Research Report

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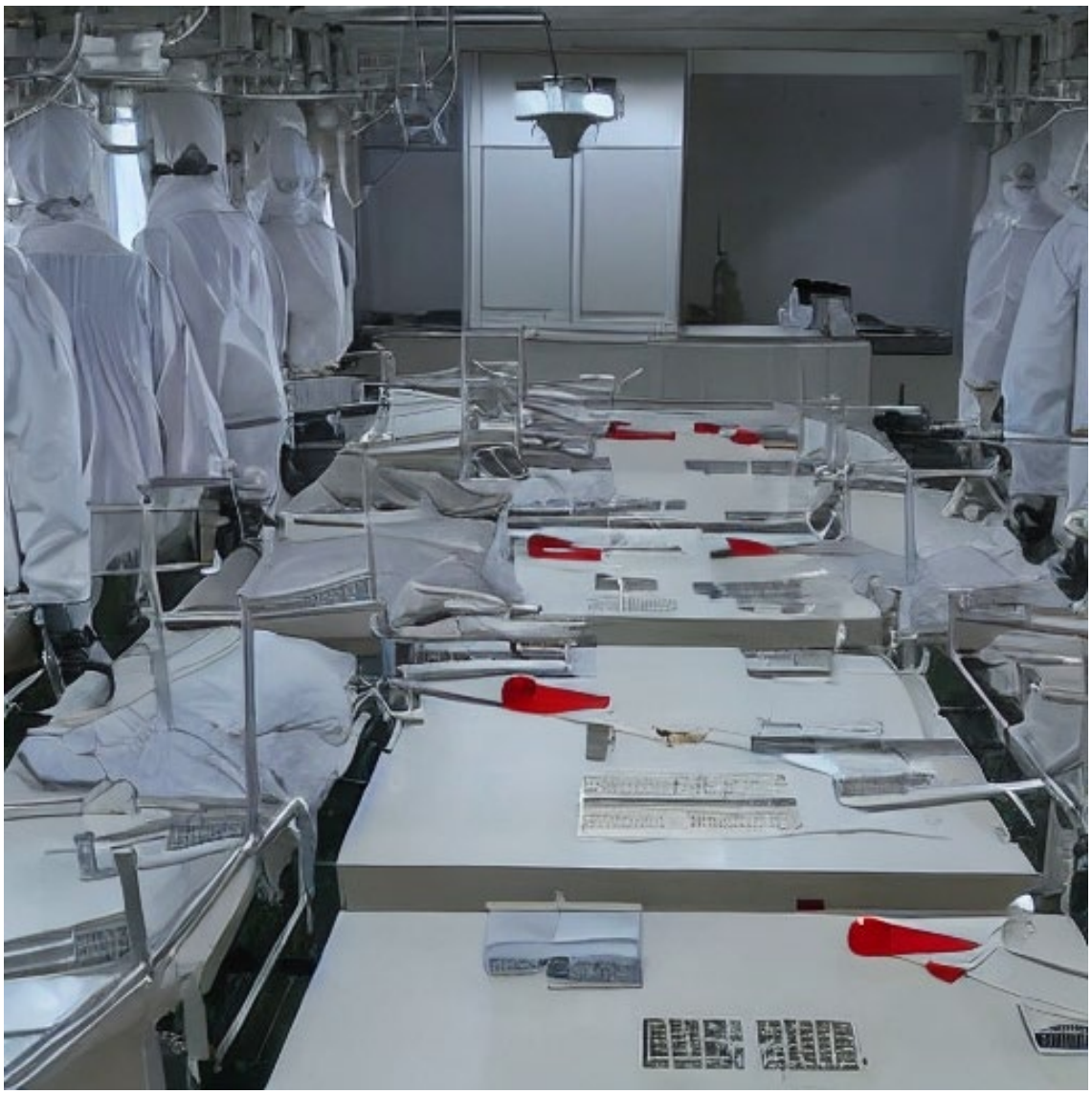
Precision Targeting Bioweapons Facilities in a Post-CCP Regime Collapse Scenario

Key Assets and Locations, Mission Options, and Strategic Execution Plan



Introduction and Strategic Rationale

Under the radar of multiple responsible bodies in the West, the Chinese Communist Party (CCP) has architected the world's most aggressive dual-use pathogen research ecosystem that spans across nominally civilian and overt military facilities in China. China's Civil-Military Fusion Law guarantees that any pathogen research activities that occur within China, including work carried out with international involvement, can be absorbed by the People's Liberation Army (PLA) at any time. Unlike NATO and the American Alliance structure (including in the Indo-Pacific), many senior PLA officers and CCP strategists do not view biological weapons as being classified as unconventional platforms. Rather, there is increasing evidence that biological weapons are viewed as being a core component of the PLA's standard order of battle.

The CCP has executed decades of massive investment in domestic Biosafety Level 3 and 4 (BSL3/4)[1] laboratory capacity combined with a clandestine effort to absorb international, and specifically Western, expertise and technical knowhow in high-risk Gain-of-Function (GoF)[2] techniques. This has resulted in a pathogen-diversified, geographically distributed, and increasingly offensively-oriented CCP capability. The PLA is unable to achieve strategic overmatch in conventional military domains against the American Alliance Structure (let alone NATO). However, bioweapons likely represent one defense domain where the CCP may assess that Beijing has distinct asymmetric advantages that can leveraged to achieve strategic effects against enemies.

It is essential that the United States has a directly executable set of options to target the full spectrum of China's dual-use pathogen research infrastructure in the event of a CCP regime collapse. The CCP is already beginning to internationalize its networks, especially in Pakistan. CCP-driven proliferation of bioweapons to other hostile states, criminal syndicates, and other threat groups has the ability to fundamentally alter global security in an irreversible manner. Precision targeting is necessary to prevent any such scenario. This report will provide a strategic-level overview of the CCP's key bioweapons research institutes and the specific type of high-risk pathogen research that they are conducting. Based on this, three precision targeting mission options are presented followed by a fundamental execution plan for these missions. This report then concludes with a net assessment that argues for the outright destruction, not restructuring, of these bioweapons facilities.

[1] 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. BSL3 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 Centres for Disease Control and Prevention, Biosafety in Microbiological and Biomedical Laboratories – fifth Edition, Atlanta, December 2009.

[2] Gain-of-Function (GoF) experiments are a controversial domain within biomedical science, defense and security, and other related fields. They are separate and distinct from other scientific methods and approaches. GoF experiments are designed to enable pathogens to develop new properties (e.g., increased transmissibility, increased lethality and drug resistance) for them to generate better information on how viruses could leap from one species to another. This can enable rapid early detection, containment and local/regional/international pandemic prevention. However, this also makes viruses more dangerous than their natural form.

Names and Demonstrated Bioweapons Development Capabilities of Key CCP-Run Institutions

Wuhan Institute of Virology (WIV)[3]

The WIV was established in 1956 as a Microbiology Laboratory of the Chinese Academy of Sciences (CAS) and it is one of the earliest national-level research institutes established after the founding of the People's Republic of China (PRC) in 1949.[4] 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.

After the SARS outbreak, the CCP initiated the construction of the BSL4 laboratory (also referred to as a P4 laboratory in China). 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 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 in 2015.[5]

WIV has established itself as a domestic 'center of excellence' across pathogens ranging from the Middle East Respiratory Syndrome (MERS), Zika, SARS and SARS-like viruses, Nipah, Ebola, HIV, and various insect-borne viruses such as Malaria. There are 65 in-house scholars listed on WIV's official 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.[6]

Perhaps the best well-known researcher at WIV is Dr. Shi Zheng-li, a French-trained and internationally recognised bat coronavirus expert with expertise in bioengineering and GoF research. Shi and several colleagues (both domestically and internationally based) have several landmark publications in leading scientific journals such as *Nature* and *Archives of Virology*. Shi's international scientific collaborators include Dr. Wang Linfa (Duke-NUS

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[3] For a more in-depth discussion on WIV, please see Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

[4] For more details, refer to 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 Wu Han 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

[5] Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

[6] Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

Graduate School of Medicine – Singapore), Dr. Ralph Baric (University of North Carolina at Chapel Hill), Dr. Jonna Mazet (University of California at Davis) and Dr. Peter Dazsak (EcoHealth Alliance). Shi also works closely with another WIV colleague Dr. Zhou Peng. Zhou was previously a postdoctoral fellow under Wang Linfa at the Duke-NUS Graduate School of Medicine.[7]

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 make this new chimera bat coronavirus more transmissible than even the most dangerous bat coronaviruses found in nature.[8]

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 experiments across multiple domains within the field of virology, including bat coronaviruses.[9]

WIV previously acknowledged housing a Military Management Division (MMD). This arrangement generated some concern around the potential dual-use nature of some of the research being done at WIV.[10] There are now no direct references to the MMD on the WIV website and information regarding previous official US State Department visits to WIV has been removed as well.[11] 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 Chinese Center for Disease Control (Chinese CDC), which is located roughly 200 yards from the Huanan Seafood Market. This market is the still-official point of origin of the COVID-19 pandemic in Wuhan according to the CCP.

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[7] 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).

[8] 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).

[9] For a full 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/

[10] 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", The Guardian, 23 May 2020.

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

Harbin Veterinary Research Institute (HVRI)[12]

HVRI was established in 1948, a year before the official founding of the PRC.[13] The Institute's first director and CCP representative was Professor Chen Lingfeng.[14] Located in Harbin (Heilongjiang Province), the HVRI is the 'go-to' institute for various animal viruses (known as zoonoses) which are potentially lethal to livestock and/or humans. HVRI has internationally recognized expertise in avian influenza viruses, namely the H5N1 and H7N9 viruses. HVRI is organized under the Chinese Academy of Agricultural Sciences (CAAS) and can award doctoral degrees. HVRI was established as the PRC's second BSL4 lab in 2018. In addition to avian influenza viruses, HVRI also researches on swine flu and other influenza viruses that infect other animal species.[15]

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 749,168 square feet) and also has a laboratory animal breeding farm covering 16,500,000 square feet in suburban Harbin. HVRI is presently developing a new site that covers 2,925,630 square feet. Given the scale of this physical expansion, HVRI is likely to hire more staff.[16]

One of the most well-known researchers at HVRI is Dr. Chen Hualen, a leading veterinary virologist who worked at the US Centers for Disease Control and Prevention (US CDC) from 1999 to 2002. Chen's recent work focuses on avian influenza viruses. Some of her experiments have generated controversy, especially bioengineering avian influenza viruses.[17] 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 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 and is a man-made creation.[18]

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[12] For a more in-depth discussion on HVRI, please see Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

[13] 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).

[14] 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).

[15] Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

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

[17] 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

[18] 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
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).

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.[19]

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. 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.[20] Even though he is Japanese, 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 specialists Dr. Ron Fouchier at Erasmus University in Holland and Dr. Chen Hualan at HVRI.[21]

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.[22]

[19] 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.
[20] 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.
[21] 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).
[22] 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).

Chinese Academy of Medical Sciences and Peking Union Medical College (CAMS-PUMC)[23]

Presently, CAMS-PUMC (commonly referred to as simply CAMS) operates a full-spectrum, nationwide infrastructure of laboratories, including BSL3/4, hospitals and educational facilities. CAMS is under the National Health Commission (NHC), a cabinet-level executive department of the State Council responsible for formulating national health policies. CAMS has 19 research institutes, six hospitals and eight schools under its umbrella. Its expert team comprises 24 members from CAS and Chinese Academy of Engineering (CAE), 1,073 PhD supervisors and 1,437 supervisors for master's students. CAMS Academic Advisory Committee has six academic divisions and 219 members, all of whom are advertised as top scientists. There are 23 national platforms for intramural scientific research, including six State Key Laboratories and five National Clinical Research Centres. Eighty-nine extramural research institutions or units have been collaborating with other domestic institutions since 2019.[24]

Within the field of virology at CAMS, the Institute of Medical Biology (IMB - Kunming), Institute of Animal Laboratory Sciences (ILAS- Beijing), Institute of Pathogen Biology (IPB - Beijing) and Christophe Merieux Lab (CML – a subunit of IPB in Beijing) are significant. ILAS in particular engages in high-risk pathogen research using animal models, such as humanized mice, ferrets and non-human primates, to identify direct infection pathways to humans.

Recent legally obtained email communications between Dr. James LeDuc at the University of Texas Medical Branch (UTMB) in Galveston, Texas and CAMS reveal that IMB houses a BSL4 lab. This lab appeared to be engaging in joint high-risk virology research with UTMB that is made only available to a select few Chinese scientists.[25] Previously, many analysts assumed that China only had two BSL4 labs, one at WIV and the other at HVRI.

The point person between the UTMB and CAMS is Dr. Shi Pei-Yong. Shi is a faculty member on LeDuc's team at UTMB and has conducted research involving the manipulation of spike proteins of the SARS-CoV-2 virus to make the pathogen more infectious than the variants that were circulating naturally.[26] This likely represented a common interest with his counterparts in Kunming.

Shi has also worked extensively with the PLA's Academy of Military Medical Sciences (AMMS) and CAMS on other infectious disease projects that involve the manipulation of viruses, such as chimeric Zika vaccine development and Zika GoF studies using mouse models.

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[23] For a more in-depth discussion on CAMS-PUMC, please see Clarke, Ryan, Lam, Peng Er, and Lin Xiaoxu, 'High-Risk Virology Research at the Chinese Academy of Medical Sciences and Peking Union Medical College', EAI Background Brief No. 1642, 24 March 2022.
Please also see Clarke, Ryan, Lam, Peng Er, Lin, Xiaoxu, Yarrow, Richard, and Eads, LJ, 'High-Risk Pathogen Research at the Chinese Academy of Medical Sciences, Guangzhou Institute of Respiratory Health and the Academy of Military Medical Sciences: Key Linkages and Strategic Implications', Center for Non-Traditional Security Studies, Singapore (forthcoming).

[24] 'Chinese Academy of Medical Sciences and Peking Union Medical College are seeking global talents', NatureCareers, 2022.
https://www.nature.com/naturecareers/employer/79137

[25] These email conversations were voluntarily shared with Ryan Clarke by Gary Ruskin from U.S. Right to Know under a Freedom of Information Request.
Please also see Yuan Zhiming, 'Current status and future challenges of high-level biosafety laboratories in China', *Journal of Biosafety and Biosecurity*, Vol. 1, Issue 2, September 2019, pp. 123-127.

[26] For example, please see Pei-Yong Shi, 'Spike mutation D614G alters SARS-CoV-2 fitness'.

One of Shi's key collaborators, Qi Chen, is the director of the Virology Lab at the Institute of Microbiology and Epidemiology (AMMS).[27] Despite these well-established linkages, the UTMB team was abruptly shut out of the BSL4 lab in Kunming that they helped develop.[28]

Dr. Chao Shan also held simultaneous dual appointments at WIV and on LeDuc's team at Galveston/UTMB. Chao has several joint publications with Shi and others demonstrating GoF research. In one 2020 PNAS study, Chao, Shi and colleagues took a pre-epidemic Asian Zika virus strain (FSS13025 isolated in Cambodia in 2010) and inserted the 'V473M' substitution that significantly increased neurovirulence[29] in neonatal mice and produced higher viral loads in the placenta and fetal heads in pregnant mice. This E-V473M mutant strain was further studied in competition experiments in cynomolgus macaques. The results showed that this mutation increased Zika's fitness for viral generation in macaques, a clear demonstration of GoF that was based on reverse genetics techniques.[30]

In September 2020, He Yuxian from CAMS and a joint team of researchers from AMMS, Beijing Institute of Lifeomics, and Institute of Military Cognition and Brain Sciences (PLA) published a study that describes their use of SARS-CoV-2 serial passaging. The rationale for this study is to improve the efficacy of vaccines.[31] Serial passaging involves continuously selecting for the most infectious viral strains, isolating them, and then combining and reinserting them back into mice to produce new viral strains that are more infectious, lethal and/or drug/vaccine-resistant than SARS-CoV-2 viruses found in nature. The majority of He Yuxian's co-authors on this study come from overtly PLA-run institutions.

In October 2021, researchers from the CAMS-controlled Christophe Merieux Laboratory in Beijing developed their own synthetic SARS-CoV-2 virus in the lab, which they refer to as the 'SARS-CoV-2-GFP replicon'. The declared logic was that experimentation on this synthetic virus would more fully inform treatment options.[32] Despite titling their paper 'Construction of Non-infectious SARS-CoV-2 Replicons and Their Application in Drug Evaluation', they note that their synthetic virus did in fact replicate over the course of their experiment.[33]

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[27] Qi Chen et al., 'Treatment of Human Glioblastoma with a Live Attenuated Zika Virus Vaccine Candidate'.
Xiao Feng I, et al., 'Development of a chimeric Zika vaccine using a licensed live-attenuated flavivirus vaccine as backbone', *Nature Communications*, Vol. 9, No. 673, 2018.
Chao Shan, et. al., 'An Infectious cDNA Clone of Zika Virus to Study Viral Virulence, Mosquito Transmission, and Antiviral Inhibitors', *Cell Host Microbe*, Vol. 19, No. 6, 8 June 2016.

[28] These email conversations were voluntarily shared with Ryan Clarke by Gary Ruskin from U.S. Right to Know under a Freedom of Information Request.

[29] Neurovirulence refers to infection of the brain.

[30] Chao Shan, et. al., 'A Zika virus envelope mutation preceding the 2015 epidemic enhances virulence and fitness for transmission', *PNAS*, Vol. 117, No. 33., 18 August 2020.
For additional GoF work conducted by Galveston/UTMB's Pei-Yong Shi and colleagues at AMMS involving Zika viruses in mice, please see Ling Yuan, et. al., 'A single mutation in the prM protein of Zika virus contributes to fetal microcephaly', Science, Vol. 17, No. 358, 17 November 2017.

[31] Gu Hongjing, et. al. 'Adaptation of SARS-CoV-2 in BALB/c mice for testing vaccine efficacy', *Science*, Vol. 369, No. 6511, 25 September 2020.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7574913/

[32] Bei, Wang, et.al., 'Construction of Non-infectious SARS-CoV-2 Replicons and Their Application in Drug Evaluation', *Virologica Sinica*, Vol. 36, No. 5, October 2021.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8034055/

[33] Bei, Wang, et.al., 'Construction of Non-infectious SARS-CoV-2 Replicons and Their Application in Drug Evaluation', *Virologica Sinica*, Vol. 36, No. 5, October 2021.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8034055/

Notably, none of the most effective SARS-CoV-2 vaccines produced globally have been developed through synthetic virus creations, serial passaging, or any other GoF techniques. Given the current rates of protection against the development of severe disease provided by current vaccines, there is no clear civilian scientific justification to develop additional vaccines that protect against artificially enhanced SARS-CoV-2 viruses. The CAMS/ study suggests that GoF, methods that were being used at WIV[34] on bat coronaviruses continue to be used at CAMS, AMMS, Institute of Military Cognition and Brain Sciences and the Beijing Institute of Lifeomics.

CAMS is also conducting GoF research on MERS. In a study titled, 'An animal model of MERS produced by infection of rhesus macaques with MERS coronavirus', Yao Yanfeng, Bao Linlin, Deng Wei and Qin Chuan from CAMS set out to determine whether monkey models were effective to study the pathogenesis of MERS infections. In this CAMS study, the research team sourced its MERS samples from known GoF scientist Dr. Ron Fouchier at Erasmus University Rotterdam (Holland) and utilized them to directly infect the lungs of Rhesus Macaques and observe their physiological responses. The researchers reported that infected monkeys showed clinical signs of disease, virus replication, histological lesions and neutralizing antibody production. They also reported that they could confirm that the monkey model supports viral growth, and manifests respiratory and generalized illness along with tissue pathology. These CAMS researchers claim to have conducted similar experiments on mouse, ferret and guinea pig models but decided not to publish the data.[35]

Dr. Bao Linlin is of particular interest in this MERS study as well as her multiple studies on H7N9 and other GoF research on avian influenza viruses. Some of Bao's GoF research is virtually identical to the research conducted by Ron Fouchier[36] in that both have engineered avian influenza (H7N9 and H5N1) viruses that could transmit between ferrets via droplets.[37]

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[34] For example, please see Shi, Zheng-Li, Baric, Ralph et. al., 'A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence', *Nature Medicine*, Vol. 21, No. 12, December 2015.
Mazet, Jonna, Daszak, Peter, Zheng-Li, Shi et. al., 'Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor', *Nature*, Vol. 503, No. 28, November 2013.
Li, Fang, Wang, Linfa, Shi, Zheng-Li, et. al, 'Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry', *Archive of Virology*, Vol. 155, 22 June 2010.

[35] Yao Yanfeng, et. al., 'An Animal Model of MERS Produced by Infection of Rhesus Macaques With MERS Coronavirus', *Journal of Infectious Diseases*, Vol. 209, No. 2, 15 January 2014.

[36] For example, please see Ron Fouchier, et. al., 'Airborne transmission of influenza A/H5N1 virus between ferrets', *Science*, 22, 336:6088 (June 2012).
Ron Fouchier, et. al., 'The Potential for Respiratory Droplet–Transmissible A/H5N1 Influenza Virus to Evolve in a Mammalian Host', *Science*, 22;336:6088 (June 2012).
Enserink, Martin, 'Flu Researcher Ron Fouchier Loses Legal Fight Over H5N1 Studies', *American Association for the Advancement of Science (ScienceMag)*, 25 September 2013.
https://www.science.org/content/article/flu-researcher-ron-fouchier-loses-legal-fight-over-h5n1-studies

[37] For example, please see Bao, Linlin, et. al., 'Novel Avian-Origin Human Influenza A(H7N9) Can Be Transmitted Between Ferrets via Respiratory Droplets', *Journal of Infectious Diseases*, Vol. 209, Issue 4, 15 February 2014.
Bao, Linlin et. al., 'Transmission of H7N9 influenza virus in mice by different infective routes', *Virology Journal*, Vol. 11, Article No. 185, 2014.
Fouchier, Ron, et. al., 'Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets'.
Fouchier. Ron, et. al., 'Gain-of-Function Experiments on H7N9', *Science*, 3 August 2013.
https://www.science.org/doi/full/10.1126/science.1243325
Fouchier, Ron, et. al., 'The Potential for Respiratory Droplet–Transmissible A/H5N1 Influenza Virus to Evolve in a Mammalian Host'.
Enserink, Martin, 'Flu Researcher Ron Fouchier Loses Legal Fight Over H5N1 Studies: Dutch court confirms that export license is needed to publish certain influenza paper', *Science*, 25 September 2013.
https://www.science.org/content/article/flu-researcher-ron-fouchier-loses-legal-fight-over-h5n1-studies

However, while Fouchier's research was criticized and has periodically ceased under EU regulations related to weapons of mass destruction, Bao's research has continued with no apparent restrictions.

CAMS represents a major component of China's ambition to become the world's leading virological center of expertise. However, its GoF research has not been subjected to any meaningful scrutiny from the international scientific community regarding potential public health risks versus benefits. CAMS has successfully absorbed international expertise to develop and operationalize its own BSL4 lab in Kunming. This lab is now able to independently conduct high-risk virological research.

CAMS is now a world leader in the development of synthetic viruses in the lab, including SARS-CoV-2 viruses, and engineering dangerous pathogens found in nature. This marks a major development in that CAMS has the capability to engineer a range of viruses for various applications, even if it is not possible to acquire a sufficient number of natural samples. Access to samples is no longer a scientific bottleneck or a source of Western leverage against Chinese institutes such as CAMS.

Academy of Military Medical Sciences (AMMS)[38]

AMMS has emerged as possibly China's most diversified and domestically self-sufficient high-risk virology research institute. AMMS has developed extensive 'in-house' capabilities, domestic scientific partnerships (including with WIV and CAMS), as well as strategic international partnerships. Under the radar of many analysts and other responsible bodies, AMMS also formed and has sustained linkages with Dr. LeDuc's team at UTMB in Galveston.[39]

Interestingly, in 2021 AMMS partnered with Yunnan Walvax Biotechnology and Suzhou Abogen Biosciences to develop an mRNA vaccine, commonly known as the ARCoV vaccine. Clinical trials have involved participants from Yunnan and Guangxi Provinces as well as Mexico, Indonesia, and Nepal. The ARCoV vaccine is currently in Phase 3 clinical

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Roos, Robert, 'Fouchier study reveals changes enabling airborne spread of H5N1', Centre for Infectious Disease Research and Policy, University of Minnesota, 21 June 2012.
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Two "gain of function" projects halted more than 4 years ago have passed new U.S. review process', *Science*, 8 February 2019.
https://www.science.org/content/article/exclusive-controversial-experiments-make-bird-flu-more-risky-poised-resume
Enserink, Martin, 'Scientists Brace for Media Storm Around Controversial Flu Studies', *Science*, 23 November 2011.
https://www.science.org/content/article/scientists-brace-media-storm-around-controversial-flu-studies

[38] For a more in-depth discussion on AMMS, please see Clarke, Ryan, Lam, Peng Er, Lin, Xiaoxu, Yarrow, Richard, and Eads, LJ, 'High-Risk Pathogen Research at the Chinese Academy of Medical Sciences, Guangzhou Institute of Respiratory Health and the Academy of Military Medical Sciences: Key Linkages and Strategic Implications', Center for Non-Traditional Security Studies, Singapore (forthcoming).

[39] Qi,Chen, Chao, Shan, Shi, Peiyong, et. al., 'Treatment of Human Glioblastoma with a Live Attenuated Zika Virus Vaccine Candidate', *mBio*, Vol. 9. Iss. 5, September/October 2018.

trials.[40] It is noteworthy that mRNA vaccines were initially viewed with suspicion in China and were actively discouraged by the CCP.

A key PLA figure in AMMS is Major General Chen Wei (陈薇), a virologist, epidemiologist, and recognized biodefense and biological anti-terrorism specialist. She was born in the small city of Lanxi in inland Zhejiang. Chen studied at Zhejiang and Tsinghua before completing a microbiology PhD at AMMS in 1998. She then was designated a part of the 'Class A talent pool' and continued to work as a researcher at AMMS.[41]

Chen simultaneously joined the PLA and AMMS in 1991 at the age of 25 with some reports claiming that she had been 'specially' recruited into the PLA. Other reports claim that she visited an AMMS laboratory shortly before graduating from Tsinghua and became inspired

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[40] Chan, Minnie, 'How China's military took a frontline role in the coronavirus crisis', South China Morning Post, 17 March 2020.
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Liu, Roxanne and Lee, Se Young, 'Chinese military researchers move a new COVID vaccine candidate into human trial', Reuters, 25 June 2020.
https://www.reuters.com/article/health-coronavirus-china-vaccine-idUSL1N2E11I2
Ma, Josephine, 'Domestic clinical trials planned for China's mRNA Covid-19 vaccine', South China Morning Post, 22 July 2021.
https://www.scmp.com/news/china/science/article/3142084/domestic-clinical-trials-planned-chinas-mrna-covid-19-vaccine
Esposito, Anthony, 'Mexico to start late-stage clinical trial for China's mRNA COVID-19 vaccine', Reuters, 11 May 2021.
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Zhuang, Pinghui, 'Coronavirus: Indonesia, Mexico approve late-stage trials of Chinese mRNA vaccine hopeful', South China Morning Post, 1 September 2021.
https://www.scmp.com/news/china/science/article/3147168/coronavirus-indonesia-mexico-approve-late-stage-trials-chinese
Babu, Judy, 'Nepal allows late-stage trials for Chinese mRNA vaccine candidate – Xinhua', Reuters, 28 August 2021.
https://www.reuters.com/world/asia-pacific/nepal-allows-late-stage-trials-chinese-mrna-vaccine-candidate-xinhua-2021-08-27/
'SARS-CoV-2 mRNA vaccine', DrugBank Online.
https://go.drugbank.com/drugs/DB15855
Chen, Gui-Ling, et. al., 'Safety and immunogenicity of the SARS-CoV-2 ARCoV mRNA vaccine in Chinese adults: a randomised, double-blind, placebo-controlled, phase 1 trial', *The Lancet Microbe*, Vol. 3, Iss. 3, 1 March 2022.

[41] '战斗在抗疫一线女院士陈薇：以最充分方案做最长期奋战', Women.org.cn, 3 February 2020
https://www.women.org.cn/art/2020/2/3/art_24_163679.html
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
'陈薇：军中女英雄，国家栋梁才', 商业文化, Vol. 19, 2021.
https://gb.global.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=SYWH202119008&uniplatform=OVERSEAS_CHS&v=YHN-_0PpaIaIF-MWvC1uVBjbEEjLGX7sH3VvE8t80PP1b9beJ5u4KCIJfkd3jnS4
'陈微：从清华女神到护国战神', 商业文化, Vol. 9, 2020.
https://gb.global.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLASN2020&filename=DXNB202009020&uniplatform=OVERSEAS_CHS&v=OkyRO4zZul7Mpx48ojvfTyBzNFQrQh5J8EjcxiUaR3BNoNhFVmSyTVUCjBjhCdQ0

by AMMS's mission and Korean War-era history.[42] In September 2021, Canada's *Globe and Mail* reported that Chen Wei had collaborated on virus research with Qiu Xiangguo, a scientist who led the vaccine and antiviral sections of Canada's National Microbiology Laboratory (NML) in Winnipeg, the only BSL4 lab in the country. Qiu and her husband Chang Keding were fired from NML in January 2021. Qiu and some of her students also had security clearances revoked and police removed them from the lab in July 2019.[43]

Months earlier, Qiu had sent Ebola[44] and Henipah virus[45] samples to WIV, with the apparent knowledge of NML's leaders. The Canadian government ordered NML scientists not to discuss Qiu and Chang with the media and initially sued the House of Commons speaker to prevent the release of information about Qiu and Chang's dismissal.[46]

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[42] '战斗在抗疫一线女院士陈薇：以最充分方案做最长期奋战', Women.org.cn, 3 February 2020
https://www.women.org.cn/art/2020/2/3/art_24_163679.html
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
'陈薇：军中女英雄，国家栋梁才', 商业文化, Vol. 19, 2021.
https://gb.global.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=SYWH202119008&uniplatform=OVERSEAS_CHS&v=YHN-_0PpaIaIF-MWvC1uVBjbEEjLGX7sH3VvE8t80PP1b9beJ5u4KCIJfkd3jnS4
'陈薇：从清华女神到护国战神', 商业文化, Vol. 9, 2020.
https://gb.global.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLASN2020&filename=DXNB202009020&uniplatform=OVERSEAS_CHS&v=OkyRO4zZul7Mpx48ojvfTyBzNFQrQh5J8EjcxiUaR3BNoNhFVmSyTVUCjBjhCdQ0

[43] Fife, Robert and Chase, Steven, 'Chinese PLA general collaborated with fired scientist at Canada's top infectious disease lab', The Globe and Mail, 16 September 2021.
https://www.theglobeandmail.com/politics/article-chinese-pla-general-collaborated-with-fired-scientist-at-canadas-top/
Ling, Justin, 'A brilliant scientist was mysteriously fired from a Winnipeg virus lab. No one knows why', Maclean's, 15 February 2022.
https://www.macleans.ca/longforms/winnipeg-virus-lab-scientist/
Pauls, Karen, ''Wake-up call for Canada': Security experts say case of 2 fired scientists could point to espionage', CBC News, 10 June 2021.
https://www.cbc.ca/news/canada/manitoba/winnipeg-lab-security-experts-1.6059097

[44] For one example of Qiu's Ebola research, please see Qiu, Xiangguo, et. al., "Equine-Origin Immunoglobulin Fragments Protect Nonhuman Primates from Ebola Virus Disease", *Journal of Virology*, Vol. 93, No. 5, March 2019.

[45] Henipah virus is closely related to the Nipah virus, which causes haemorrhagic disease with an 80% lethality rate. At present, Nipah virus has only been clinically detected in Malaysia, Singapore, India, and Bangladesh. It is therefore unclear why Henipah virus samples were being illicitly sent to Chen Wei by Qiu Xiangguo. For additional information on Henipah/Nipah virus, please see:
Luby, Stephen, et. al., 'Assessing the feasibility of Nipah vaccine efficacy trials based on previous outbreaks in Bangladesh', *Vaccine*, Vol. 39, Iss. 39, 15 September 2021.
Luby, Stephen, et. al., 'Nipah Virus Transmission from Bats to Humans Associated with Drinking Traditional Liquor Made from Date Palm Sap, Bangladesh, 2011–2014', *EID Journal*, Vol. 22, No. 4, April 2016.
'Nipah Virus International Conference Proceedings', Coalition for Epidemic Preparedness Innovations, National Institute of Allergy and Infectious Diseases, and Duke-NUS Graduate School of Medicine, Singapore, 9-10 December 2019.
https://cepi.net/wp-content/uploads/2020/06/2019-Nipah-Conference-Proceedings.pdf
Wang, Linfa, et. al., 'Evidence of Henipavirus Infection in West African Fruit Bats', *PLOS ONE*, 23 July 2008.

[46] Fife, Robert and Chase, Steven, 'Chinese PLA general collaborated with fired scientist at Canada's top infectious disease lab', The Globe and Mail, 16 September 2021.
https://www.theglobeandmail.com/politics/article-chinese-pla-general-collaborated-with-fired-scientist-at-canadas-top/

In 2021, researchers from WIV and the Chinese Communist Party Central Military Commission Joint Logistic Support Force (CCP CMC JLSF, which AMMS is subordinated to) published a study describing a high-risk serial passaging experiment with a SARS-CoV-2 virus. One of the key scientists involved in this study was WIV's Shi Zheng-Li.[47] To further investigate the genetic susceptibility of SARS-CoV-2 during serial passage (a clear GoF technique) on different cells, this team identified nine cell lines (human, non-human primate, and swine) susceptible to the SARS-CoV-2 virus. These nine cell lines were then serially passaged with increasingly virulent variants of the SARS-Cov-2 virus and monitored to identify the most transmissible combinations.[48] There is no identifiable civilian biomedical application for this type of research.

During the course of this serial passaging experiment, the viral loads of SARS-CoV-2 increased exponentially along with increased transmission fitness driven by evolutionary adaptations gained from serial passaging. These scientists note that human tissue (including lung, liver, colon, larynx, and skin), monkey (kidney), and swine (testicle) were most susceptible to SARS-CoV-2.[49] The key 'discovery' made by these scientists in this 2021 study is that the SARS-CoV-2 virus replicated most efficiently in human cell lines (classified as Huh-7, Calu-3, Caco-2 in this paper) and non-human primate cells (classified as Vero E6 in this paper) but less so in swine cells. The specific verification that the Vero E6 cell line is suitable for viral amplification is presented as a primary 'scientific breakthrough'.[50]

Ling, Justin, 'A brilliant scientist was mysteriously fired from a Winnipeg virus lab. No one knows why', Maclean's, 15 February 2022.
https://www.macleans.ca/longforms/winnipeg-virus-lab-scientist/
Pauls, Karen, ''Wake-up call for Canada': Security experts say case of 2 fired scientists could point to espionage', CBC News, 10 June 2021.
https://www.cbc.ca/news/canada/manitoba/winnipeg-lab-security-experts-1.6059097

[47] Shi, Zheng-Li, Hu, Ben, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.
For a more in-depth discussion on Shi Zheng-Li's high-risk pathogen research, see Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

The following studies conducted at WIV demonstrate, in aggregate, how to engineer a bat coronavirus to directly infect humans without the need for an intermediate mammalian host for the first time in history:

Shi, Zheng-Li, Baric, Ralph et. al., 'A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence', *Nature Medicine*, Vol. 21, No. 12, December 2015.
Mazet, Jonna, Daszak, Peter, Zheng-Li, Shi et. al., 'Isolation and characterization of a bat SARS-like coronavirus that uses the ACE2 receptor', *Nature*, Vol. 503, No. 28, November 2013.
Li, Fang, Wang, Linfa, Shi, Zheng-Li, et. al, 'Angiotensin-converting enzyme 2 (ACE2) proteins of different bat species confer variable susceptibility to SARS-CoV entry', *Archive of Virology*, Vol. 155, 22 June 2010.

[48] Zheng-Li Shi, Ben Hu, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.
Additional scientific evidence demonstrating the clear GoF implications of this study for both animals and humans of this study can be found in:
Shi, Zheng-Li, Zheng, Yufei, et. al., 'SARS-CoV-2 rapidly adapts in aged BALB/c mice and induces typical pneumonia', *Journal of Virology*, Volume 95, Iss. 11, June 2021.
Liu, Li-Teh, et. al., 'Isolation and Identification of a Rare Spike Gene Double-Deletion SARS-CoV-2 Variant From the Patient With High Cycle Threshold Value', *Frontiers in Medicine*, 6 January 2022.

[49] Shi, Zheng-Li, Hu, Ben, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.

[50] Shi, Zheng-Li, Hu, Ben, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.

These researchers also noted their surprise that none of the tested bat cell lines supported SARS-CoV-2 replication. This finding appears to directly conflict with their own assertion in the introduction of their own paper that SARS-CoV-2 is natural in origin and entered the human population via bats.[51] This lack of viral replication in bat cell lines was also observed by scientists from the University of Hong Kong in a 2020 study that was published by the United States Centers for Disease Control and Prevention (US CDC).[52]

This lack of SARS-CoV-2 replication in bat cell lines could also contradict the official position of Beijing that SARS-CoV-2 and the subsequent COVID-19 pandemic is the result of a zoonotic spillover event. How can the SARS-CoV-2 virus be reliably determined to originate from bats in nature when the virus does not actually replicate in bat cells? Interestingly, this lack of transmissibility of the SARS-CoV-2 virus in bat cells is consistent with other leading researchers who have claimed that this virus is uniquely adapted to directly infect and transmit amongst human cells, not other animal species.[53]

Qi Chen (Director of IVM under AMMS) has a well-established track record of conducting high-risk pathogen research with Chinese counterparts from WIV and CAMS as well as international collaborators at UTMB in Galveston.[54] In July 2021, Qi and colleagues published a study on an experiment that involved deliberately infecting the olfactory system of humanized mice[55] to stimulate rapid viral replication, massive cell death, and cause neurological damage.[56] There is also no identifiable civilian biomedical application for this research.

Once this new human disease pathway has been discovered, characterized, and 'optimized', the foundation has been laid for additional high-risk research focusing specifically on the human brain. As SARS-CoV-2 infections primarily impact the respiratory system (and the lungs in particular), it can be assessed that this specific study likely has dual-use applications. A key declared finding of this study is that SARS-CoV-2-infected humanized mice experienced a damaged olfactory system, degradation of immune cell function, and impaired olfactory function. They note that these findings have direct implications for human health. Robust viral replication and direct antiviral responses were only detected in the olfactory systems of the infected humanized mice and not in other parts of the brain, thus identifying a

[51] Shi, Zheng-Li, Hu, Ben, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.
[52] Lau, Susanna, et. al., 'Differential Tropism of SARS-CoV and SARS-CoV-2 in Bat Cells', *Emerging Infectious Diseases*, Vol. 26, No. 12, December 2020.
[53] Petrovsky, Nikolai, et. al., 'In silico comparison of SARS-CoV-2 spike protein-ACE2 binding affinities across species and implications for virus origin', *Scientific Reports*, Vol. 11, 24 June 2021.
Quay, Steven, 'A Bayesian analysis concludes beyond a reasonable doubt that SARS-CoV-2 is not a natural zoonosis but instead is laboratory derived', *Zenodo*, 29 January 2021.
[54] For additional information, please see Clarke, Ryan Lam, Peng Er, and Lin, Xiaoxu, 'High-Risk Virology Research at the Chinese Academy of Medical Sciences and Peking Union Medical College', EAI Background Brief No. 1642, 24 March 2022.
[55] Humanized mice are mice that are genetically modified to have lungs that are genetically identical to humans. Humanized mice are used in multiple biomedical domains to most closely simulate how disease pathogenesis occurs in humans.
[56] Qi, Chen, et. al., 'SARS-CoV-2 infection in the mouse olfactory system', *Cell Discovery*, Vol. 7, No. 9, 2021. Please also see Qi Chen, Chao Shan, Shi Peiyong, et. al., 'Treatment of Human Glioblastoma with a Live AttenuatedZika Virus Vaccine Candidate', *mBio*, Vol. 9. Iss. 5, September/October 2018.

new 'efficient' route for SARS-CoV-2 infection in human beings by using an ACE2 humanized mouse model.[57]
Both Chen Wei and Qi Chen at AMMS have a well-established track record of working with some of the world's most dangerous pathogens under questionable biomedical rationales. Qi has more publicly available research, in particular with Shi Peiyong and Chao Shan from UTMB on GoF experiments. However, it is unclear as to whether this indicates that Qi is indeed more active than Chen or if much of Chen's research has remained confidential. Within the AMMS organizational structure, Chen is clearly a more strategic leader than Qi.

Chen's established linkages with Qiu Xiangguo (formerly of NML) are significant, especially in the domain of Henipah/Nipah virus. Henipah virus has not been clinically detected in China and there are already adequate diagnostics available in the market. As this virus has only been clinically detected in Malaysia, Singapore, India, and Bangladesh and is characterized by irregular and short-duration outbreaks, there is not a viable market for a vaccine either. Even in the event that a Henipah/Nipah virus vaccine was claimed to have been developed in China, it would be unlikely to have a substantial uptake in these countries.[58] Given these epidemiological and market conditions, why would Major General Chen Wei be sourcing these viral samples from Qiu at NML in Winnipeg?

Another key observation is that AMMS has continued its high-risk research on the SARS-CoV-2 virus even during the most acute phases of the global COVID-19 pandemic. None of this research, including the serial passaging experiments, have been credibly attributed to any new biomedical breakthrough. Much of the high-risk pathogen research at AMMS appears to be done 'in-house' or with a narrowly-defined set of transnational partners. As self-reliance in the virology domain is the overtly stated aim of Chen Wei, AMMS is likely on the pathway to a nearly complete domestic orientation. While a similar trend has been observed with other Chinese virology research institutes such as WIV, HVRI[59], and CAMS[60], it is more pronounced in the case of AMMS.

AMMS carries out high-risk experiments in its own right while also enabling other nominally civilian institutions in China. Displaced high-risk research that was previously conducted at other institutes, such as WIV, would have 'top cover' protection to be conducted, especially given Major General Chen Wei's status within the highest levels of the CCP. It should be

[57] Qi, Chen, et. al., 'SARS-CoV-2 infection in the mouse olfactory system', *Cell Discovery*, Vol. 7, No. 9, 2021.
[58] For examples of a lack of trust in Chinese-manufactured vaccines, please see Yong, Michael, 'People who got Sinovac vaccine nearly 5 times more likely to develop severe COVID-19 than Pfizer: Singapore study', ChannelNewsAsia, 14 April 2022.
https://www.channelnewsasia.com/singapore/covid-19-vaccines-sinovac-pfizer-moderna-singapore-study-2625511
'Hundreds of Thai medical workers infected despite Sinovac vaccinations', Reuters, 11 July 2021.
https://www.reuters.com/world/asia-pacific/hundreds-thai-medical-workers-infected-despite-sinovac-vaccinations-2021-07-11/
Wong, Teresa, 'Covid: Is China's vaccine success waning in Asia?', BBC, 19 July 2021.
https://www.bbc.com/news/world-asia-57845644
[59] For analysis on WIV and HVRI, please see Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore.
https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf
[60] For analysis on CAMS, please see please see Clarke, Ryan, Lam, Peng Er, and Lin, Xiaoxu, 'High-Risk Virology Research at the Chinese Academy of Medical Sciences and Peking Union Medical College', EAI Background Brief No. 1642, 24 March 2022.

noted that the 2021 SARS-CoV-2 GoF serial passaging study also involved Shi Zheng-Li from WIV.[61] This is unlikely to be purely coincidental given the amount of global attention now being paid to WIV.

Three Mission Options - Destruction of the CCP's Bioweapons Program and Capture of Key Personnel

The high-risk pathogen research institutes that have been assessed in this report and their respective BSL3/4 laboratories pose a range of challenges in terms of targeting. Any actions, especially in the cyber domain, that involve sabotage or physical degradation can further escalate the risks posed by these laboratories. Such actions could actually increase the probability of a pathogen escape event by causing critical biocontainment equipment malfunctions. As such, any targeting operation would need to involve the entire physical removal of all bioweapons materials and enabling infrastructure while ensuring that these capabilities can under no circumstances be regenerated at the site in question. Also, given the geographically distributed and pathogen-diverse nature of the CCP's bioweapons program, these facilities will need to be targeted simultaneously. Sequential targeting would enable these various network nodes to 'fail over' to each other and continue to operate.

In addition to the specific institutions identified in this report, Chinese CDC facilities in close proximity in Beijing, Wuhan, and Kunming should also be in scope with regards to targeting. Chinese CDC has complementary capabilities in these locations (Wuhan CDC has a BSL3 lab roughly 200 yards from the Huanan Seafood Market), and this infrastructure must also be taken offline. Lastly, the Pakistan Army's Defense Science and Technology Organization (DESTO) in Rawalpindi should be considered in scope as there is increasing evidence that WIV has mirrored some high-risk pathogen research capability in this institution.[62] However, DESTO targeting options will be addressed in future work given the different set of variables associated with Pakistan.

Mission Option 1 involves an initial team of specialists to forcibly enter a bioweapons facility and execute the primary mission of bioweapons material removal while a second team would need to remain behind to secure the site and maintain access control. This operation would require the establishment and robust maintenance of air superiority in and around the site. Remnants of the CCP/PLA and/or the Ministry of State Security (MSS) would have an incentive to attempt to physically destroy these facilities and the evidence of their bioweapons program in the event of regime collapse. There is also the potential for malicious pathogen releases.

On the ground, the American team would need to control the geography within at least a one-mile radius of the site in question with active deterrent and preventative patrols as well as integrated air defense. Mission Option 1 would involve an overt American military presence alongside special operators and civilian specialists. In addition to the execution teams, the

[61] Shi, Zheng-Li, Hu, Ben, et. al., 'Genetic Mutation of SARS-CoV-2 during Consecutive Passages in Permissive Cells', *Virologica Sinica*, Vol. 26, 2021.
[62] Clarke, Ryan, 'The International Frontier of the CCP's Bioweapons Program Wuhan Institute of Virology, Chinese Academy of Medical Sciences, and the Pakistan Army's Defence Science and Technology Organization', The Klaxon, 14 April 2022.
https://static1.squarespace.com/static/5de08d699f40c13aa68de2ee/t/6257ac00eb8d8d7ccddc5eba/1649912833748/The+Emerging+Frontier+of+the+CCP+Bioweapons+Program+-+Dr+Ryan+Clarke.+14+April+2020.pdf

logistics of bioweapons material transportation, storage, and destruction is as critical as the initial site entry and physical removal component. These logistics capabilities would need to be configured around the specifics of the known high-risk pathogens that are stored on-site (i.e., SARS-CoV-2 viruses).

Mission Option 1 can utilize information operations to generate perceptions of outbreaks within key CCP bioweapons facilities to minimize the number of people on site and/or in the immediate vicinity at specific timings. During the most acute phases of the COVID-19 outbreak in China, both WIV and the HVRI were operating at severely reduced capacity with many staff working from home. However, staff deemed critical and PLA personnel remained on-site. In the case of WIV, Major General Chen Wei essentially temporarily took over the management of WIV in March 2020 before handing it back to the official leadership.[63] Given this precedent and demonstrated pattern of institutional behavior, it is likely possible to utilize targeted information operations to generate perceptions of an outbreak within a Chinese facility or facilities in question to minimize the number of staff on-site at a given time and to also increase the probability of direct interaction with strategic personnel who have remained on-site.

Mission Option 2 would not involve an overt American presence on the ground but would instead focus on the physical destruction and, through the generation of extreme temperatures, the destruction of hazardous biological materials. These effects can be achieved through conventional air strikes or missile strikes (sea- and/or ground-launched) or a combination of the two. After action damage assessment will be critical to evaluate the effectiveness of the operation and determine whether additional follow-up actions are required. Mission Option 2 would involve the physical destruction of key CCP bioweapons research facilities and any additional evidence that would be present inside the site in question.

Ordnance used in Mission Option 2 would need to generate temperatures that would eviscerate all known high-risk pathogens that are stored on site (i.e., Nipah viruses) with at least a 50% overshoot ratio in the event that bioweapons researchers have further modified viruses to make them more heat tolerant. Ordnance would also have 'bunker-busting' capability on the account that some (if not all) of the CCP bioweapons facilities may have subterranean structures underneath them.

Mission Option 3 would be driven by the capture of key CCP/PLA bioweapons personnel and eliminating these capabilities through a more controlled process that is driven by knowledge of the specifics of each site. However, Option 3 would still involve an American presence on the ground (and possibly in the air) as each site is being dismantled although this could take less overt forms. Mission Option 3 would likely be the most challenging but also has the potential to capture the most intelligence regarding the CCP's bioweapons program while also obtaining a high degree of confidence that the entire program has been destroyed. Aggressive mission planning could likely begin earlier than Mission Option 2 or 3 as some of those who have intricate knowledge of the CCP's bioweapons programs reside outside of China.

[63] Clarke, Ryan and Lam, Peng Er, 'Coronavirus Research Networks in China: Origins, International Linkages and Consequences', Centre for Non-Traditional Security Studies, May 2021, Singapore. https://rsis-ntsasia.org/wp-content/uploads/2021/06/NTS-Asia-Monograph-Coronavirus-Research-in-China-by-Ryan-Clarke-and-Lam-Peng-Er-May2021-1.pdf

Mission Option 3 planning can involve the sabotage of critical supply chains associated with bioweapons research via coordination with American and Allied Multinationals. While the purely scientific component of China's high-risk pathogen research apparatus has decoupled from the West, it remains dependent upon key Western multinationals to supply specialized laboratory equipment, machines, high-performance analytical software, and other critical inputs. As the CCP does not presently have any identifiable remedies for this dependency, there is an executable opportunity to directly target key supply chains that are enabling high-risk pathogen research within China. This can be executed on-shore via the domestic Chinese offices of Western multinationals.

Key options include, but are not limited to:

- Enabling remote access and control of supplied equipment to Chinese laboratories and other facilities that have a high probability of engaging in bioweapons development.
- Inserting performance issues into key equipment that has a high probability of engaging in bioweapons development. These performance issues would not produce nonlinearities or generate risks in experiments, but rather would prevent them from being conducted at the last minute.
- Manipulation of software to provide information that represents that a specific experimental or analytical function has been conducted and results generated when these actions have not in fact taken place

Another component of Mission Option 3 is the establishment of front-companies in Southeast/South Asian and Middle Eastern countries to operate as on-shore/in-region high-value distributors of technologies developed at WIV, HVRI, CAMS, AMMS, or other Chinese institutions and/or companies. As most of Southeast and South Asia as well as the Middle East lacks its own advanced biomedical sector, there has been strong growth in the establishment of local/regional distributors who seek to sell Chinese diagnostics, vaccines, therapeutics, prophylactics, medical/laboratory equipment, and other related products. Leading distributors are able to access the latest R&D pipeline coming out of China by making up-front bulk purchases. This model enables Chinese institutions and companies to generate additional sources of revenue and directly access a range of markets via local partners who de-risk the environment for them.

This ongoing trend presents an opportunity to establish distribution companies that focus specifically on 'next-generation' Chinese diagnostics, vaccines, and other capabilities that would provide a direct line of sight onto the leading bioengineering/GoF research being done within Chinese institutions and/or companies with clear applications for mission planning, precision targeting, and recruitment of CCP bioweapons personnel.

The unique selling point of a high-value distributor is the ability to rapidly identify key emergent outbreak zones through effective surveillance and dynamically route the relevant Chinese COVID-19 diagnostics (for example) to the location/s in question. This is accomplished through the innovative utilization of a distributor's existing COVID-19-specific production facilities and supply chains. The Chinese institute or company in question will 'layer' on top of this existing physical infrastructure with key datasets and other unique scientific assets and overall expertise and knowhow regarding optimal COVID-19 surveillance strategies and outbreak response protocols. Fundamentally, a high-value distributor has the ability to establish a strategic partnership focused on the development of

next-generation, low-cost and easy to administer COVID-19 diagnostics that take into account the full range and variation of current and potential future COVID-19 strains. Such companies can be established in key countries of interest.

A final component of Mission Option 3 planning is to facilitate and enable defections from locations via academic/industry conferences in perceived CCP-neutral countries. There is a widespread view within the CCP that Beijing is now the generator and distributor of best practices in the domain of biosecurity as opposed to its previous 'junior partner' status of consumer of best practices from the West. CCP information operations have effectively embedded the notion that China was the 'first in, first out' of the COVID-19 pandemic across Southeast Asia and the Middle East. These developments can be harnessed and repurposed to recruit and enable the defections of leading Chinese scientists who occupy various positions across the CCP's high-risk pathogen research apparatus.

Scientists from WIV and elsewhere have already begun to host conferences in China with digital international participation to share China's experiences in dealing with the COVID-19 pandemic. A natural progression of this trend is to host similar conferences that showcase Chinese 'leadership' and focus on 'joint capacity building' in countries that are considered friendly (or at least neutral) to the CCP. Countries such as Malaysia, Thailand, Indonesia, Burma, Sri Lanka, Bangladesh, Pakistan, the United Arab Emirates, and Saudi Arabia could all serve as potential sites for these conferences. Discrete travel arrangements can be kept on 'hot standby' to bring Chinese conference participants to the United States (or another location) on immediate notice.

Execution Pathway - Key Government Agencies and Use of Unconventional Assets

Mission Option 1

As Mission Option 1 involves a two-phase, ground-based forced building entry and occupation focus, US Army Special Operations Command would take the lead in terms of operational planning and execution. The initial entry team would need to be a combination of special forces operators, Army biodefense personnel (hazardous material management and transportation logistics), specialist civilian personnel with pathogen-specific expertise, and possibly intelligence community specialists who can augment the operation.

US Army Ranger Chalks would provide strongpoints in order to secure and control the immediate geography and execute deterrent patrols until the entry team has completed their Mission. Following the successful removal of all bioweapon materials and destruction of all related infrastructure at the site in question, the Ranger Chalks that have been on deterrent patrols will shift to building/s control and protection while fresh Ranger Chalks will be deployed to backfill them and carry out patrols. The experienced Rangers will transfer their local knowledge and tactical guidance to the newly deployed Rangers. The combined Ranger element will remain deployed on-site until a strategic determination is made that there is a zero probability of the specific site/s in question being reconstituted in any way.

Mission Option 2

As Mission Option 2 involves conventional air and/or missile strikes that require the physical destruction of buildings and potential subterranean structures, the US Air Force and its fleet of strategic bombers, missiles, and fighter jets would take the lead in target development and deploying the type of heavy ordnance required to achieve key Mission endpoints. US Air

Force operations can be augmented by the United States Navy, specifically through the use of missile strikes (submarine- and/or surface destroyer-based) to provide strikes to remove enemy air defense capabilities and/or provide follow-on strikes after an Air Force bombing run.

Mission Option 2 would require some specialist involvement, either from the Army, Intelligence Community, and/or other civilian personnel. However, these inputs would be more narrowly focused on ensuring that the air and/or missile strikes will eviscerate all biological weapons materials and render the site/s in question permanently destroyed with zero probability of reconstitution. There would be no effort to occupy the ground under Mission Option 2 and the exclusive focus would be on precision targeting (continuous if necessary) using US Air Force and possible US Navy assets.

Mission Option 3

Mission Option 3 would involve unconventional and clandestine operations originating outside of China in order to shape ground conditions in and around CCP bioweapons facilities. Given this mission focus, the Central Intelligence Agency would serve as the lead with strategic augmentation from the State Department, US Joint Special Operations Command, US Department of Commerce, and US Department of the Treasury. The primary focus of Mission Option 3 is to strategically encircle, steadily degrade, and subsequently assume direct control of CCP bioweapons sites through asymmetric means. While the US military would likely be involved in the critical execution phases towards the end of the process, civilian agencies possess many of the tools, technical knowhow, and export control capabilities to enable the effective execution of Mission Option 3 alongside the Central Intelligence Agency in the initial and middle phases of Mission Option 3.

However, it is essential that the Central Intelligence Agency and US Joint Special Forces Command closely coordinate activities. The nature of Mission Option 3 could involve rapidly emergent opportunities to take direct action against a critical node in the network of one or more of the CCP's bioweapons institutes. This could involve precision targeting a critical supply chain or facilitating the defection of a scientist from a third location. Mission Option 3 fundamentally requires that analytical/technical units of the Central Intelligence Agency to be in direct synchronization with civilian agencies such as the State Department, Treasury, or Commerce while the Central Intelligence Agency's operational units must also be ready to execute kinetically with US Joint Special Operations Command. While Mission Option 3 is the most multidimensional and complex, it is also the option that generates the highest probability of obtaining the most complete intelligence picture of the CCP's bioweapons program and ensuring its complete destruction in the event of a CCP regime collapse.

Net Assessment – Destruction is the Only Option

The CCP's bioweapons program has been consistently developed without interruption virtually since the founding of the PRC. The CCP has benefitted from and absorbed extensive international technical expertise in the domains of GoF, synthetic virus creation, and other high-risk pathogen research domains. This pattern is in stark contrast to the former Soviet Union's biological weapons program which was much more limited in terms of range of pathogens, was highly fragmented and clandestine, and did not benefit from knowledge transfer from the West. Over the course of the COVID-19 pandemic, the CCP has

demonstrated that is willing to sacrifice the lives of millions of innocent people in order to protect the regime and its own corrupt interests.

It is unlikely that the bioweapons institutes that have been assessed in this report can be repurposed and positioned as pure public health research organizations. Bioweapons development as a core institutional focus, direct engagement with the PLA, and decades of CCP control and conditioning likely render WIV, HVRI, ILAS (CAMS), IPB (CAMS), CML (IPB-CAMS), AMMS, and their local China CDC counterparts unreformable. Never before in human history has there been a biological weapons program such as the one that has been developed by the CCP. American precision targeting will drive its elimination as well as the continuous surveillance and follow-up actions that will prevent its reconstitution after the CCP collapses.