January 2021. https://www.globaltimes.cn/page/202101/1213588.shtml

of viral expertise) and the HVRI has a comparative advantage in avian and swine flu research. This chapter explains the drivers of international partnerships in risky viral research. Their transnational cooperation includes the training of Chinese virology experts, physical design and construction of the WIV lab, collaboration in GoF research and experiments, and even the direct transfer of research funds from the United States to Chinese labs such as the WIV. Hence, it is no exaggeration to say that the United States and China were "in it together" conducting risky GoF research.

Chapter three empirically maps the dense transnational networks between Western and Chinese virology labs. This includes the USAID PREDICT and EcoHealth Alliance's funding and "sub-contracting" of viral research to the WIV. A major section of this chapter explains how the French Institut Pasteur and Institut Merieux helped to design the WIV but their French experts had been subsequently marginalised from this BSL4 after it was established. Another section explains the Japan Initiative for Global Research Network on Infectious Diseases (J-GRID) and the HVRI to collaborate on avian flu research in Harbin. This chapter reveals that China today has acquired significant expertise in virology research thanks to its collaboration with the Western and Japanese scientific communities. Indeed, China has acquired sufficient capabilities over the past few decades to even conduct its own autonomous pathogen research and training of the next cohort of Chinese virologists. The Chinese student of yore in virology is now a master but international collaboration is still useful and necessary given the global nature of pandemics.

In the final chapter, we discuss the future of Chinese virology labs and their transnational links. We note that Beijing is committed to build advanced BSL3 labs in every Chinese province (the PRC has 23 provinces, five autonomous regions, and four municipalities directly under the Central Government). In 2020, China passed its biosecurity law to tighten the management of its virology labs. A year thereafter, the Five-Year Plan of the 14th National People's Congress laid out more ambitious plans for a technologically advanced and self-reliant China. This Plan targets a 7% annual growth in R&D. It will also enhance the capabilities of Chinese virology labs.

This chapter concludes that as the PRC (People's Republic of China) is enhancing its capability in virology research and in dealing with deadly pandemics, it is emerging as a comprehensive superpower in the military, diplomatic, economic, cultural and pathogen domains. Indeed, China may rise to become the global number one virology power within the next two to three decades, in part, thanks to Western assistance in training and collaboration in the past. Notwithstanding the "decoupling" of the United States and China in trade, investments, finance and flow of human talent (including virology scientists), there are still incentives for China, the West and Japan to collaborate on pathogen research for mutual benefits such as sharing information and viral samples, albeit to a lesser extent as before given the mutual suspicions in the wake of the COVID-19 pandemic.

Another conclusion from our research is that there is a lack of a proper regulatory and monitoring system of global governance to anticipate and cope with the domestic and international research on pathogens including risky GoF experiments. While the World Health Organisation (WHO) is responsible for flagging deadly pandemics and investigating their origins, it has remained silent on GoF experiments including bat coronavirus. Indeed, transnational virology research is like an "anarchical society" where international collaboration between the unregulated scientific communities of China, the West and Japan has often been ignored by many national governments and regional organisations like the EU (European Union) and ASEAN (Association of Southeast Asian Nations) and the UNSC (United Nations Security Council). Simply put, this lacuna in the global governance of deadly pathogen research has troubling implications for human security.

# *Chapter One*

# PATHOGEN RESEARCH NETWORKS IN CHINA: ORIGINS AND STEADY DEVELOPMENT

## Origins: Chinese students abroad

Chinese virologists and other related biomedical scientists began receiving training in advanced techniques and establishing subsequent scientific partnerships with Western institutions as early as the 1930s. For example, Professor Gao Shangyin, who is widely considered to be a founder of modern virology in China, went to the Rollins College in US for his undergraduate education in 1930 and earned his PhD from Yale in 1935. Professor Gao also founded the Wuhan Microbiology Laboratory in 1956, the predecessor institute to WIV.[3]

Initial progress in the field was incremental and problematic due to a combination of the loss of Soviet technical assistance and the domestic chaos triggered by the Great Leap Forward (1958-1962) and the Cultural Revolution (1966-1976). There is no record of Chinese publications before 1982 in Biomedical Social Sciences in the Web of Science (WS) database which covers majority of the publications in this field since 1900.

Following the normalization of Sino-US relations in 1978 and paramount leader Deng Xiaoping's economic reforms from the same year, there was a large wave of Chinese students across many disciplines (including virology) sent to the West for scientific training. As a result, the share of Biomedical publications from China over all publications in this field recorded by WS gradually increased since 1982 (**Figure 1**). The first few batches of Chinese students sent to the United States were mature scholars with families and strong links to China to ensure that they returned home.[4]

[3] Vlak, Just, "Professor Shang yin Gao (1909–1989): His legacy in insect cell culture and insect virology", *Journal of Invertebrate Pathology*, 95:3 (2007).

[4] Wei, William, "China's Brain Drain to the United States: Views of Overseas Chinese Students and Scholars in the 1990s", *China Review International*, 4:1 (1997).

**Figure 1. Percentage of Global Publications Originating from China in the Field of Biomedical Science: Steady Growth**


Source: Authors' calculation based on search results from Web of Science.

Between 1978 and 2000 over 200,00 Chinese students went to the US alone. 57,000 of these students were directly funded by the Chinese government while another 102,000 were funded by government-related entities and companies. Some of these students returned upon completion of their studies while others chose to work abroad before returning to China to train the next generation of scientists. The 1989 Tiananmen Square incident did not significantly impede the outward flow of Chinese students.[5]

This trend was particularly pronounced in the field of virology, epidemiology, and other related clinical/scientific fields. For example, the head of the Chinese Center for Disease Control and Prevention, Dr Gao Fu (also known as George Gao), did his doctoral training at Oxford (1991), researched at the University of Calgary, and then returned to Oxford as a post-doctoral researcher. Gao then worked at Harvard Medical School in 1999 (funded by the UK's Wellcome Trust) and subsequently became a Lecturer at Oxford (2001-2004).[6]

There were virtually no restrictions on Chinese students studying scientific or technical fields in the United States, such as biological engineering. The Deng Xiaoping era from 1978 to 1989 has been referred to as a 'golden period' in Sino-US relations where there was a continuous flow of Chinese students into the United

[5] Zhang, Yabin and Ma, Xiaoqing, "65 Years of Study Abroad History: From Soviet Union to the US, From Paid by Government to Paid by Family", Edited by Xiaoyi Wang, Data.163, 28 September 2014.

[6] Chinese Academy of Sciences (CAS), "Gao Fu". http://people.ucas.ac.cn/~GeorgeGao

States with nearly unrestricted field of study.[7] This trend continued in the post-Cold War era until the era of the COVID-19 global pandemic amid the sharp deterioration in Sino-US relations.

The 2003 Severe Acute Respiratory System (SARS) pandemic was a catalyst for China to swiftly enhance its biomedical research and BSL4-related domestic capabilities. The Chinese leadership prioritized the country to be adequately prepared for the next major outbreak by building more domestic infrastructure and enhancing specific transnational scientific partnerships. The term "biosafety (生物安全)" appeared in China's 10th Five-Year Plan (FYP) for the first time in 2001[8] prior to the 2003 SARS pandemic. In Section 2 (Cultivating the Bio-industry) of the 10th chapter (Accelerating the Development of High-tech Industries) in China's 11th FYP Outline in 2006, the need to "guarantee biosafety (保障生物安全)" is also emphasized.[9]

This document mentioned "biosafety research facilities (生物安全研究设施)" for the first time in an official FYP. In column 14 (Major Science and Technology Special Projects and Major Science and Technology Infrastructures) of Chapter 27 (To Accelerate Science and Technology Innovation), it specifically addresses and identifies major science and technology infrastructure such as the construction of spallation neutron sources, strong magnetic field devices, large-scale astronomical telescopes, and agricultural biosafety research facilities. To achieve these national objectives, China invited leading Western scientists who obtained unique and career-enhancing access to Chinese clinical/scientific networks, viral samples (such as SARS, avian influenza, and swine flu), and datasets. As we can see from Figure 1, the global share of biomedical publications from China increased to be above 1% after 2003.

The period of 2008 to 2019 saw a major increase in the number of Chinese students going to the United States. The academic year of 2008/2009 saw 98,235 Chinese students heading to the United States. This figure increased to 369,548 by academic year of 2018/2019. The most popular course was business management with engineering coming in a near second followed by computer science and mathematics. Interestingly, the majority of these students appeared to be self-funded.[10] This rapid increase in the representation of a specific nationality in American universities and laboratories is unprecedented.

[7] For example, see Vogel, Ezra, *Deng Xiaoping and the Transformation of China*, Belknap Press: 2011.
Vogel, Ezra (ed.), *Living with China: U.S./China Relations in the Twenty-first Century*, W.W. Norton: 1997.

[8] National People's Congress of the People's Republic of China, "Report on the Outline of the Tenth Five-Year Plan for National Economic and Social Development (2001)", 2001.

[9] National People's Congress of the People's Republic of China, "Report on the Outline of the 11th Five-Year Plan for National Economic and Social Development (2006)", 2006.

[10] This data has been derived from, Statista, "Number of college and university students from China in the United States from academic year 2008/09 to 2018/19".
https://www.statista.com/statistics/372900/number-of-chinese-students-that-study-in-the-us/

## How Do BSL4 Labs Operate?

BSL4 labs are specifically designed to handle a range of analytical tasks and experiments with the world's most dangerous pathogens. In principle, a BSL4 lab has globally consistent standards, protocols, and training regimes regardless of which specific country the facility is in. The network ecosystems of BSL4 (and some specialized BSL3 labs) have highly dense connections and almost daily (if not daily) interactions with other peer labs within China and across the world. This is due to the finite number of these labs as well as the highly specialized research that occurs within them that only a select group of scientists are even capable of conducting.

Flows between these labs include (but are not limited to) datasets, scientific/clinical opinions, new technological methods and parameters for experiments, personnel themselves[11], physical samples, re-agents, and even temporary loaning of spare capacity. For example, one common practice is to allow peer labs to utilize polymerase chain reaction (PCR) machines and other hardware that is being underutilized in its current environment. Internationally, the overall mode of interaction between BSL4 labs is collegiate with little competitive friction between groups due to a clear strategic preference from international funding bodies for multi-institutional and even multi-country research. As such, barriers to the abovementioned flows are minimal.

However, virology research in China appears to emphasize coronavirus. Publications from WIV and HVRI show that these two institutions have become more pathogen-specific and specialized with the WIV focusing on coronaviruses. HVRI appears to focus on avian influenza viruses, swine flu, and a range of other related zoonotic and exotic viruses.

Many of the international scientific partnerships in coronaviruses (especially bat-borne), avian influenza research (as well as other research on other rare but dangerous pathogens) are driven by combination of self-interest mixed with pragmatic scientific considerations. This research on bat coronaviruses was previously considered highly obscure. Many working in this field around the world faced challenges such as finding permanent positions, obtaining adequate funding, and peer recognition. Close international partnerships were essential to collectively secure research funds, data, scientific journal editorial board connections, and physical samples required for their field to survive, attract talent, and grow.

A small number of lab groups distributed throughout China (and a cluster of Western countries) became highly prominent in a manner uncharacteristic of many other branches of science. Chinese scientists who work in these fields have a highly constrained set of options within China (and even globally) that involve working under a handful of prominent scientists. This configuration may form a "mutual echo chamber" on types of pathogen research needed to be done and biosafety. This is problematic in a scientific field that is inherently

[11] Visiting research positions are common between peer labs.

risky in bat coronavirus, avian flu, and other pathogen research. Many other scientific fields are characterized by a more diverse range of lab groups with competing approaches and methods. This has minimized the risk of blindly pursuing a scientific end-goal without adequate consideration of potential negative consequences, including catastrophic ones.

Since the advent of its post-Mao reform era, the PRC made strategic and sustained investments in higher education. This included scholarships for Chinese students to study in top international universities (especially in the United States), domestic scientific training (to seed the next generation), and laboratory facility construction. Beijing also established many programs (such as the Thousand Talents Program) for international scientists to serve as advisors and visiting research scientists in the PRC. China has frequently hosted high-profile international conferences (including a pipeline of 2021 conferences)[12] and funded spin-off companies in the Mainland to attract foreign scientists to partner with Chinese researchers.[13]

## WIV –China's First BSL4 Lab: past and present

While the PRC has over 800 civilian virology labs across the country[14], its two BSL4 labs are among the best known globally in terms of research output, international partnerships, and deep integration into the Chinese larger public health system (civilian and military). The WIV was established in 1956 as a Microbiology Laboratory of CAS and it is one of the earliest national-level research institutes established after the founding of the PRC in 1949. In 1961, the Microbiology Laboratory of CAS was upgraded to CAS Central South Institute of Microbiology and then renamed as CAS Wuhan Institute of Microbiology in 1962. In 1970, during the Cultural Revolution, it separated from CAS and was renamed as Hubei Institute of Microbiology. In June 1978, it returned to the CAS and was named the Wuhan Institute of Virology of CAS with research disciplines adjusted accordingly.[15] WIV eventually established the first Biosafety Level 4 (BSL4) lab in China in 2015 in cooperation with the French government.[16]

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[12] See Bioexpo – China 2021, "The 4th China International BioPharma Conference & Exhibition", 19-21 September 2021. http://www.cajc-china.com/?_l=en

[13] For example, see Terry, Mark, "China Has Big Presence in Top 10 Biotech IPOs this Year", *BioSpace*, 17 July 2019. https://www.biospace.com/article/top-10-biopharma-ipos-in-the-first-half-of-2019/

"Top Virologists of the Global Virus Network (GVN) Meet in China to Address Threats", *Business Wire,* 12 May 2015. https://www.businesswire.com/news/home/20150512006108/en/Top-Virologists-Global-Virus-Network-GVN-Meet

[14] Gao, George, "For a better world: Biosafety strategies to protect global health', *Biosafety and Health*, 1:1 (June 2019).

[15] See Wuhan Institute of Virology (WIV), "中国科学院武汉病毒研究所喜迎建所五十周年华诞" (Wuhan Institute of Virology, Chinese Academy of Sciences celebrates its 50th anniversary; Zhong guo ke xue yuan Wuhan bing du yan jiu suo xi yin jian suo wu shi zhou nian hua dan), 11 January 2006.http://www.whiov.cas.cn/xwdt_160278/zhxw2019/201911/t20191111_5428884.html

[16] Economic Times, "China flaunts French connection to Wuhan lab; Ambivalent on WHO probe into origin of coronavirus", 7 May 2020. https://economictimes.indiatimes.com/news/international/world-news/china-flaunts-french-connection-to-wuhan-lab-ambivalent-on-who-probe-into-origin-of-coronavirus/articleshow/75600806.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

After the SARS outbreak, the Chinese government initiated the construction of the BSL4 laboratory. WIV's BSL4 lab is jointly constructed by the CAS and the Wuhan local government. The technology and equipment of the BSL4 laboratory in Lyon, France were also used. Chinese and French architects and scientists jointly designed the laboratory, and the Chinese construction unit completed the construction of the laboratory and the installation of its main facilities and equipment. After more than a decade, the major construction work of WIV's BSL4 lab was finished.

Since the outbreak of the COVID-19 outbreak in Wuhan in December 2019, the WIV has attracted global attention because the WIV is China's first BSL4 lab and is located in the epicentre of this global epidemic. Despite the disruption and the lockdown of Wuhan city, the WIV worked round the clock to sequence the DNA of this mysterious coronavirus and presumably to discover a vaccine to save lives. The People's Liberation Army (PLA), led by Major General Dr Chen Wei, also inspected the WIV.[17] She was a key scientist who tackled SARS in 2003. The PLA is led by the Central Military Commission and headed by the Chinese Communist Party (CCP) General Secretary and Chinese President Xi Jinping. The WIV is managed by the Chinese Academy of Sciences (CAS) under the State Council headed by Chinese Premier Li Keqiang. Notwithstanding this parallel system of governance (party and state) in China, Major General Chen inspected the WIV amidst a national crisis.

## WIV: Western-trained Founding Fathers

The three most important founders of WIV are Dr Gao Shangyin, Dr Chen Huagui, and Dr Jian Haoran. They obtained their PhDs abroad before the founding of the People's Republic of China in 1949. Dr Chen received his PhD in microbiology from the School of Bacteria and Tropical Diseases, University of London in 1939.[18] Dr Jian received his PhD in soil microbiology from the University of Wisconsin in 1948.[19]

All three founding fathers were active and leading united front party members. Gao Shangyin was a member of the Central Committee of the Democratic League and a member of the Central Senate Committee of the Democratic League.[20] Chen Huagui joined the CCP in 1956 and was a representative of the 3rd, 4th and 6th

[17] Chan, Minnie and Zheng, William, "Meet the major general on China's coronavirus scientific front line", *South China Morning Post*, 3 March 2020.
https://www.scmp.com/news/china/military/article/3064677/meet-major-general-chinas-coronavirus-scientific-front-line

[18] Xinhua, "在"土地上"默默耕耘的陈华癸" (Chen Huagui who works silently on the "land": Zai tu di shang mo mo geng yun de Chen Huagui), 6 November 2018.
http://www.xinhuanet.com/science/2018-11/06/c_137595169.htm

[19] Institute of Microbiology - Guangdong Academy of Sciences, "简浩然教授" (Professor Jian Haoran; Jian Haoran jiao shou), 26 August 2013.
http://www.gdim.cn/jggk/lrld/201308/t20130826_121604.html

[20] See Wuhan Digital Local Chronicles Museum at "武汉市志-第八卷 社会人物大事记: 高尚荫" (Wuhan City Chronicles-Volume 8 Memorabilia of Social Figures: Wuhan shi zhi – Di ba juan she hui ren wu da shi ji: Gao Shangyin), Accessed 26 April 2021.
http://szfzg.wuhan.gov.cn/book/dfz/bookread/id/273/category_id/58160.html

National People's Congress.[21] According to the official website of the Institute of Microbiology at the Guangdong Academy of Sciences (where Jian Haoran retired from), he was the alternate member of the 5th and the member of the 6th Central Committee of the Chinese Kuomintang Revolutionary Committee, member of the Standing Committee of the 5th Hubei Provincial People's Congress, and representative of the 2nd Guangzhou Municipal People's Congress. He was also a member of the CCP.[22]

## Management Structure of WIV: party and state (provincial and national)

The WIV has formal organizational ties to CAS, CCP (party represented on the WIV Board of Directors as well as the CAS Leadership), provincial and city governments, and various other bodies. CAS is the peak scientific academy of China in Beijing under the State Council led by Premier Li Keqiang. CAS sets the strategic direction to the country's broader national technology development. It has more than 71,000 staff and has direct official oversight of WIV.[23] The President of CAS is Dr Hou Jianguo. He is also the CCP secretary of CAS and an Academician of Chinese Academy of Sciences (ACAS). Among the seven Deputy Presidents of CAS, only Gao Hong Jun is not a member of CAS CCP Leader Group. However, Gao Hong Jun is a Member of the Standing Committee of the 12th and 13th National Committee of the Chinese People's Political Consultative Conference and an ACAS member. Four other Deputy Presidents of CAS are also ACAS members: Zhang Ya Ping, Zhang Tao, Li Shu Shen and Zhou Qi.

Dr Wang Yanyi is the Director General of WIV while also holding the position of Deputy Chair of a United Front political party in Wuhan. She is married to Dr Shu Hongbing, a fellow immunologist who has held several senior positions at Wuhan University College of Life Sciences (Dean) and Wuhan University (Vice President). The power couple of Wang and Shu has a track record of joint publications.[24] They represent an established formal and informal relationship between the WIV, CAS, CCP, as well as other research institutes in Wuhan working in key areas of virology.

The apex of the WIV pyramid is a CCP oversight team led by Party Secretary Xiao Gengfu. Another CCP member within WIV is Deputy Secretary of the Party Committee and Secretary of the Disciplinary Committee

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[21] Chen, Huanchun, Yu, Ziniu and Li, Xueyuan, "陈华癸先生诞辰 100 周年纪念文集" (The 100th Anniversary of the Birth of Mr. Chen Huakui), China Science Publishing & Media Ltd. Beijing: 2014.

[22] Institute of Microbiology - Guangdong Academy of Sciences, "简浩然教授" (Professor Jian Haoran: Jian Haoran jiao shou), 26 August 2013. http://www.gdim.cn/jggk/lrld/201308/t20130826_121604.html

[23] See Chinese Academy of Sciences, 中国科学院简介" (Introduction to Chinese Academy of Sciences; Zhongguo ke xue yuan jian jie), 20 December 2020.
https://www.cas.cn/zz/yk/201410/t20141016_4225142.shtml
Chinese Academy of Sciences, "侯建国" (Hou Jianguo).
https://www.cas.cn/houjianguo/

[24] For example, see Wang, (YY), Shu, (HB), et. al., "VISA is an adapter protein required for virus-triggered IFN-beta signalling", *Molecular Cell*, 19:6 (16 September 2005).
Wang, (YY), Shu, (HB), et. al., "A20 is a potent inhibitor of TLR3- and Sendai virus-induced activation of NF-kappa B and ISRE and IFN-beta promoter", *FEBS Letters*, 576: 1-2 (8 October 2004).

He Changcai. There are several other official CCP personnel within WIV, namely Guan Wuxiang, Sun Xiaolian, Li Liping, Cui Zongqiang, and Tong Xiao. However, they are listed as Party Committee members but with no descriptions of their respective roles. He Changcai's mandate is presiding over the overall work of the Disciplinary Committee, assisting the Party Committee to ensure good governance, and implementing the CCP's official policy, party discipline, relevant laws and regulations, as well as WIV's own rules and regulations.[25]

## WIV scientists: domestic and international networks

WIV has established itself as a centre of excellence in pathogen research such as the Middle East Respiratory Syndrome (MERS), Zika, SARS and SARS-like viruses, Nipah, Ebola, HIV, and various insect-borne viruses such as malaria.[26] There are 65 in-house scholars listed on WIV's website, including 36 senior research fellows, five junior research fellows and 24 associate research fellows. Among them, there are 28 senior research fellows, one junior research fellow and six associate research fellows who have education, working or academic visiting experience abroad. The domestic and education experiences of the WIV scholars are linked to 44 universities and institutions over 17 provinces and municipalities. Some scholars are not listed on WIV's official website but claim affiliation with WIV. For example, there are four scholars listed on the official website of the State Key Laboratory of Virology at Wuhan University (WHUKLV). But their names do not appear on WIV's official website. However, the WHUKLV's official website indicates that they are also affiliated with WIV.

Perhaps the best well-known researcher at WIV is Dr Shi Zhengli, a French-trained and internationally recognised bat coronavirus expert with expertise in bioengineering. Shi and several colleagues (both domestic and international) have several landmark publications in leading scientific journals such as *Nature* and *Archives of Virology*. Shi's international collaborators include Dr Ralph Baric (University of North Carolina at Chapel Hill), Dr Jonna Mazet (University of California at Davis) and Dr Peter Daszak (EcoHealth Alliance).[27]

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[25] Wuhan Institute of Virology (WIV), "Party Committee – Wuhan Institute of Virology, Chinese Academy of Sciences". http://www.whiov.cas.cn

[26] See, for example, Shi Zhengli's bat coronavirus bioengineering team at WIV and Chen Hualen's avian influenza bioengineering team at HVRI.

[27] See Shi, Zhengli, Baric, Ralph et. al., "A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence", *Nature Medicine*, 21:12 (December 2015).
Mazet, Jonna, Daszak, Peter, Shi, Zhengli et. al., "Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor", *Nature*, 503:28 (November 2013).
Li, Fang, Wang, Linfa, and Shi, Zhengli, et. al, "Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry", *Archive of Virology*, 155 (22 June 2010).
Zheng, Lei-Ping, Daszak, Peter, Shi, Zhengli, et. al. 'Bat Severe Acute Respiratory Syndrome-Like Coronavirus WIV1 Encodes an Extra Accessory Protein, ORFX, Involved in Modulation of the Host Immune Response', Journal of Virology, 90:14, July 2016.
Wang, Ning, Daszak, Peter, Shi, Zhengli, et. al. 'Serological Evidence of Bat SARS-Related Coronavirus Infection in Humans, China', Virologica Sinica, 2 March 2018.

Their studies used novel methods to enable a bat coronavirus to directly infect human beings without the need for an intermediate mammalian host. For example, the 2003 SARS coronavirus might have originated in bats and then infected humans via another mammal species, possibly pigs or civet cats. Additional experiments enabled these researchers to create this new chimera bat coronavirus more transmissible than even the most dangerous bat coronaviruses found in nature.[28] WIV has capabilities across a range of "wet lab" environments that deal with physical biological materials as well as "dry lab" environments that utilise advanced computational methods, including artificial intelligence and machine learning. This "end-to-end" capability enables WIV to conduct state-of-the-art experiment across many domains within the field of virology including bat coronaviruses.[29]

WIV previously acknowledged housing a Military Management Division (MMD). This arrangement raised concerns about the potential dual-use nature of some of the research being done at WIV.[30] There are now no direct references to the MMD on the WIV website. Information regarding previous official US State Department visits to WIV has also been removed.[31] However, there is still evidence of cooperation between WIV and military related organizations or activities on WIV's own website. For example, the team lead by Peng Ke and Xiao Gengfu from WIV have a joint online publication, titled "Calcium channel blockers reduce severe fever with thrombocytopenia syndrome virus (SFTSV) related fatality" in the journal *Cell Research* with a team led by Wei Liu from the Academy of Military Science of the Chinese People's Liberation Army (AMS).[32] WIV also has dense connections with other institutions in Wuhan, such as the Wuhan Institute of Technology, Wuhan University (specifically the Medical School), Wuhan University of Science and Technology, and the Wuhan branch of the China CDC (located near the Huanan Seafood Market, possibly the initial point of origin of the COVID-19 pandemic in Wuhan).

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[28] See, Shi, Zhengli, Baric, Ralph, et. al., "A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence", *Nature Medicine*, 21:12 (December 2015). See also Mazet, Jonna, Daszak, Peter, Shi, Zhengli, et. al., "Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor", *Nature*, 503:28 (November 2013).
Li, Fang, Wang, Linfa, and Zhengli, Shi et. al, "Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry", *Archive of Virology*, 155 (22 June 2010).

[29] For a detailed organizational chart, see Wuhan Institute of Virology (WIV), "Administration, Wuhan Institute of Virology – Chinese Academy of Sciences".
http://english.whiov.cas.cn/About_Us2016/Administration2016/

[30] Owen, Glen, "Wuhan virus lab was signed off by EU Brexit chief Michel Barnier in 2004 – despite French intelligence warnings that China's poor bio-security reputation could lead to a catastrophic leak", *Guardian*, 23 May 2020.

[31] Rogin, Josh, "State Department cables warned of safety issues at Wuhan lab studying bat coronaviruses", *New York Times*, 14 April 2020.

[32] Wuhan Institute of Virology, "武汉病毒所/生物安全大科学中心联合军科院研究团队发现钙离子通道抑制剂能够治疗发热伴血小板减少综合征（SFTS" (The research team of Wuhan Institute of Virology/Biosafety Science Center and the Academy of Military Sciences found that calcium channel inhibitors can treat fever with thrombocytopenia syndrome), 30 August 2019.
http://www.whiov.cas.cn/kxyj_160249/kyjz_160280/201911/t20191103_5420105.html
Peng, Ke, et. al, 'Calcium channel blockers reduce severe fever with thrombocytopenia syndrome virus (SFTSV) related fatality', *Cell Research*, 29 (2019).

From 1981 to 2020, WIV produced 2,288 publications co-authored with scientists from 1,728 institutions across 80 countries (including China). There were no record before 1981. According to this publication record, scientific cooperation between WIV is particularly consistent with 138 institutions across 23 countries (measured by a track record of at least 5 joint publications).[33]

Domestically, WIV researchers have relatively more active cooperation with colleagues from 119 other institutions (have 5 or more joint publication). Especially, WIV has the most productive scientific partnerships with the University of Chinese Academy of Sciences (709 joint publication), the Wuhan University (358 joint publication), the Institute of Biophysics Chinese Academy of Sciences (162 joint publication). It also has very active cooperation with the Academy of Military Medical Sciences China (24 joint publications) and the Second Military Medical University (8 joint publications).[34] These joint publications demonstrate WIV's close relationship with both China's academy and military.

Besides the WIV's domestic networks and partnership with the West, it also has links to the Third World. WIV appears to be a mentor to some virology scientists from developing countries. For example, the Gates Foundation has sponsored visits from many African countries to visit WIV.[35]

## HVRI: BSL4 for Avian and Swine Flu

The HVRI was established in 1948 as "the Animal Epidemic Prevention Institute of the Agriculture and Forestry Department of the Northeast Administrative Committee (东北行政委员会农林处家畜防治所)"[36], a year before the PRC was founded.[37] It is the first Veterinary Institute under the CCP's regime. In 1949, it was renamed the Veterinary Research Institute of the Ministry of Agriculture of the Northeast People's Government. In 1955, the institute was reorganized under the Ministry of Agriculture of the People's Republic of China and was called the Harbin Veterinary Research Institute.[38]

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[33] Information retrieved from Web of Science by authors.
Web of Science is a leading automated scientific literature review software tool that enables researchers to query international scientific publications across specific scientific domains, including those directly related to the field of virology.

[34] Information retrieved from Web of Science by authors. See, for example, Wuhan Institute of Virology and the Center for Biosafety Mega-Science, CAS, "The research team of Wuhan Institute of Virology/ Biosafety Science Center and the Academy of Military Sciences found that calcium channel inhibitors can treat fever with thrombocytopenia syndrome (SFTS)", 30 August 2019.

[35] Wuhan Institute of Virology (WIV). "Experts of public health from 10 African countries visited WIV, CAS", 21 November 2018. http://english.whiov.cas.cn/Exchange2016/Foreign_Visits/201811/t20181121_201447.html

[36] Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, "历史沿革" (History). http://www.hvri.ac.cn/zjhsy/lsyg/index.htm

[37] The modern study of virology in China traces its origins to Dr Wu Lien Teh, a Cambridge-educated infectious disease physician from Penang island, Malaya (present day Malaysia). Dr Wu spearheaded a successful campaign to contain the 1910-1911 Manchurian epidemic that resulted in 60,000 fatalities. Harbin today is home to a museum dedicated to Dr Wu as a plague fighter. See Ma, Zhongliang and Li, Yanli, "Dr. Wu Lien Teh, plague fighter and father of the Chinese public health system", *Protein Cell*, 7:3 (March 2016).

[38] Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, "历史沿革" (History). http://www.hvri.ac.cn/zjhsy/lsyg/index.htm

The Institute's first director and CCP representative was Professor Chen Lingfeng.[39] From September 1931 to July 1935, he studied at Lingnan University in Guangzhou. From December 1938 to February 1940, he was the Technical Assistant and Deputy Head of the Agricultural School of the Construction Department of Shaanxi-Gansu-Ningxia Border Area. From February 1940 to April 1946, he was Technical Director and Field Director in Guanghua Farm in the Shaanxi-Gansu-Ningxia Border Region. From June to November 1946, he worked as an Agricultural Commissioner in the Shanghai Office of the Liberated Area Relief Administration. From March to November 1947, he served as the field director of the Northeast Jiamusi Agricultural Testing Field. From November 1947 to December 1947, he was preparing to establish the Animal Epidemic Prevention Institute of the Agriculture and Forestry Department of the Northeast Administrative Committee (the predecessor of the Harbin Veterinary Research Institute of the Chinese Academy of Agricultural Sciences) in Harbin. From 1948 to March 1953, he served as the director of the HVRI.[40] He was also very active in government and was the representative of the Second National People's Congress.

Located in Harbin (Heilongjiang Province), the HVRI is the "go-to" institute for various animal viruses (known as zoonotics) which are potentially lethal to livestock and humans. The HVRI has internationally recognized expertise in avian influenza viruses, namely the H5N1 and H7N9 viruses. HVRI is under the Chinese Academy of Agricultural Sciences (CAAS) and can award doctoral degrees. HVRI was established as China's second BSL4 lab in 2018. Besides avian influenza viruses, HVRI also researches on swine flu and other flu viruses that may infect other animal species.

CAAS is a peak scientific academy in Beijing responsible for the national development in agricultural science and related areas. CAAS is led by CCP members and also reports to the State Council. The HVRI has 566 staff with 76 senior researchers. HVRI is physically large (covering more than 69,600 square metres) and also has a laboratory animal breeding farm covering 1,532,900 square metres in suburban Harbin. HVRI will relocate to a new site that covers 271,800 square meters. Given the scale of this physical expansion, HVRI is likely to hire more staff.[41]

While it is likely that the CCP exerts similar WIV-style governance and ideological control over HVRI, information regarding specific CCP personnel and their functions at HVRI itself is more opaque than the WIV. However, the CAAS does provide information on CCP personnel within its governance structure. For example, Tang Huajun serves both as President of CAAS and as an official Member of the Leading Party

[39] Yuan, Ping, "The Chinese Society of Animal Husbandry and Veterinary Medicine held an academic annual meeting to show the appearance of experts. Animal husbandry and veterinary experts highlight the role of science and technology to promote animal husbandry. Experts at the meeting wish Chen Lingfeng 90th birthday", *China Animal Husbandry*, 19 (2003).

[40] Harbin Veterinary Research Institute, Chinese Academy of Sciences, "沉痛悼念陈凌风同志" (Deeply mourn Comrade Chen Lingfeng). http://www.hvri.ac.cn/xwzh/zhdt/145379.htm

[41] Chinese Academy of Agricultural Sciences (CAAS) "About Us - Harbin Veterinary Research Institute". http://www.hvri.ac.cn/en/aboutus/athvri/index.htm

Group, Ministry of Agriculture.[42] Other prominent CCP members are Zheng Hecheng (Secretary of the Leading Party Group – CAAS), Li Jieren (Head of Discipline Inspection Group – CAAS), Liu Daqun (Member of Leading Party Group – CAAS), and Jia Guangdong (Director General, Department of Personnel – CAAS).[43]

From the period of 1987 to 2020, HVRI produced 1,814 publications co-authored with scientists from 809 institutions across 52 countries, including China. Before 1987, there is no record. According to these publication record, the cooperation between HVRI and 50 international institutions across 12 countries are especially active (as measured by 5 or more joint publications).[44]

Domestically, HVRI researchers have relatively more active cooperation with colleagues from 74 other institutions. HVRI has the most productive scientific partnerships with the Northeast Agricultural University China (232 joint publications), the Harbin Medical University (80 joint publications), and the Northeast Forestry University China (70 joint publications). It also has close cooperation with the Academy of Military Medical Sciences China (42 joint publications), Air Force Military Medical University (7 joint publications), China Ministry of Agriculture (18 joint publications), and WIV (10 joint publications).[45] These joint publications show HVRI'S close relationship with both China's academy and military.

HVRI has many international partnerships, including an industry collaboration with leading animal health company Boehringer Ingelheim. The "industry-academia-research" exchange platform was established in May 2019 and a first in China. This partnership encompasses training (classroom and lab-based), joint research and development, and student exchanges that enable HVRI postgraduate students to conduct research within the broader Boehringer Ingelheim corporate scientific infrastructure.[46]

One of the most well-known researchers at HVRI is Dr Chen Hualan, a leading veterinary virologist who worked at the US Centers for Disease Control and Prevention from 1999 to 2002. Chen's recent work focuses on avian influenza viruses. Some of her experiments have generated controversy, especially GoF work on avian influenza viruses.[47]

One of Chen's most controversial studies was published in June 2013 on experimental methods that enabled the H5N1 avian influenza virus to develop pandemic potential by picking up entire genes from H1N1. This H1N1 is the highly virulent influenza virus that caused a global epidemic in 2009. By combining segments of

[42] While many scientific personnel within CAAS, HVRI, and/or WIV are members of the CCP, it is not typically officially declared.

[43] Chinese Academy of Agricultural Sciences (CAAS), "Leadership – Chinese Academy of Agricultural Sciences". http://www.caas.cn/en/administration/Leadership/index.html

[44] Information retrieved from Web of Science by authors.

[45] Ibid.

[46] Boehringer Ingelheim, "Boehringer Ingelheim and Harbin Veterinary Research Institute set up "industry-academia-research" exchange platform", 10 May 2019. https://www.boehringer-ingelheim.com/press-release/new-exchange-platform-harbin-research-institute

[47] Enserink, Martin, "Single Gene Swap Helps Bird Flu Virus Switch Hosts", *Science*, 2 May 2013. https://www.sciencemag.org/news/2013/05/single-gene-swap-helps-bird-flu-virus-switch-hosts

H5N1 and H1N1 viruses in her lab, Chen developed a new hybrid virus that can transmit airborne between mammals. Such a chimera virus is not found in nature.[48]

## Summary

In the critical early developmental period, Chinese scientists benefitted from open and unrestricted access to Western education, mentorship, datasets, and other key scientific inputs. Subsequently, a small core of both Chinese and international scientists emerged and collaborated on risky pathogen research. Many international scientists saw unique opportunities in China often not present in their home countries such as substantial research funding, strong investment in core scientific infrastructure for novel experiments, and a relatively permissive operating environment. This has boosted China's capability in virology research to the extent where the country is now leading in this domain. It is now capable of autonomous research and development in this field and less dependent on its erstwhile Western pathogen mentors.

[48] Ibid.
Also see Chen, Hualan, et. al., "H5N1 Hybrid Viruses Bearing 2009/H1N1 Virus Genes Transmit in Guinea Pigs by Respiratory Droplet", *Science*, 340: 6139 (21 June 2013).

# *Chapter Two*

# CHINESE BIOSAFETY LEVEL 4 LABORATORIES AND THEIR KEY INTERNATIONAL LINKAGES

## Global Virology Partnerships: Key drivers

The origins and diffusion of risky pathogen research are clear and unambiguous. This research began in key Western countries and then diffused to China. Indeed, the most high-risk components were "outsourced" to a few key Chinese labs.[49] Apparently, some Western lab groups engaging in these scientific activities believed that they could influence and guide these experiments in China. However, this has not occurred.

The network of advanced BSL3 labs and BSL4 labs[50] have highly dense connections and almost daily interactions within China and across the world. This is due to the finite number of these labs as well as the highly specialized research that occurs within them that only a select group of scientists are even capable of conducting. Many of the international scientific partnerships in coronaviruses (especially bat-borne), avian influenza research, swine flu, as well as other research on other rare but dangerous zoonoses are driven by combination of self-interest mixed with pragmatic scientific considerations.

Many working in the field around the world faced challenges such as finding tenured positions for themselves, obtaining adequate funding, and attaining scientific recognition. Close international partnerships were essential to collectively secure research funds, data, scientific journal editorial board connections, and physical samples required for their field to thrive.[51] A small number of virology lab groups in China and a few Western countries became highly prominent in a manner uncharacteristic of many other branches of science.[52] Scientists who work in these fields have a highly constrained set of options that involve working under a handful of prominent scientists. This characteristic is particularly pronounced in China.

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[49] For example, see Lin, Christina, "Why US outsourced bat virus research to Wuhan", *Asia Times*, 22 April 2020.

[50] BSL4 is the highest level of biosafety precautions and facilities are specifically designed for work with pathogens that could easily be transmitted within the laboratory and cause severe to fatal disease in humans for which there are no available vaccines or treatments. Biosafety level 3 is appropriate for work involving microbes which can cause serious and potentially lethal disease via the inhalation route. Many of the protocols and other control measures in BSL4 and BSL3 labs are similar. For a more detailed technical overview, see United States Centers for Disease Control and Prevention, Biosafety in Microbiological and Biomedical Laboratories – 5th Edition, Atlanta, December 2009.
Shu, Yuelong, Cox, Nancy, et. al., 'A ten-year China-US laboratory collaboration: improving response to influenza threats in China and the world, 2004-2014', BMC Public Health, 19:520, 10 May 2019.

[51] This is based upon the professional experience of Ryan Clarke when he worked in the fields of biodefense and public health in the Asia-Pacific, United States, and United Kingdom.

[52] Ibid.

## Are GoF Experiments necessary for major scientific advances?

GoF experiments are a controversial domain within biomedical science, defense and security fields. They are distinct from other scientific methods and approaches. These experiments are deliberately designed to enable pathogens to acquire and develop new properties including increased transmissibility, increased lethality, and resistance to drugs. Such lab-made chimera viruses are potentially more dangerous than viruses found in nature.

These "Frankenstein" experiments are supposed to generate predictive knowledge and insight for scientists to anticipate how viruses could leap from one species to another, and then trigger the next lethal pandemic. Armed with such lab-based knowledge, the global health community can then prepare for early and swift detection, containment and prevention of the next deadly pandemic. As evidenced by the COVID-19 outbreak as well as other coronavirus outbreaks such as the Middle East Respiratory Syndrome (MERS), the track record of this research is dubious. First reported in Saudi Arabia in 2012, MERS spread to many countries including Thailand and South Korea. Avian flu viruses such as H5N1 (2003) and H7N9 (2013) originated in China, have broken out. Simply put, GoF experiments thus far have not prevented any pandemics.

GoF experiments have also been conducted on many dangerous pathogens including the Highly Pathogenic Avian Influenza H5N1 (HPAI H5N1 – often referred to as simply H5N1). Before the COVID-19 outbreak, GoF research on H5N1 was considered to be the most high-risk and controversial. Many scientists have voiced outright opposition to these experiments.[53] Some sceptics have pointed out that no major vaccine has been developed despite GoF research on H5N1, SARS, MERS, or any other highly dangerous pathogens.

Funding streams, data sharing, joint publications, and other related outputs on GoF research on H5N1 have taken place with Western scientists working in partnership with their Chinese counterparts. GoF transnational research on bat coronaviruses have gained prominence in recent years. Given the potential risks posed by GoF bat coronavirus research, it is critical that the transnational research network is mapped, characterized, and accurately described for a more comprehensive assessment of risks and benefits.

## WIV's International GoF Links

The WIV bat coronavirus research group led by Dr Shi Zhengli has pioneered experiments that enable bat coronaviruses to directly infect human cells without the traditional need for an intermediate host such as a civet cat, pangolin, mink, marmot or a pig. Despite being a highly controversial research field, Shi has openly

[53] For example, see Rey, Felix, Schwartz, Olivier, and Wain-Hobson, Simon, "Gain-of-function research: unknown risks", *Science*, 342(6156):311 (18 October 2013).

published her GoF research. A substantial portion of this research was originally done with scientists from the University of North Carolina at Chapel Hill.[54]

Despite the severe COVID-19 outbreak in the United States, several other American lab groups, such the Galveston National Laboratory (another BSL 4 facility which is part of the University of Texas at Austin system) openly claimed that WIV had impeccable standards and that the COVID-19 virus could simply not have escaped from the facility.[55] The U.S. Department of Education investigated the links between the University of Texas and various Chinese labs (WIV in particular) as well as the Chinese state-owned telecommunications giant Huawei.[56] Apparently, the Director of the Galveston National Laboratory, Dr James Le Duc, visited WIV several times during the construction phase of WIV's BSL4 facility and provided advisory inputs.[57]

Another key member of Shi's team is Dr Zhou Peng. He completed his Ph.D. training at the Australian Centre for Disease Preparedness (formerly known as the Australian Animal Health Laboratory) in Geelong, Australia. Zhou Peng's placement was jointly funded by the Chinese and Australian governments.[58] Zhou then completed a post-doctoral fellowship at the Duke-NUS Medical School in Singapore.[59]

Arguably, GoF experiments are widely assessed to have little or no real scientific value. No current consequential coronavirus therapeutic, diagnostic, vaccine, or any other relevant breakthrough has been directly attributed to this work. In fact, the University of North Carolina researchers ended their collaboration with the WIV in October 2014 after the US government banned federal funding on all GoF studies on influenza, MERS, and SARS. However, Shi and her team continued their work at WIV after being officially licensed in 2015 by NIH (National Institutes of Health) to both continue bat coronavirus GoF research and receive American funds despite the ban and funding moratorium within the United States itself.[60] This is ironical indeed.

Besides its US partnerships, WIV has a strong French connection. The Institute was designed with substantial French technical assistance[61] followed by a scientific exchange program that never quite materialized. Only a

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[54] For example, see Menachery, Vineet, et. al., "SARS-like cluster of circulating bat coronavirus pose threat for human emergence", *Nature Medicine*, 21:12 (December 2015).
WIV also conducts research on the Middle East Respiratory Syndrome (MERS), Zika, SARS and SARS-like viruses, Nipah, Ebola, HIV, and various insect-borne viruses such as Malaria.

[55] McKay, Hollie, "Prominent university bio lab urged to reveal extent of relationship with Wuhan lab at centre of coronavirus outbreak", *Fox News*, 1 May 2020.

[56] For example, see O'Keefe, Kate, "U.S. Probes University of Texas Links to Chinese Lab Scrutinized Over Coronavirus", *Wall Street Journal*, 1 May 2020.

[57] Ferguson, John Wayne, "Galveston bio lab explains connections to Wuhan", The Daily News, 22 April 2020.

[58] Burke, Kelly, "Australian CSIRO in Geelong linked to coronavirus "bat laboratory" theory", *7 News*, 28 April 2020.

[59] For example, see Zhou, Peng, Shi, Zhengli, et. al., "IFNAR2-dependent gene expression profile induced by IFN-alpha in Pteropus alecto bat cells and impact of IFNAR2 knockout on virus infection", *PLOS ONE*, 17 January 2018.

[60] Lin, Christina, "Why US outsourced bat virus research to Wuhan", *Asia Times*, 22 April 2020.

[61] Both Institut Pasteur and Institut Merieux were heavily involved in the physical design and development of key management and scientific protocols.

token French researcher (there were supposed to be up to 50) conducted research at WIV. These developments generated concern within French intelligence and security circles[62] given the nature of the experiments done at WIV and the fact that WIV is reputed to have a Military Management Division (MMD). If indeed this is the case, the MMD represents a People's Liberation Army (PLA) presence in WIV.[63]

## Bat Coronavirus GoF 'Breakthroughs': International Cooperation

Joint Sino-US-Australian teams[64] published several GoF studies in leading scientific journals such as *Nature* and *Archives of Virology* in 2010, 2013, and 2015. These studies showed how a bat coronavirus can directly infect human cells without the need for an intermediate mammalian host.[65] Additional experiments enabled these researchers to make these lab-modified bat coronaviruses more transmissible than bat coronaviruses found in nature.[66] These experiments sparked major debates within the scientific, security and defense communities.

However, the concerns raised against these controversial experiments were ignored by this transnational network of bat coronavirus GoF researchers. They continued their work openly at various institutions in China, Australia, and the United States, amongst others. This research was done publicly with the knowledge and awareness of possibly thousands of peers. Moreover, most high-risk GoF experiments were "outsourced"[67] to China in response to domestic criticisms of tinkering with nature in other Western countries, especially the United States. Dr. Simon Wain-Hobson, a leading virologist at Institut Pasteur in Paris, openly warned that GoF experiments are potentially dangerous, especially if there is a leak from the lab.[68]

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Shi Zhengli obtained her doctorate at Montpellier 2 University in Montpellier, France.

[62] Owen, Glen, "Wuhan virus lab was signed off by EU Brexit chief Michel Barnier in 2004 – despite French intelligence warnings that China's poor bio-security reputation could lead to a catastrophic leak", *Guardian*, 23 May 2020.

[63] Ibid.

[64] The Australian Centre for Disease Preparedness, Australia's BSL4 lab in Geelong (city southwest of Melbourne) has remained silent despite the fact that extensive research was conducted on bat coronaviruses in this facility with Shi Zhengli even spending time there as a visiting scientist in 2006.

[65] See Shi, Zhengli, Baric, Ralph et. al., "A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence", *Nature Medicine*, 21:12 (December 2015).
Mazet, Jonna, Daszak, Peter, Zhengli, Shi et. al., "Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor", *Nature*, 503:28 (November 2013).
Li, Fang, Wang, Linfa, Shi, Zhengli, et. al, "Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry", *Archive of Virology*, 155 (22 June 2010).

[66] See Shi, Zhengli, Baric, Ralph et. al., "A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence", *Nature Medicine*, 21:12 (December 2015).
Mazet, Jonna, Daszak, Peter, Shi, Zhengli, et. al., "Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor", *Nature*, 503:28 (November 2013).
Li, Fang, Wang, Linfa, and Shi, Zhengli, et. al, "Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry", *Archive of Virology*, 155 (22 June 2010).

[67] Lin, Christina, "Why US outsourced bat virus research to Wuhan", *Asia Times*, 22 April 2020.

[68] Akst, Jef, "Lab-Made Coronavirus Triggers Debate", The Scientist, 16 November 2015.
Wain-Hobson, Simon "An Avian H7N1 Gain-of-Function Experiment of Great Concern", *mBio*, 5:5 (September/October 2014).

After initial denials, NIH Director Anthony Fauci has officially acknowledged that US$600,000 was subcontracted to WIV as part of a US$3.7 million granted awarded to Daszak's EcoHealth Alliance. These US taxpayer-provided funds specifically supported bat coronavirus GoF research projects at the same time that identical work was banned and shut down in the United States itself.[69]

## Summary

Chinese pathogen facilities are closely networked with many Western laboratories which provided significant assistance, including physical design and construction of facilities, joint design and execution of the most high-risk experiments, and even direct transfer of research funds to Chinese institutions such as WIV. Indeed, under the mentorship of the West, Chinese virology labs have impressively grown in capability.

[69] Alexander, Harriet, 'Fauci and NIH defend giving $600K to Wuhan to study how viruses can transmit from bats to humans before COVID-19 outbreak - after being accused of funding 'gain of function' research in heated argument with Rand Paul', *Daily Mail Online*, 26 May 2021.
https://www.dailymail.co.uk/news/article-9618623/Fauci-NIH-confirm-600-000-public-money-went-Wuhan-two-weeks-Rand-Paul-row.html

It should also be noted that this US$600,000, while specifically targeted towards bat coronavirus GoF research, represents a mere fraction of the US$337.6 million that has been given to China for biomedical research (including virology) by the Gates Foundation. For additional information, see:
Qu, Tracy, 'The Bill & Melinda Gates Foundation is spending millions in China, a fraction of its total funding', *South China Morning Post*, 6 May 2021.
https://www.scmp.com/tech/big-tech/article/3132384/bill-melinda-gates-foundation-spending-millions-china-fraction-its

# *Chapter Three*

# CRITICAL ASSISTANCE FROM VIROLOGY NETWORKS ABROAD

This chapter examines the invaluable foreign assistance to the two Chinese BSL4 laboratories in Wuhan and Harbin and the Institute Pasteur of Shanghai, especially during their formative years. Chinese pathogen laboratories have now acquired considerable expertise and are no longer dependent on foreign mentors. However, transnational collaboration is still mutually useful in this field. External networks have helped to strengthen the top Chinese laboratories to the extent that they can operate autonomously. Given the rising capability of these labs, China is on the road to becoming a "virology power" second to none.

**USAID and PREDICT Project**

Since 2009, the United States Agency for International Development (USAID) funded the PREDICT project (US$200 million total funding) as part of its Emerging Pandemic Threats (EPT) program. The Trump Administration ended this program in March 2020. PREDICT's mandate was to enhance global surveillance capability, which includes novel sample collection of viruses in nature and subsequent physical sample distribution and data sharing.[70] These activities were meant to more rapidly and accurately detect "zoonotic spill over events" (i.e. animal viruses making the "species jump" and infecting humans). Much work done by PREDICT was on bat coronaviruses in tropical Asia, especially in Yunnan province of China and Assam and Nagaland in Northeast India.[71]

A major recipient of PREDICT funds (as well as NIH funds)[72] and other material support is the EcoHealth Alliance, a non-profit organization based in New York city. EcoHealth Alliance also focuses on tropical Asia, including Southeast Asia, and has been openly endorsed by USAID. The Head of EcoHealth Alliance, Dr Peter Daszak, is one of the lead WHO investigators tasked to examine the origins of the COVID-19 pandemic. Daszak featured prominently in many documentaries such as "Coronavirus, Explained" where he openly discussed his work in bat caves in Yunnan.[73] Daszak has supported the WIV (including publicly calling Shi

[70] For example, see USAID PREDICT Semi-Annual 2019 Report. https://ohi.sf.ucdavis.edu/sites/g/files/dgvnsk5251/files/files/page/SAR2019-draft-final-compressed.pdf

[71] Ibid.

[72] For example, see Peter Daszak, "Understanding the Risk of Bat Coronavirus Emergence", NIH Grant Database. https://grantome.com/grant/NIH/R01-AI110964-06

[73] For a recent mainstream American media example, see Zaugg, Julie, "The virus hunters who search bat caves to predict the next pandemic", CNN, 27 April 2020. See also Anthony, Simon, Daszak, Peter, et. al., "Global patterns in Coronavirus diversity", *Virus Evolution*, 3:1: (2017), Letko, Michael, et. al., "Bat-borne virus diversity, spillover, and emergence", *Nature Reviews Microbiology*, 18 (2020),Li, W., Shi, Z. Yu, M., Ren, W., Smith, C., Epstein, J.H., Wang, H., Crameri, G., Hu, Z., Zhang, H., Zhang, J., McEachern, J., Field, H., Daszak, P., Eaton, B.T., Zhang, S., Wang, L. "Bats Are Natural Reservoirs of SARS-Like Coronaviruses", *Science* (2005), Daszak, Peter, et. al., "Global hotspots and correlates of emerging zoonotic diseases", *Nature Communications*, 8:1124 (24 October 2017), Shi, Zhengli, Zhou Peng, Daszak, Peter, et. al., "Fatal swine acute diarrhoea syndrome caused by an HKU2-related coronavirus of bat

Zhengli a 'hero' [sic.]). Daszak has provided a blueprint strategy to prevent a repeat of the '2019-nCoV outbreak'. The reality check is that despite marketing itself as the expert team in the virology field, the EcoHealth Alliance clearly missed this outbreak.[74]

EcoHealth Alliance also has a close relationship with the University of California at Davis, another major partner of USAID's PREDICT Program. UC Davis hosts the One Health Institute, which received a US$85 million grant from USAID in October 2019 for "capacity building" in Southeast Asia.[75] The One Health Initiative's mandate and mission overlap with that of EcoHealth Alliance. The Executive Director of the One Health Initiative (and scientific collaborator with Daszak) is Dr Jonna Mazet. The One Health Initiative is housed in UC Davis's School of Veterinary Medicine with associated laboratory and other physical clinical research infrastructure.

EcoHealth Alliance has a relatively flat management structure and is not officially tied to any academic institution. This allows the EcoHealth Alliance to serve as the "tip of the spear" for bat coronavirus surveillance work in Yunnan and Northeast India. Perhaps this "sub-contracted" fieldwork represents activities that One Health Initiative and PREDICT program personnel cannot carry out personally in those Asian localities. Daszak and his team have joint publications with Shi Zhengli and Zhou Peng at WIV. Similarly, Mazet has joint publications with Shi and Daszak.[76] Their close transnational collaboration in virology is evidenced by these publications.

## Global Virome Project: A Privatized Transnational Enterprise

Mazet, Daszak and Dr Dennis Carrol serve on the Global Leadership Team of the Global Virome Project (GVP). The GVP is a consultancy for infectious disease control programs and "managing partner investment and optimizing return on investment". Carrol previously headed USAID's Emerging Pandemic Threats Program that supported PREDICT.[77]

origin", *Nature*, 556:7700 (April 2018) and Shi, Zhengli, Daszak, Peter, et. al., "Discovery of a rich gene pool of bat SARS-related coronaviruses provides new insights into the origin of SARS coronavirus", *PLOS Pathogens* (30 November 2017)

[74] For example, see Daszak, Peter, et. al., "A strategy to prevent future epidemics similar to the 2019-nCoV outbreak", *Biosafety and Health*, 2:1 (March 2020).

[75] Kerlin, Kat, "$85M to Develop a One Health Workforce for the Next Generation - USAID Award Supports New Project Led by UC Davis One Health Institute", University of California at Davis, 9 October 2019.

[76] For example, see Daszak, Peter, Mazet, Jonna, Shi, Zhengli, et. al., "Joint China-US Call for Employing a Transdisciplinary Approach to Emerging Infectious Diseases", *Ecohealth*, 12:4 (2015)

[77] For more information, see Gardy, Jennifer, "Leadership – Global Virome Project", Global Virome Project. http://www.globalviromeproject.org/who-we-are/leadership/jennifer-gardy
See also Gardy, Jennifer "What We Do – Malaria", Bill and Melinda Gates Foundation. https://www.gatesfoundation.org/What-We-Do/Global-Health/Malaria/Strategy-Leadership/Jennifer-Gardy

Dr Gao Fu (George Gao), Director of the Chinese Center for Disease Control and Prevention in Beijing (China CDC), officially endorsed the GVP in 2018.[78] Gao was at the Institute of Microbiology at the Chinese Academy of Sciences then. Gao did his doctorate at Oxford (1991), conducted research at the University of Calgary, and then returned to Oxford for a post-doctoral fellowship. Gao then worked at Harvard Medical School in 1999 (funded by the UK's Wellcome Trust) and eventually became a Lecturer at Oxford (2001-2004).[79] As the Director of the China CDC, Gao is a key figure in China's international linkages in virology research.[80] China's CDC in Beijing manages pandemics in that country and has a branch with a laboratory in Wuhan.

Another key member of the GVP team is Dr Jennifer Gardy. She simultaneously serves on its Leadership Board while being the Deputy Director of the Malaria Team at the Bill and Melinda Gates Foundation. Earlier, Gardy was at the British Columbia Centre for Disease Control and the University of British Columbia's School of Population and Public Health, where she held the Canada Research Chair in Public Health Genomics. Her research focused on the use of genomics to understand pathogen transmission, and to incorporate techniques drawn from genomics, bioinformatics, modelling, information visualization, and the social sciences.[81]

## French Assistance: From central to peripheral role in WIV

France has strong historical links to the city of Wuhan. Since the advent of the Dengist reform era, French companies and educational institutions have helped to develop Wuhan as a biotechnology hub.[82] Then French Foreign Minister Michel Barnier signed the bilateral agreement to build the BSL4 lab at the WIV in 2004.[83]

Apparently, the French side expected to play a leading role even after the design, construction and development of the WIV lab. However, these aspirations were mistaken. In reality, the WIV's collaboration with the French was a temporary "build-operate-transfer" model instead of a long-term "mentor-mentee model". The latter model was appropriate when Chinese virology lagged far behind its French counterparts

[78] See, for example, Gao, George, Mazet, Joanna, Daszak, Peter, et. al., "The Global Virome Project", *Science*, 359: 6378 (23 February 2018).

[79] Chinese Academy of Sciences, "Gao Fu".
http://people.ucas.ac.cn/~GeorgeGao

[80] Another famous figure in the field of epidemiology in the PRC is Professor Zhong Nanshan, reputed to be the key scientist who successfully tackled the 2003 SARS pandemic in the Chinese Mainland. That he studied at St Bartholomew's Hospital in London and the University of Edinburgh Medical School reveals the critical scientific assistance from abroad for Chinese students in this field.

[81] Gardy, Jennifer, "Leadership – Global Virome Project", Global Virome Project.
http://www.globalviromeproject.org/who-we-are/leadership/jennifer-gardy.
Gardy, Jennifer "What We Do – Malaria", Bill and Melinda Gates Foundation.
https://www.gatesfoundation.org/What-We-Do/Global-Health/Malaria/Strategy-Leadership/Jennifer-Gardy

[82] See, for example, Wuhan Institute of Virology (WIV), "Exchanges - Wuhan Institute of Virology".
http://english.whiov.cas.cn/Exchange2016/ and Wuhan Institute of Virology (WIV), "Partnerships - Wuhan Institute of Virology".
http://english.whiov.cas.cn/International_Cooperation2016/Partnerships/. See also Wuhan Institute of Virology (WIV), "Joint Research Units".
http://english.whiov.cas.cn/International_Cooperation2016/Joint_Institutes2016/

[83] Owen, Glen, "Wuhan virus lab was signed off by EU Brexit chief Michel Barnier in 2004 – despite French intelligence warnings that China's poor bio-security reputation could lead to a catastrophic leak", *Guardian*, 23 May 2020.

and required considerable technical assistance. However, this is no longer the case when many Chinese researchers have gained world class expertise in virology. Simply put, the WIV today does not require French scientific leadership.

Institut Pasteur and Institut Merieux led in the physical design and development of key management and scientific protocols of WIV in its initial developmental stages. Upon the construction and completion of the WIV complex, a Franco-Sino scientific exchange program was to follow. But that did not happen. As mentioned earlier, only a token French researcher was a visiting researcher at WIV when the original agreement stipulated that up to 50 researchers were to come from France.[84] Regardless, Gabriel Gras, a former French government official who directly supervised the implementation of biosecurity standards and protocols over a multi-year period at WIV, stated in June 2021 that there is a '0 per cent' chance the COVID-19 virus leaked from the Institute.[85] No specific evidence was provided for this assertion.

In June 2016, then-French Ambassador to China Maurice Gourdault-Montagne bestowed the Medal of Knight of the National Order of Merit (French: Chevalier de L'Ordre National du Mérite) and the Medal of Knight of the Order of Academic Palms (French: Chevalier dans l'Ordre des Palmes académiques) on Shi Zhengli as well as fellow WIV colleague Dr Yuan Zhiming. The award coincided with the ceremony where control of WIV's BSL4 lab was formally handed over to the Chinese.[86] French ambassadors and other senior officials frequently visited WIV since 2014 (Table 1). Besides the WIV, the French government and scientific establishment also have close ties to the Institute Pasteur of Shanghai. Both French-supported virology labs in Wuhan and Shanghai have a close horizontal partnership under CAS.

[84] Owen, Glen, "Wuhan virus lab was signed off by EU Brexit chief Michel Barnier in 2004 – despite French intelligence warnings that China's poor bio-security reputation could lead to a catastrophic leak", *Guardian*, 23 May 2020.

[85] Power, John, 'Exclusive | '0 per cent' chance: former French official who oversaw safety standards at Wuhan lab dismissed leak theory', South China Morning Post, 11 June 2021.
https://www.scmp.com/week-asia/health-environment/article/3136833/0-cent-chance-french-official-who-oversaw-safety

[86] Wuhan Institute of Virology, "The French Ambassador to China bestowed medals on Professor Zhiming Yuan and Professor Zhengli Shi in Wuhan Institute of Virology", 1 August 2016.
http://english.whiov.cas.cn/Exchange2016/Foreign_Visits/201712/t20171215_187978.html

## Table 1

## WIV: Close Sino-Franco Collaboration

| Date of Official Visit | French Personnel Involved | French Government |
|---|---|---|
| 29 October 2014 | Ambassador Maurice Gourdault-Montagne | Government |
| 24 September 2015 | Counsellor for Science and Technology of the Embassy of France, Mr. Pierre Lemonde | Government |
| 16 December 2016 | Dr Herve Bourhy of Institut Pasteur | Government – visit under the auspices of The EMERGENGES 2016 Program launched by the French Embassy in China which supports French-Chinese cooperation in emergent infectious diseases. |
| 12 September 2017 | Wuhan Consul General Olivier Guyonvarch | Government |
| 29 January 2018 | French Senator for Overseas Civic Affairs M. Christophe-Andre Frassa | Government |
| 26 March 2018 | Ambassador Jean-Maurice Ripert | Government |
| 22 May 2018 | General Coordinator of French-Sino Cooperation on Prevention and Control of Emerging Infectious Diseases Jean-Michel Hubert | Government |
| 24 January 2019 | Wuhan Consul General Olivier Guyonvarch, Counselor from the Embassy of France in China, and Pierre Lemonde, Science and Technology Attaché from Consulate General of France in Wuhan Mr. Yann Moreau | Government |

Source: Foreign Visits, Wuhan Institute of Virology.
http://english.whiov.cas.cn/Exchange2016/Foreign_Visits/index_1.html

## Institute Pasteur of Shanghai (IPS), Chinese Academy of Sciences

Institut Pasteur (IP) established its first presence in China in 1899. Historically, IP has provided biomedical education in Mainland China and Hong Kong. In August 2004, CAS, the Shanghai Municipal Government and the Institut Pasteur in Paris signed a cooperation agreement to create the IPS, CAS.[86] This agreement followed the signing of a letter of intent in January 2004 in Paris, in the presence of then-Chinese President Hu Jintao and then-French Prime Minister Jean-Pierre Raffarin. Presumably, the 2003 SARS epidemic was a catalyst to Beijing's eagerness to boost its virology capability with assistance from Paris the following year.

However, the IPS has a different governance structure from other Institut Pasteur labs in the world. Besides its organizational ties to CAS, IPS has a strong CCP presence at the management level with Si Shengli serving as the CCP Secretary while Chen Fengwei serves as the Secretary General of Discipline and Inspection.[87] The CCP and CAS now play leading roles in these previously French-assisted institutions, IPS and WIV. Nevertheless, IPS is a symbol of cordial Sino-French diplomatic ties with the French Ambassador to China, Laurent Bili, visiting IPS in December 2019.[88]

## J-GRID and HVRI – A Jointly Managed Lab on Avian flu in Harbin

The Japan Initiative for Global Research Network on Infectious Diseases (J-GRID) brings together top Japanese virologists and other related specialists and oversees joint programs in Thailand, Vietnam, Zambia, India, Indonesia, Philippines, Ghana, Myanmar, and China. The Japanese universities involved include Osaka University, Nagasaki University, University of Tokyo, Hokkaido University, Okayama University, Kobe University, Tohoku University, Tokyo Medical and Dental University, and Niigata University.[89]

J-GRID lead researchers at the University of Tokyo are responsible for the Chinese partnerships and has established a strong relationship with HVRI. The University of Tokyo team is the only international group that has strong scientific relationships characterized by jointly run labs at HVRI. In contrast to Institut Pasteur, the University of Tokyo team has a symmetrical peer-to-peer laboratory partnership structure with HVRI

[86] "Inauguration of the Institut Pasteur of Shanghai – Chinese Academy of Sciences", Press Release, Institut Pasteur-Chinese Academy of Sciences (IPS-CAS), Shanghai, 10 October 2004.
https://www.pasteur.fr/en/inauguration-institut-pasteur-shanghai-chinese-academy-sciences

[87] Institut Pasteur-Chinese Academy of Sciences (IPS), "Senior Management - Institut Pasteur of Shanghai".
http://english.shanghaipasteur.cas.cn/Overview2016/ms2016/sm2016/
Four out of the five-person management team at IPS are Chinese nationals.

[88] Institut Pasteur-Chinese Academy of Sciences (IPS), "A delegation led by Ambassador of France in China visited Institut Pasteur of Shanghai, CAS", 10 December 2020.
http://english.shanghaipasteur.cas.cn/IPIN2016/News2016/201912/t20191210_227526.html

[89] Division of Infectious Diseases Research, Department of Research Promotion, Japan Agency for Medical Research and Development, "Research Activities of Japan Initiative for Global Research Network on Infectious Diseases (J-GRID)", July 2018.

colleagues. The University of Tokyo team is led by Dr Yasushi Kawaguchi from the Institute of Medical Sciences who intimated that he visited labs in Beijing on a bi-monthly basis.

Dr Yoshihiro Kawaoka is a member of this leadership team and is the Chief of the Joint China-Japan Joint Research Group on Avian Influenza Virus housed in HVRI.[90] Kawaoka is a key scientist in China's transnational virology research network. He also has an appointment at the University of Wisconsin at Madison and has long-time scientific partnerships with Dutch avian influenza GoF specialist Dr Ron Fouchier at Erasmus University in Holland and Dr Chen Hualan at HVRI.[91] Kawaoka has joint publications with Chen Hualan.

While Kawaoka's work with his colleagues at HVRI was focused on avian flu viruses, he has diversified to COVID-19 research too. In a July 2020 study, Kawaoka and his international team assessed the replicative ability and pathogenesis of SARS-CoV-2 isolates in Syrian hamsters. They found that SARS-CoV-2 isolates replicated efficiently in the lungs of hamsters and caused severe pathological lung lesions that shared characteristics with SARS-CoV-2−infected human lungs. They also found that SARS-CoV-2−infected hamsters mounted neutralizing antibody responses and were protected against future SARS-CoV-2 reinfections. In addition, passive transfer of convalescent serum to previously uninfected hamsters efficiently suppressed the replication of the virus in the lungs. Kawaoka and his colleagues claimed that their findings prove that this "Syrian hamster model" helps to better understand SARS-CoV-2 pathogenesis and testing vaccines and antiviral drugs.[92]

## India's National Centre for Biological Sciences and WIV

The Indian government investigated a bat coronavirus study in the Northeast Indian state of Nagaland carried out by researchers from India, Singapore, China and the United States. The investigation focused on scientists from India's National Centre for Biological Sciences (NCBS), WIV, Uniformed Services University of the Health Sciences (US), and the Duke-NUS Medical School (Singapore). The enquiry sought to determine if scientists obtained bat and human bio samples without proper permission and ethical protocol.[93] The investigation has now been concluded.

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[90] Division of Infectious Diseases Research, Department of Research Promotion, Japan Agency for Medical Research and Development, "Research Activities of Japan Initiative for Global Research Network on Infectious Diseases (J-GRID)", July 2018.

[91] For example, see Chen, Hualan Kawaoka, Yoshihiro, et. al., "A Single-Amino-Acid Substitution in the NS1 Protein Changes the Pathogenicity of H5N1 Avian Influenza Viruses in Mice", *Journal of Virology*, 82:3 (February 2008).
Chen, Hualen, Kawaoka, Yoshihiro, et. al., "A Duck Enteritis Virus-Vectored Bivalent Live Vaccine Provides Fast and Complete Protection against H5N1 Avian Influenza Virus Infection in Ducks", *Journal of Virology*, 85: 21 (November 2011).

[92] Kawaoka, Yoshihiro, et. al., "Syrian hamsters as a small animal model for SARS-CoV-2 infection and countermeasure development", *PNAS*, 117: 28 (14 July 2020).

[93] Shajan Perappadan, Bindu, "Study on bats and bat hunters in Nagaland to be probed", *Hindu*, 3 February 2020.

The Indian government was concerned that bat and human bio samples from India were shared with WIV. A five-member team from the Indian Council of Medical Research investigated this research in Nagaland and then submitted their findings to the Indian Ministry of Health.[94] One concern was triggered by an October 2019 study published in *PLOS Neglected Tropical Diseases*, a new journal funded by the Bill and Melinda Gates Foundation. This study focuses on human bat hunters who had continuous exposure to bat-borne pathogens, namely filoviruses. [95] The study concluded that Nagaland has several filoviruses in bats with the accompanying possibility for filovirus transmission from bats to humans.

The co-authors of this study include WIV scientists, including Shi Zhengli, and researchers from NCBS and Duke-NUS. NCBS acknowledged that WIV provided reagents[96] for this study, which could be classified as biological materials. The US Defense Threat Reduction Agency (DTRA) funded this research via Duke NUS Medical School.[97] Duke-NUS then channeled funds to the NCBS in Bangalore as well as WIV for various forms of technical and scientific assistance.[98] This multi-dimensional relationship developed in spite of geopolitical rivalries, trade disputes, and other factors that would have disrupted many other transnational networks. They are "strange bedfellows" in bat research indeed. The US-funded partnership between Duke-NUS, NCBS, and WIV took place openly as evidenced by their joint publications.

## Links Between WIV and Canada's National Microbiology Lab

Canada's National Microbiology Lab in Winnipeg has links with WIV, though more in key logistical (namely viral sample sharing) and critical knowledge transfer domains. These are strategic modes of interactions that are not always immediately apparent. They do not immediately manifest themselves in the form of joint publications and joint grant award publicity. This case of cooperation between various researchers at Canada's National Microbiology Lab and the WIV highlights the opaque nature of this transnational network of pathogen research.

In July 2019 leading Ebola researcher Dr Qiu Xiangguo and her entire research team were escorted out of their lab and were taken into custody by the Royal Canadian Mounted Police. Apparently, Qiu was planning to ship dangerous pathogens including Ebola and Henipah virus samples to WIV. Qiu was fired but the National Microbiology Lab stated that her dismissal was unrelated to this clandestine shipment.[99] Qiu also made at least

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[94] Ibid.

[95] Dovih, Pilot, Shi, Zhengli, et. al., "Filovirus-reactive antibodies in humans and bats in Northeast India imply zoonotic spillover", *PLOS Neglected Tropical Diseases*, 13:10 (31 October 2019).

[96] Reagents encompass a range of biological or chemical materials that are necessary to carry out key laboratory tests and analyses.

[97] Ibid.

Shajan Perappadan, Bindu, "Study on bats and bat hunters in Nagaland to be probed", *Hindu*, 3 February 2020.

[98] Dovih, Pilot, Shi, Zhengli, et. al., "Filovirus-reactive antibodies in humans and bats in Northeast India imply zoonotic spillover", *PLOS Neglected Tropical Diseases*, 13:10 (31 October 2019).

[99] Blackwell, Tom, "Dismissal and investigation by RCMP of Winnipeg co-inventor of Ebola drug stuns colleagues", *National Post*, 16 July 2019.

five trips to China between 2017-2018 to train staff at WIV. The Canadian government acknowledged that the costs were borne by third-parties and not Public Health Canada. It is also established that Qiu met with collaborators in Beijing during her trips. Some Canadian colleagues at the National Microbiology Lab were worried that Qiu's trips might have national security implications.[100]

Qiu is one of the inventors of ZMapp, the most effective therapeutic for Ebola virus. One of her key collaborators, Wang Hualei, is linked to the Academy of Military Medical Sciences, a Chinese military medical research institute in Beijing.[101] Qiu also obtained many scientific awards in Canada for her research and held an academic appointment at the University of Manitoba.

## Laying the Transnational Foundation for GoF Experiments: Dutch HPAI H5N1 Experiments

The transnational collaboration of GoF experiments can be traced to research on HPAI H5N1 viruses. Dr Ron Fouchier at Erasmus Medical Center in Rotterdam, Holland was a pioneer on HPAI H5N1. Apparently, avian flu specialist Dr Chen Hualan at HVRI has benefitted significantly from this research. Returning the compliment, Fouchier has cited the work done by Chen and her colleagues at HVRI as a justification for his own controversial HPAI H5N1 GoF experiments in Holland.[102] Chen did not appear to collaborate directly with Fouchier but with Yoshihiro Kawaoka, a long-time collaborator of Fouchier.[103] While this connection between Fouchier and Chen may have one slight degree of separation, it is significant nonetheless because they are directly or indirectly part of the same transnational network.

Fouchier has conducted controversial experiments that successfully engineered HPAI H5N1 viruses to transmit between ferrets without direct contact. Ferrets are the mammals that most closely genetically resemble humans for the purposes of these experiments.[104] This work was highly controversial with many

[100] Blackwell, Tom, "In mystery investigation of two Canadian scientists, a request for Ebola, henipavirus from the Wuhan lab", National Post, 5 May 2020. See also Pauls, Karen, "Canadian government scientist under investigation trained staff at Level 4 lab in China", *CBC News*, 3 October 2019.

[101] Pauls, Karen, "Canadian scientist sent deadly viruses to Wuhan lab months before RCMP asked to investigate", *CBC News*, 14 June 2020.
Wang, Hualei Qiu, Xiangguo, et. al., "Equine-Origin Immunoglobulin Fragments Protect Nonhuman Primates from Ebola Virus Disease", *Journal of Virology*, 93:5 (March 2019).

[102] Center for Infectious Disease Research and Policy (CIDRP), "Dutch researcher resumes H5N1 transmission studies", University of Minnesota, 28 February 2013.
https://www.cidrap.umn.edu/news-perspective/2013/02/flu-news-scan-resuming-h5n1-research-h7n3-mexico-fda-flu-strain-selections

[103] For example, see Chen, Hualan, Kawaoka, Yoshihiro, et. al., "A Single-Amino-Acid Substitution in the NS1 Protein Changes the Pathogenicity of H5N1 Avian Influenza Viruses in Mice", *Journal of Virology*, 82:3 (February 2008).
Chen, Hualan, Kawaoka, Yoshihiro, et. al., "A Duck Enteritis Virus-Vectored Bivalent Live Vaccine Provides Fast and Complete Protection against H5N1 Avian Influenza Virus Infection in Ducks", *Journal of Virology*, 85: 21 (November 2011).

[104] For example, see Fouchier, Ron, et. al., "Airborne transmission of influenza A/H5N1 virus between ferrets", *Science*, 22;336:6088 (June 2012)

leading virologists and other scientists warning that Fouchier was directly engaging in GoF research under the guise of public health.

The Dutch government did take notice and forced Fouchier to obtain a European Union-compliant Export License prior to pursuing further HPAI H5N1 GoF research. This EU regulatory regime is to prevent the unauthorized proliferation of weapons of mass destruction. An Export License was not granted to Fouchier and he unsuccessfully challenged this decision in a Dutch court in September 2013. Initially, some analysts believed that this court ruling would end this type of GoF research.[105] However, in 2019 the US government (which had previously successfully pressured the Dutch government to shut down Fouchier's research) quietly lifted the moratorium on HPAI H5N1 GoF research. This about turn by the US is indeed a puzzle. Fouchier has resumed his experiments at Erasmus.[106] Arguably, Fouchier's pioneering GoF research sets the foundation for the bat coronavirus GoF research carried out at WIV and avian flu at HVRI.

It also appears that while his HPAI H5N1 GoF research was under pressure, Fouchier became more deeply involved in coronaviruses, starting with MERS. MERS was first officially isolated in Saudi Arabia by Dr Ali Zaki, an Egyptian doctor working at the Dr Soliman Fakeeh Hospital in Jeddah, Saudi Arabia.[107] Zaki claims that he sent the MERS samples to Fouchier for PCR testing and virus identification/characterization after being ignored by Saudi authorities. Fouchier completed this task in June 2012 and patented several critical datasets and other intellectual property related to the virus. Meanwhile, Zaki was dismissed from his position and left Saudi Arabia.[108]

Fouchier then went on to share these MERS samples with the National Microbiology Lab in Winnipeg, Canada. The then-director of the National Microbiology Lab, Dr Frank Plummer, openly criticized the Material Transfer Agreements (MTA) that governed these Saudi-origin MERS samples as being too restrictive. Plummer also noted that China freely shared samples of the H7N9 bird flu virus during previous pandemics.[109]

Apparently, Fouchier is one of the modern founders of GoF research. His scientific methods, transnational partnership structures and modalities, and other outputs helped to form a critical foundation. This foundation has been advanced by the bat coronavirus GoF research carried out by scientists at WIV and others around the world. It has also been advanced by the avian influenza GoF research conducted by Chen Hualan at HVRI and her scientific collaborators.

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Fouchier, Ron, et. al., "The potential for respiratory droplet-transmissible A/H5N1 influenza virus to evolve in a mammalian host", *Science*, 22;336:6088 (June 2012).

[105] Enserink, Martin, "Flu Researcher Ron Fouchier Loses Legal Fight Over H5N1 Studies", *American Association for the Advancement of Science (ScienceMag)*, 25 September 2013.

[106] Kaiser, Jocelyn, "EXCLUSIVE: Controversial experiments that could make bird flu more risky poised to resume", *American Association for the Advancement of Science (ScienceMag)*, 8 February 2019.

[107] Kupferschmidt, Kai, "As Outbreak Continues, Confusion Reigns Over Virus Patents", *American Association for the Advancement of Science (ScienceMag)*, 28 May 2013.

[108] Ibid.

[109] Crowe, Kelly, "Saudi coronavirus work stymied at Canadian lab", CBC News, 29 May 2013.

## Summary

While China benefited from indispensable international virology expertise, it did not yield control of its labs to any foreign government or international organization. These labs were closely supervised by the state (national and provincial), CCP, CAS and CAAS. Our case studies of the two BSL4 labs in Wuhan and Harbin, and the IPS support this observation. Thanks to critical support from virology networks abroad, top Chinese labs can now "stand on one's own two feet". Indeed, China is emerging to be a "Great Virology Power" ready for the next global pandemic.

# *Chapter Four*

# The Future of Chinese Virology Laboratories: China as "Number One"?

## China's New Virology Frontier: Advanced BSL3 Lab Infrastructure in Every Province

In May 2020 China's National Development and Reform Commission (NDRC) issued a plan for every Chinese province to have at least one BSL3 lab. The NDRC cited the COVID-19 outbreak as the catalyst to this new initiative.[110] Earlier in 2004, China launched a national BSL program that accredited 42 BSL3s.[111] In addition, four mobile BSL-3 laboratories were imported from the Labover company (headquartered in Montpellier, France) and distributed to institutes in Beijing, Shanghai, and Guangdong. These imported labs will enable mobile nationwide surveillance of pathogens and to support emergency response operations.[112]

Both Beijing and the southern Chinese province of Guangdong will serve as two key nodes of this nationwide BSL3 rollout. Guangdong may build up to 30 BSL3 labs and one BSL4 lab (which would be China's third official BSL4 lab). Under this initiative, Beijing will also build its first BSL3 permanent (non-mobile) lab.[113]

This rapid proliferation of BSL3 labs, if executed in line with NDRC directives, will fundamentally expand the scale, scope, and structure of virology research in China. Given China's one-party state bureaucracy, every provincial BSL3 lab would probably come under CAS or CAAS governance with the CCP on the management board. This would also involve close collaboration with city- and provincial-level governments given the strong localism witnessed even in the centralised one-party state in China. Under this structure, WIV and HVRI and their respective research activities and operational structures would be frames of reference for these more numerous BSL3 (and possibly BSL4) labs with strong provincial links that nonetheless fall under CCP oversight via CAS or CAAS management.

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[110] "All provinces in China are asked to set up P3 lab: ministries", *Global Times*, 20 May 2020. https://www.globaltimes.cn/content/1188916.shtml

[111] The majority of these BSL3 labs are located in key Chinese cities such as Beijing, Shanghai, and Guangzhou.

[112] Yuan, Zhiming, "Current status and future challenges of high-level biosafety laboratories in China", *Journal of Biosafety and Biosecurity*, 1:2 (September 2019).

[113] Zhang, Phoebe, "Top-grade biosafety lab building spree planned in southern China", *South China Morning Post*, 25 May 2020. See also "Beijing to build P3 laboratory", *Global Times*, 18 May 2020. https://www.globaltimes.cn/content/1188638.shtml, and Lei, Li, "Visiting the mobile P3 lab that contributed to curbing COVID-19 in Beijing", *Global Times*, 12 July 2020.

## Chinese virology labs: greater self-reliance amid US-China "decoupling"?

China today possesses world-class pathogen expertise. China is now capable of training its own future generations of virologists onshore. In the years ahead, China need not send large numbers of its students to the West for virology training as has been the case with previous generations. Conceivably, China can opt out of any future global governance frameworks pertaining to GoF or other virology research at little or no cost to China itself.

However, driven by the desire to remain close to cutting edge developments outside of China, key labs like the WIV and HVRI will continue collaborating with international virology networks. While Chinese virologists have previously had open and free access to research and educational opportunities in key Western countries, and the United States in particular, this trend may not continue. The broader context of Sino-US decoupling across multiple areas of trade, technology, capital markets, and other strategic matters is likely to inhibit transnational collaboration. China then will have greater incentive to boost virology research on its own efforts.

## PRC's New Biosafety Law and 14th 5-Year Plan: improving and strengthening labs?

On 17 October 2020, the Standing Committee of the National People's Congress (NPC) passed a Biosecurity Law which took effect on 15 April 2021. Under this new legislation, the country will roll out 11 basic systems for biosafety risk prevention and control which includes a risk monitoring and early warning system, an information sharing and release system, an emergency response system, and an investigation and traceability system.[114] This new law follows up on an authoritative Party Directive issued in February 2020 which declared a "People's War" on the COVID-19 virus and gave clear instructions to avoid theft, leakage, and misplacement of biological samples.[115]

This Biosafety Law emphasizes the responsibilities of relevant local authorities at all levels in the building and improvement of the biosafety systems, with administrative penalties and fines to be imposed for failure to adhere to the law. The Biosafety Law warned that medical institutes and their staff who conceal, falsely inform, delay or omit the reports of infectious diseases, animal or plant epidemics, or diseases of unknown causes,

[114] Lin, Wan, "China passes first biosafety law following COVID-19 epidemic, raises level to national security", *Global Times*, 18 October 2020.

[115] Party Committee of the Beijing Municipal Center for Disease Control and Prevention, "Beijing CDC Party Committee issued a wartime status order to suspend or remove middle-level cadres that cause major adverse effects on prevention and control", 13 February 2020.
http://t.m.china.com.cn/convert/c_k5AE9Pn8.html

will be reprimanded and directors of the institutes will be sanctioned and have their professional certificates suspended.[116]

If the Biosafety Law and its accompanying epidemiological information/intelligence infrastructure are effectively implemented alongside a rapidly expanding BSL3 and BSL4 network, Beijing will likely possess the most advanced infectious disease control system in the world. It should be noted that China already possessed an advanced infectious disease control system even prior to the COVID-19 outbreak. One key implication of these developments is that the PRC would likely be the most prepared country for the next major pandemic and would be able to identify and contain any threats ahead of other advanced Western countries and Japan.

In March 2021, the NPC passed the 14th Five-Year Plan with a vision for a technologically advanced and self-reliant China. This Plan targets a 7% annual growth in R&D. The latest Five-Year Plan identified seven "frontier" technological fields in which the state should boost domestic capabilities:

- New generation artificial intelligence,
- Quantum information,
- Integrated circuits (semiconductors),
- Neuroscience and "brain-inspired" research,
- Genetics and biotechnology,
- Clinical medicine and health,
- Deep sea, deep space and polar exploration.

Simply put, the PRC seeks to be more technologically advanced and self-reliant. Presumably, this grand strategy will also apply to the country's ambitious virology R&D. Though the latest Five-Year Plan did not explicitly elaborate on the future of Chinese pathogen research, we can surmise that this multi-disciplinary field falls within the broad categories of "genetics and biotechnology", "clinical medicine and health", and possibly even "new generation artificial intelligence". It can be anticipated that more money and human resources will be channelled to virology research under the 14th Five-Year Plan.

## Pandemic readiness and geopolitical impact: underscore importance of virology labs

The enhancement of top Chinese laboratories to cope with future pandemics is necessary for China's geopolitical interests. That the COVID-19 pandemic temporarily disrupted the military operations of some countries (including the United States) was a salutary lesson for many and presumably for the PLA too. A Chinese proverb says: "crisis is opportunity". A case can be made that the PLA and Chinese Coast Guard were

[116] Lin, Wan, "China passes first biosafety law following COVID-19 epidemic, raises level to national security", *Global Times*, 18 October 2020.

more assertive since the COVID-19 pandemic broke out in December 2019.[117] When a few of Beijing's maritime rivals were reeling from the pandemic, the PLA and the Chinese Coast Guard were able to flex their naval muscles. Beijing was able to do this because the country was "first in, and first out" of this pandemic (to be sure, Chinese foreign policy was already more assertive over maritime disputes before the COVID-19 pandemic).

The first confirmed COVID-19 case in the United States was on January 21, 2020. By May 2021 the US had suffered more than 600,000 fatalities.[118] Many states and cities were locked down. The US Navy had to rapidly withdraw many assets including the aircraft carriers USS Theodore Roosevelt and USS Ronald Reagan, from the Asia-Pacific due to COVID-19 infection risks.[119] However, in June the same year, the US deployed an unprecedented three aircraft carrier fleets in a show of strength and resolve.

The PLA deployed the Liaoning Aircraft carrier naval battle group through the international waters of the Miyako Strait off the coast of Taiwan on the immediate tails of the US Navy's temporary withdrawal. Chinese naval activities coincided with the PRC State Council's official declaration on April 18, 2020 that the prefectural-level city of Sansha (under Hainan province and located on Yongxing Island in the South China China) now "administers waters in the South China Sea". Presumably, Beijing perceived an opportunity to strike amid the COVID-19 outbreak when other claimant states were distracted. In the scenario of a future global pandemic outbreak, it is not inconceivable that the PLA and the Chinese Coast Guard may take advantage of a strategic vacuum again when the maritime forces of its geostrategic rivals are disrupted by a lethal and contagious virus. In this regard, highly capable Chinese virology labs will have a dual civilian-military function: protecting both the general civilian population and enabling the military (to exercise its strategic and tactical options).

## Conclusion

Our research illuminates the hitherto opaque but substantial international networks of Chinese civilian virology laboratories. It empirically supports the argument that China and the United States and its allies have cooperated on virology research since the Cold War era. Indeed, the United States and its Canadian, European, Australian and Japanese allies have trained cohorts of Chinese scientists and students in this field since Chinese paramount leader Deng Xiaoping adopted the reformist road to modernize and strengthen the PRC in 1978. Thanks to these strong transnational networks of virology collaboration, China today has acquired sufficient capabilities to conduct its own autonomous pathogen research and training of the next cohort of

[117] Clarke, Ryan, "Is China Converting COVID-19 Into a Strategic Opportunity?", *EAI Background Brief*, No. 1545, East Asian Institute, National University of Singapore, 9 July 2020.
[118] In comparison, total American casualties during the Vietnam War totalled 47,424.
[119] Crews from a total of five US aircraft carriers tested positive for COVID-19.

Chinese virologists. We also argued that the "Chinese student of yore in virology is now a master but international collaboration is still useful and necessary given the global nature of pandemics".

We note that Beijing is committed to build advanced BSL3 labs in every Chinese province. The 2021 Five-Year Plan of the 14th National People's Congress has laid out more ambitious plans for a technologically advanced and self-reliant China. This Plan targets a 7% annual growth in research and development. We anticipate that these plans will boost the capabilities of Chinese virology laboratories significantly.

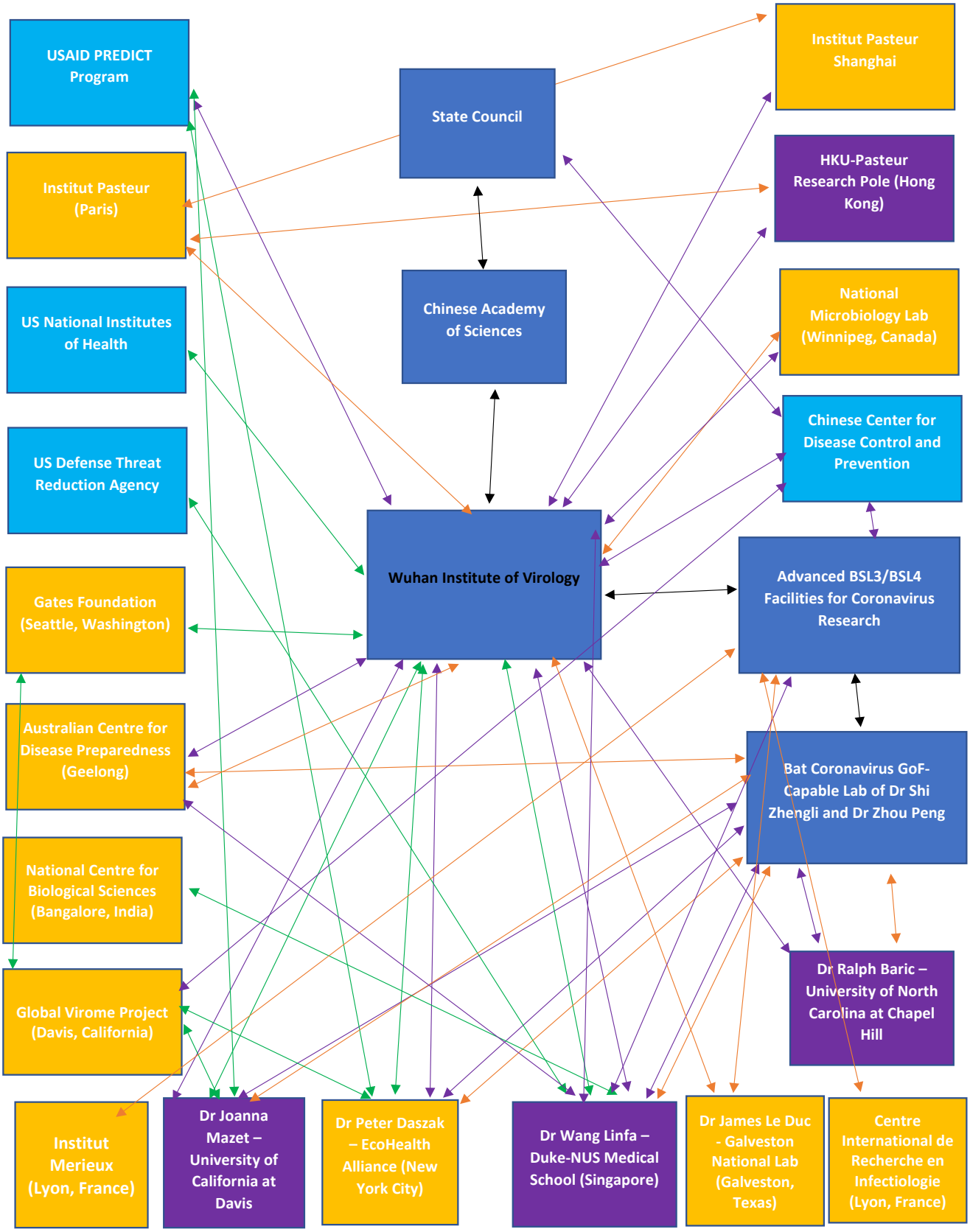
By enhancing its capability in virology research and in dealing with deadly pandemics, the PRC is emerging as a comprehensive superpower in the military, diplomatic, economic, cultural and pathogen domains. Indeed, China may become the global number one virology power within the next two to three decades, in part, thanks to Western assistance in training and collaboration in the past. If indeed the PRC becomes "number one" in virology research, its economy and military operations are likely to be the least disrupted during the next global pandemic. As such, China's status as the world's leading global power, underpinned by its virology research, will then be consolidated. Beijing has sought to boost its "soft power" by offering its Sinovac vaccine to many Third World countries reeling from the COVID-19 pandemic. We anticipate that Chinese virology labs in the years ahead will be mobilized for vaccine research and Beijing's vaccine diplomacy.

Presumably, to be "number one" in virology is a good thing for the PRC. Its party-state, society and military will obviously welcome such a capability. Conceivably, countries which have considerably benefited from Beijing's vaccine diplomacy are likely to appreciate China as number one in this domain. But will the US superpower welcome China's emergence as the "number one virology power"? In the context of their superpower rivalry, most probably not. To answer this question vicariously, we assume that it is a strategic imperative that the US and its allies comprehensively improve their virology capabilities to maintain a balance of power, engage in vaccine diplomacy and enhance human security.

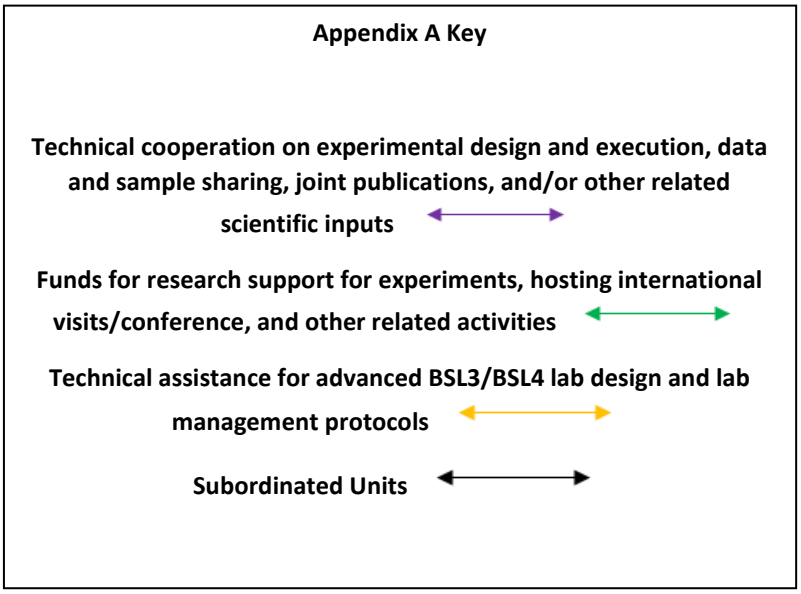
The authors also note that there is a lack of a proper regulatory and monitoring system of global governance to anticipate and cope with the domestic and international research on pathogens including risky GoF experiments. Indeed, the World Health Organisation (WHO) has remained curiously silent on GoF experiments including bat coronavirus. We opine that transnational virology research is like an "anarchical society" where international collaboration between the unregulated scientific communities of China, the West and Japan has often been ignored by many national governments and regional organisations like the EU, ASEAN, and the UNSC. Indeed, this wilful ignorance in the global governance of potentially deadly pathogen research has troubling implications for human security.

## APPENDIX A:

## WIV TRANSNATIONAL LINKAGES NETWORK GRAPH

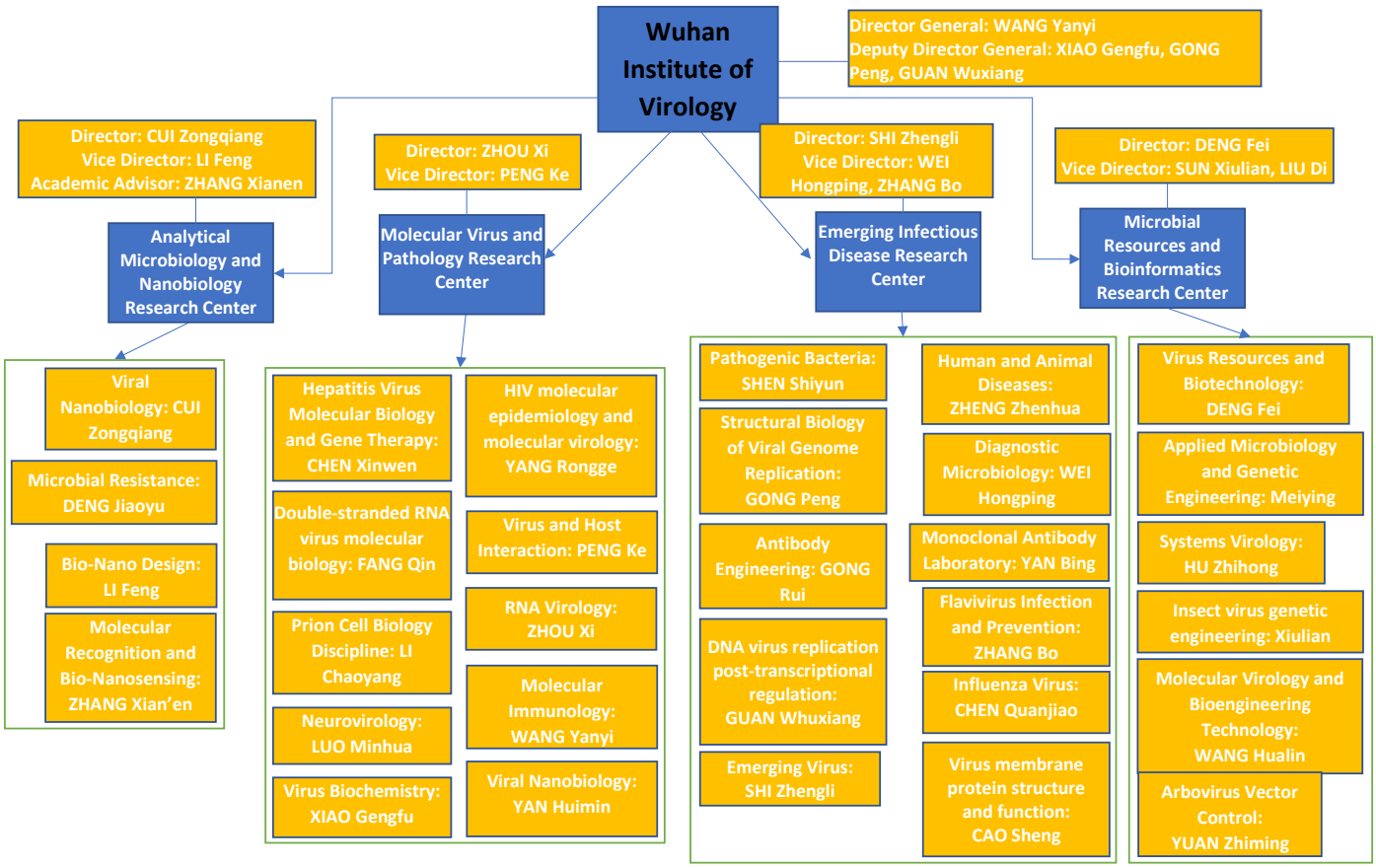


**Appendix A Key**

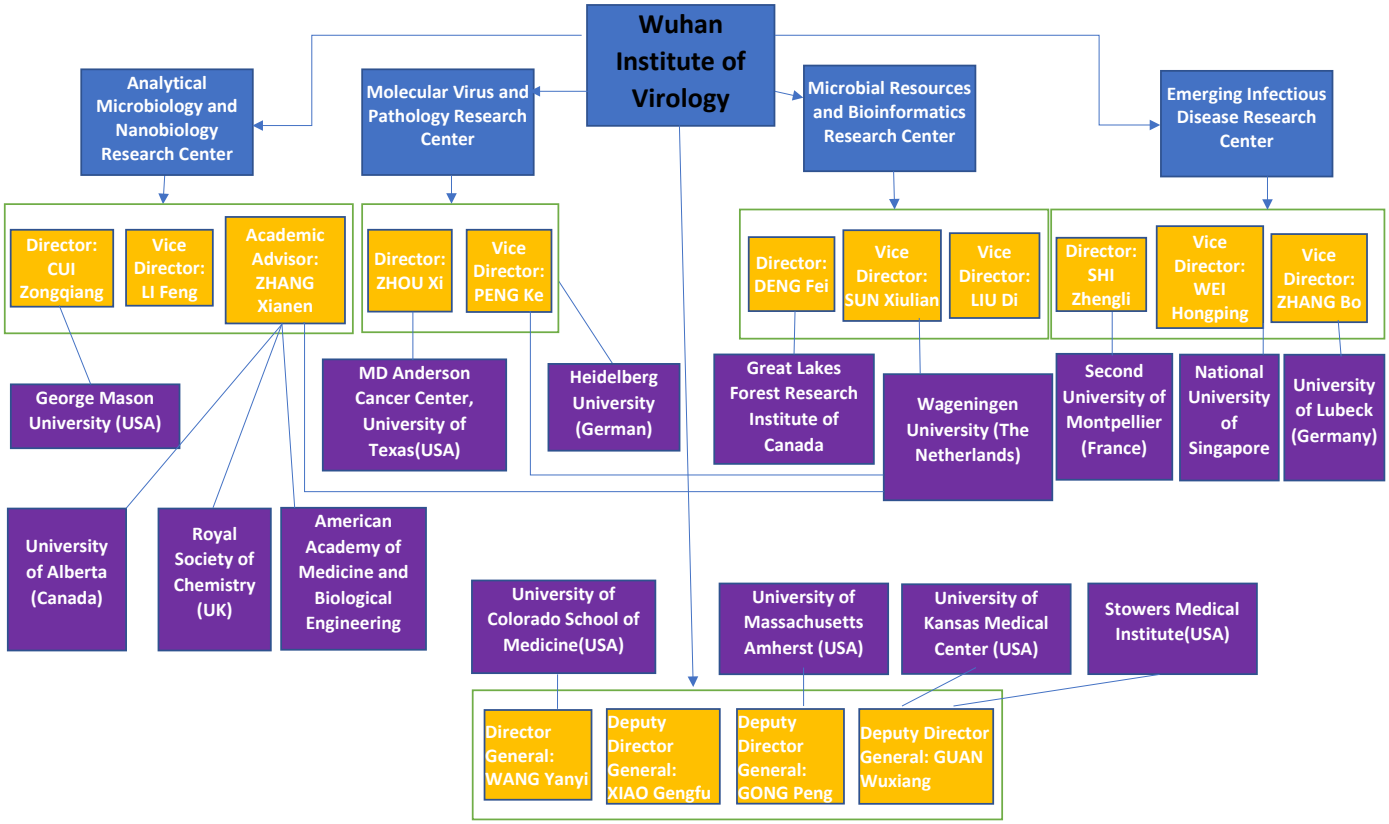


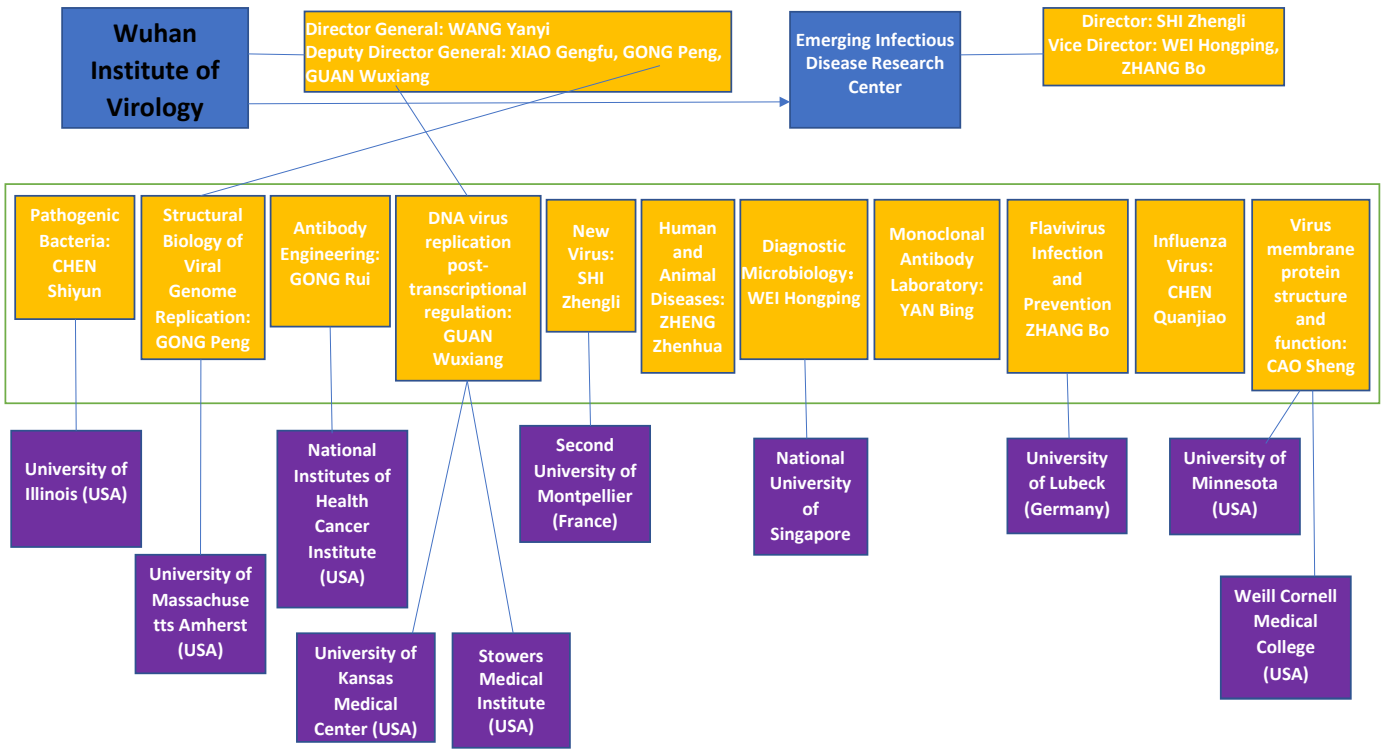
## APPENDIX B:

## WIV ORGANISATIONAL CHART

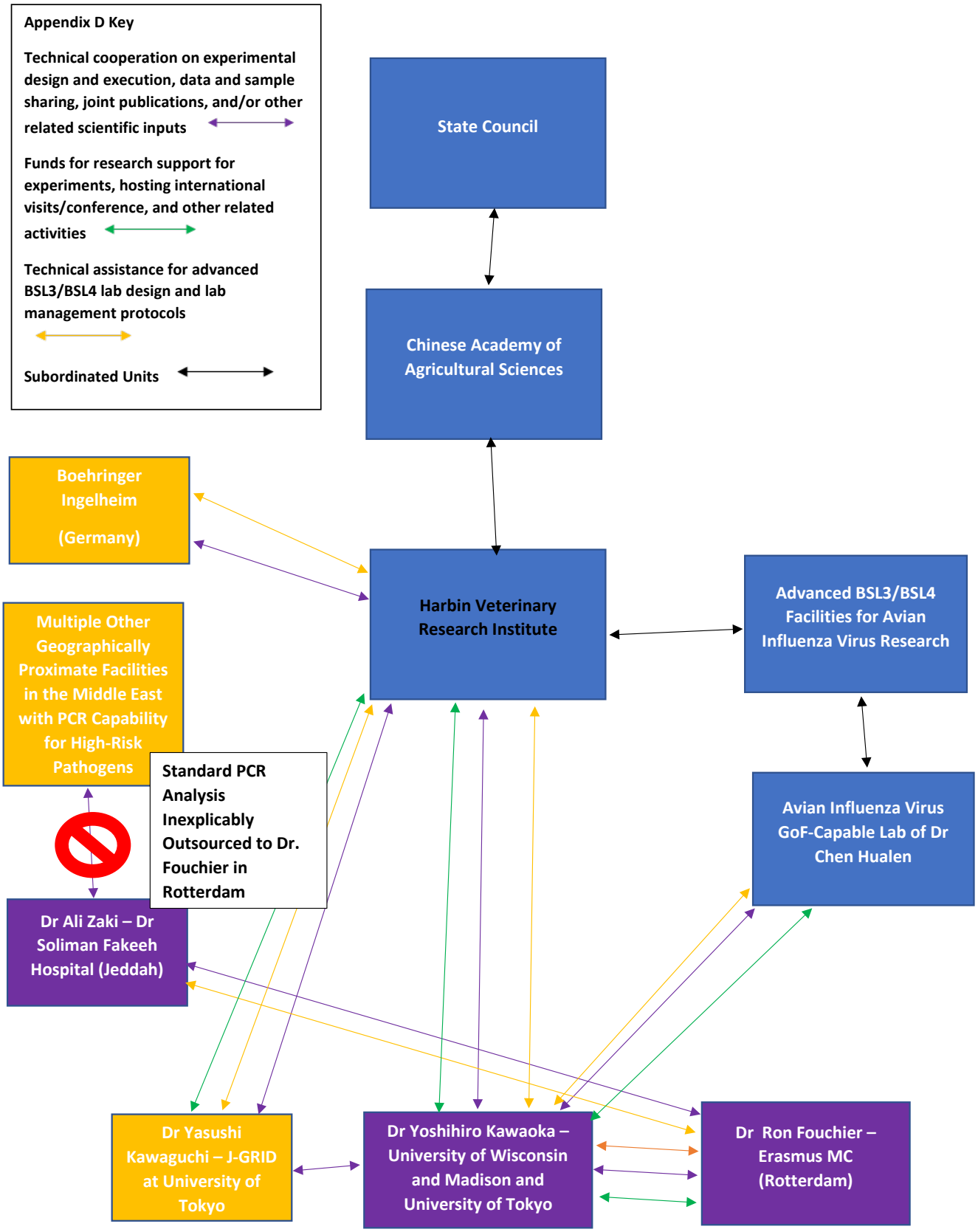


# APPENDIX C:
# WIV TRANSNATIONAL EDUCATIONAL LINKAGES

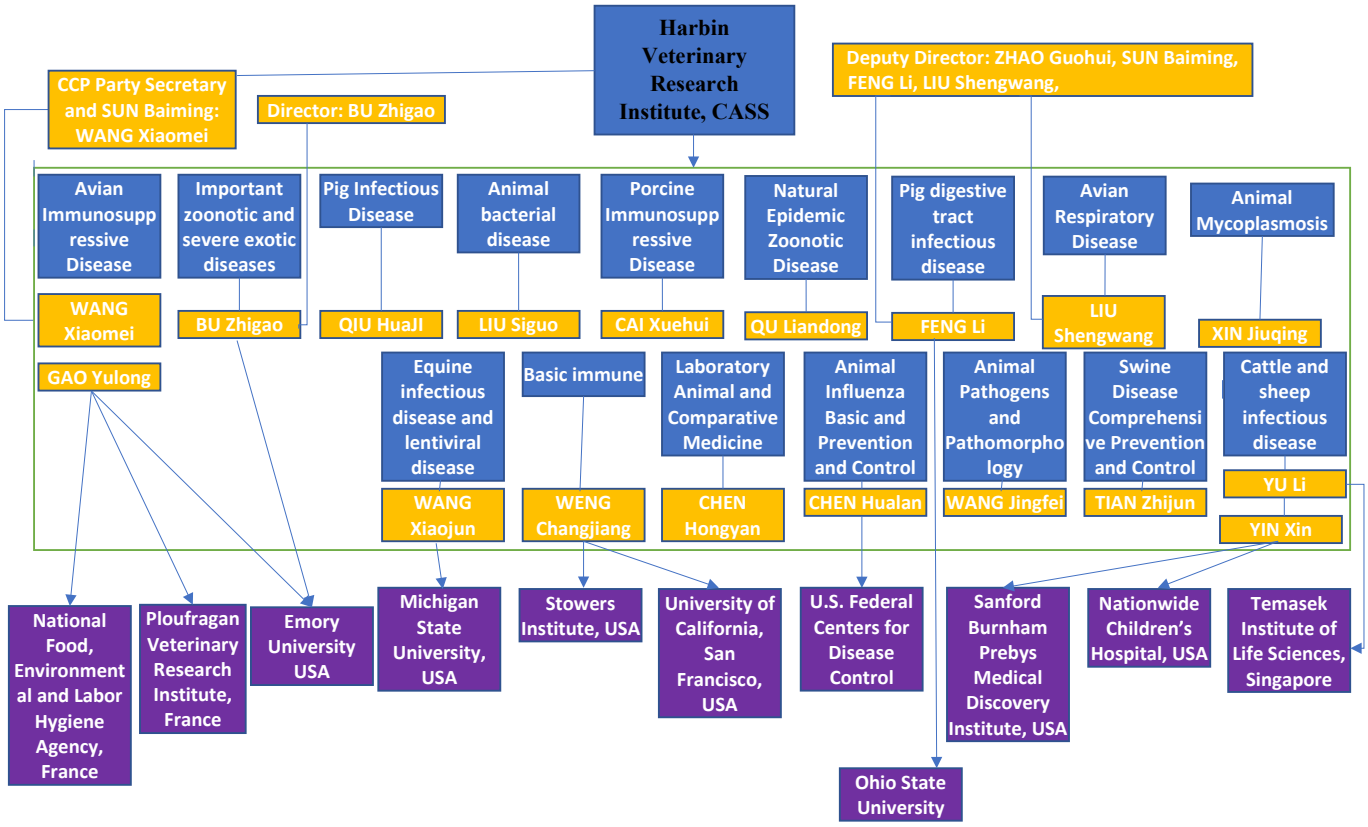


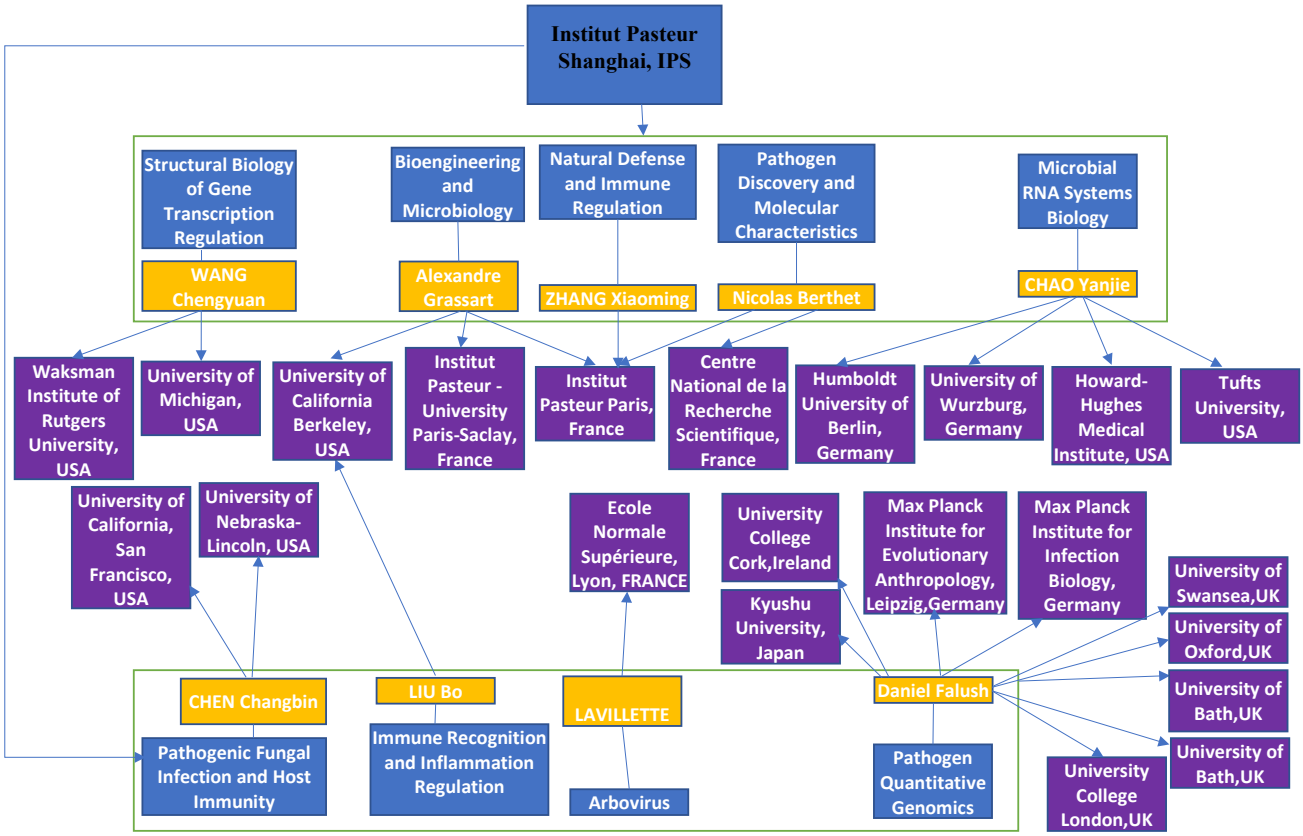
# APPENDIX D:
# TRANSNATIONAL LINKAGES OF HVRI

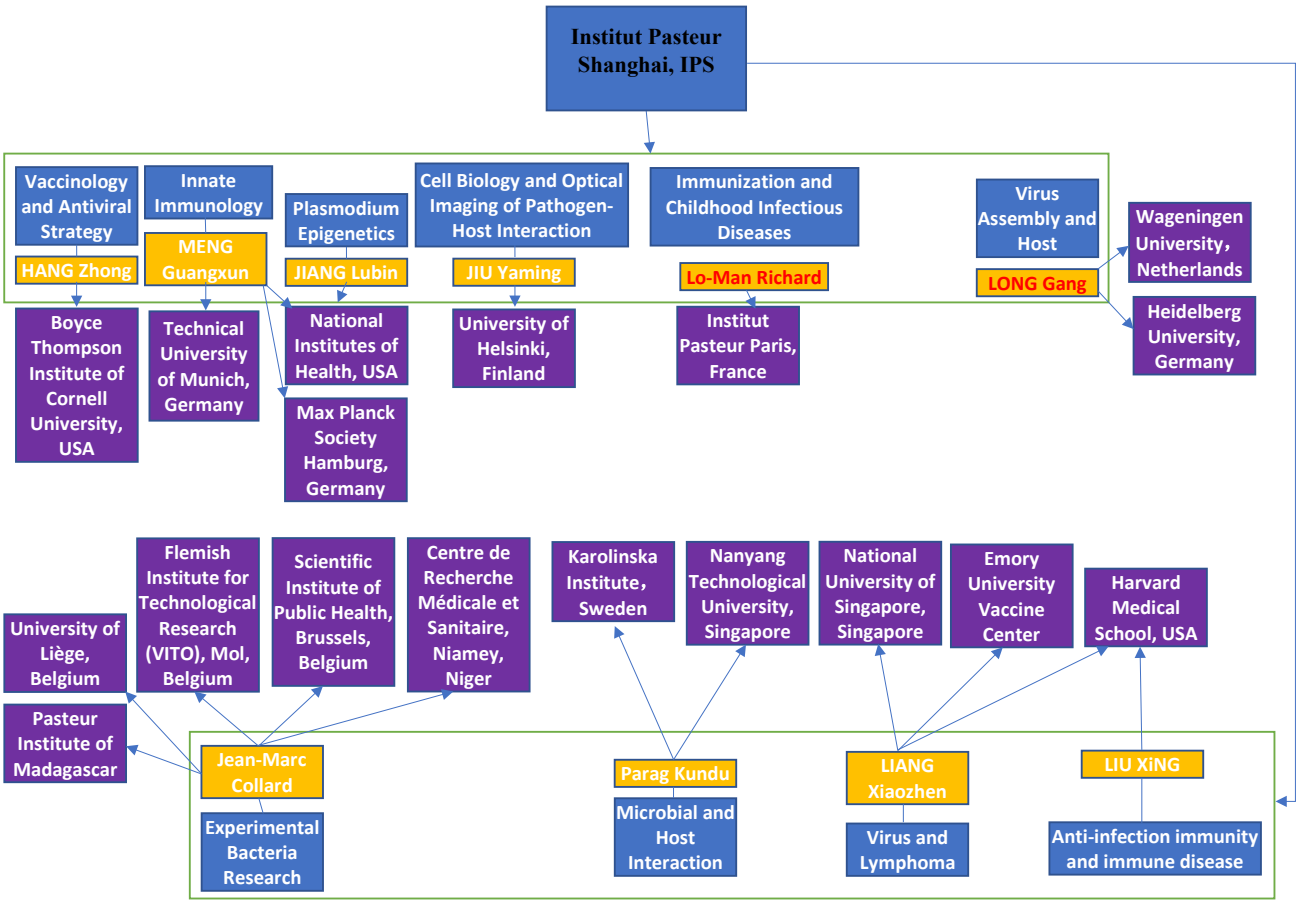


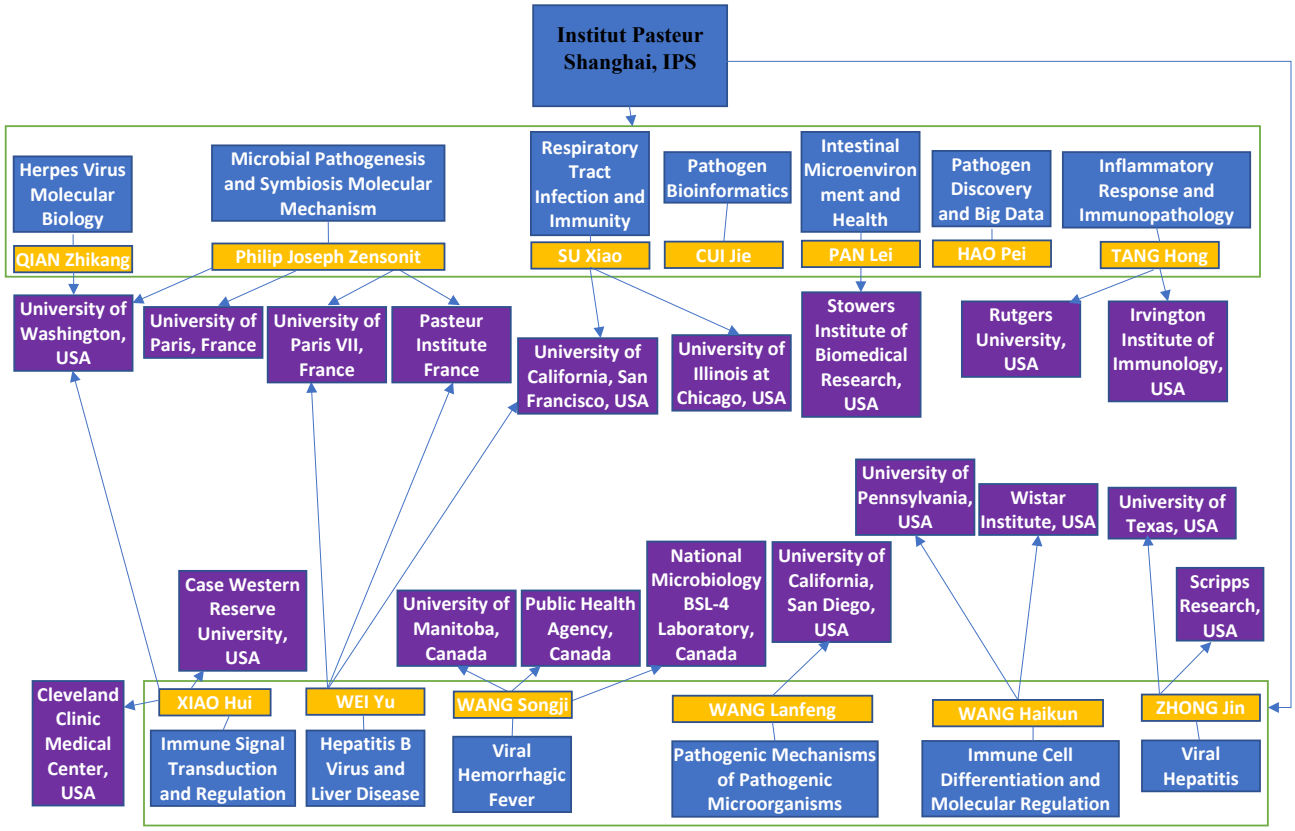
# APPENDIX E:
# HVRI TRANSNATIONAL EDUCATIONAL LINKAGES



## APPENDIX F:
## TRANSNATIONAL EDUCATIONAL LINKAGES OF INSTITUTE PASTEUR OF SHANGHAI – CHINESE ACADEMY OF SCIENCES




Institut Pasteur Shanghai, IPS
Vaccinology and Antiviral Strategy
HANG Zhong
Innate Immunology
MENG Guangxun
Plasmodium Epigenetics
JIANG Lubin
Cell Biology and Optical Imaging of Pathogen-Host Interaction
JIU Yaming
Immunization and Childhood Infectious Diseases
Lo-Man Richard
Virus Assembly and Host
LONG Gang
Wageningen University, Netherlands
Heidelberg University, Germany
Boyce Thompson Institute of Cornell University, USA
Technical University of Munich, Germany
National Institutes of Health, USA
Max Planck Society Hamburg, Germany
University of Helsinki, Finland
Institut Pasteur Paris, France
University of Liège, Belgium
Pasteur Institute of Madagascar
Flemish Institute for Technological Research (VITO), Mol, Belgium
Scientific Institute of Public Health, Brussels, Belgium
Centre de Recherche Médicale et Sanitaire, Niamey, Niger
Karolinska Institute, Sweden
Nanyang Technological University, Singapore
National University of Singapore, Singapore
Emory University Vaccine Center
Harvard Medical School, USA
Jean-Marc Collard
Experimental Bacteria Research
Parag Kundu
Microbial and Host Interaction
LIANG Xiaozhen
Virus and Lymphoma
LIU XiNG
Anti-infection immunity and immune disease


Institut Pasteur Shanghai, IPS
Herpes Virus Molecular Biology
QIAN Zhikang
Microbial Pathogenesis and Symbiosis Molecular Mechanism
Philip Joseph Zensonit
Respiratory Tract Infection and Immunity
SU Xiao
Pathogen Bioinformatics
CUI Jie
Intestinal Microenvironment and Health
PAN Lei
Pathogen Discovery and Big Data
HAO Pei
Inflammatory Response and Immunopathology
TANG Hong
University of Washington, USA
University of Paris, France
University of Paris VII, France
Pasteur Institute France
University of California, San Francisco, USA
University of Illinois at Chicago, USA
Stowers Institute of Biomedical Research, USA
Rutgers University, USA
Irvington Institute of Immunology, USA
University of Pennsylvania, USA
Wistar Institute, USA
University of Texas, USA
Case Western Reserve University, USA
University of Manitoba, Canada
Public Health Agency, Canada
National Microbiology BSL-4 Laboratory, Canada
University of California, San Diego, USA
Scripps Research, USA
Cleveland Clinic Medical Center, USA
XIAO Hui
Immune Signal Transduction and Regulation
WEI Yu
Hepatitis B Virus and Liver Disease
WANG Songji
Viral Hemorrhagic Fever
WANG Lanfeng
Pathogenic Mechanisms of Pathogenic Microorganisms
WANG Haikun
Immune Cell Differentiation and Molecular Regulation
ZHONG Jin
Viral Hepatitis

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## *About The NTS-Asia Consortium*

The NTS-Asia Consortium was launched in January 2007 as a network of NTS research institutes and think tanks. The aims of the consortium are as follows:

- To develop a platform for networking and intellectual exchange between regional NTS scholars and analysts
- To build long-term and sustainable regional capacity for research on NTS issues
- To mainstream and advance the field of NTS studies in Asia
- To collate and manage a regional database of NTS publications and other resources

NTS issues include the challenges to the survival and well-being of peoples and states that arise from nonmilitary sources, such as climate change, resource scarcity, infectious diseases, natural disasters, irregular migration, food shortages, people smuggling, drug trafficking and transnational crime. These dangers are transnational in scope, defying unilateral remedies and requiring comprehensive – political, economic and social – responses, as well as the humanitarian use of military force. NTS studies also look at the multidimensional civilian angle to security in conjunction with state, military and governmental actors.

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