

**HIGH-RISK VIROLOGY RESEARCH AT  
THE CHINESE ACADEMY OF  
MEDICAL SCIENCES AND  
PEKING UNION MEDICAL COLLEGE**

Ryan CLARKE, LAM Peng Er & LIN Xiaoxu

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## **Executive Summary**

1. The Chinese Academy of Medical Sciences (CAMS) operates a full-spectrum, nationwide infrastructure of Biosafety Level 3 and 4 (BSL3/4) laboratories, hospitals and educational facilities. CAMS is one of China's largest and most strategically consequential networks that has not been adequately analysed.
2. CAMS merged with the Peking Union Medical College (PUMC) to operate as a single institution in 1957. CAMS-PUMC is under the National Health Commission, a cabinet-level executive department of the State Council which is responsible for formulating national health policies.
3. CAMS-PUMC leads a cluster of 19 medical institutes, including the Institute of Animal Laboratory Sciences in Beijing which engages in high-risk pathogen research using animal models to identify direct infection pathways to humans.
4. CAMS also runs the Institute of Medical Biology (IMB) with a BSL4 lab in Kunming, Yunnan province. The lab's flagship virology project, "Kunming National High-level Biosafety Research Centre for Non-Human Primates", serves as a national centre of excellence for the management and governance of high-security laboratories.
5. The IMB has developed a new COVID-19 vaccine that appears to be based on human and non-human primate samples. Its factory will produce between 500 million and one billion doses annually. It is at the vanguard of China's efforts to address the COVID-19 pandemic through mass vaccination.
6. Some Chinese scientists at IMB have been educated and trained in the United States. The IMB has collaborated in high-risk virology research with Dr James LeDuc, director of the Galveston BSL4 Lab, University of Texas Medical Branch. However, LeDuc's access to the IMB's BSL4 lab in Kunming was revoked in June/July 2019.

7. CAMS/PUMC is now a world leader in the development of synthetic viruses in the lab, including SARS-CoV-2 viruses. This marks a major development in that CAMS/PUMC has the independent capability to engineer a range of viruses for various applications after learning from the West.
  
8. The significance of CAMS and its institutes like the IMB is that they are rapidly developing China into a “great virology power”. In a COVID-19 global pandemic world and its aftermath, China is steadily emerging as a comprehensive great power with an independent ability to conduct cutting-edge virology research.

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## Historical Origins, Organisational Changes and Current Structure

- 1.1 The US-based Rockefeller Foundation formally established the Peking Union Medical College Hospital (PUMC) in 1917. Penang-born Dr Wu Lien-Teh, the first Nanyang Chinese to obtain a medical degree from Cambridge University, was deeply involved in the PUMC's early preparatory establishment. Wu, who was known for his role in ending the great Manchurian Plague of 1910-11, added credibility to the establishment.<sup>1</sup> With Wu serving as a founding father, virology research was in the "DNA" of the PUMC.
- 1.2 PUMC evolved over the Republican period, Japanese invasion, Chinese civil war, Great Leap Forward and Cultural Revolution. Notwithstanding the turbulent past century, PUMC maintained its top nationwide position and offered American-style medical education along the Johns Hopkins model with an eight-year Medical Degree programme.
- 1.3 Nevertheless, PUMC was not immune to the upheavals and disruptions in 20th century China. In 1951 the Chinese Communist Party (CCP) took over PUMC and nationalised it on the suspicion that PUMC was operating as a front for American "imperialism" in China. PUMC's name was changed to China Union Medical

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<sup>1</sup> Kevin Tan, 'The Plague Fighter: Dr Wu Lien-Teh and His Work', National Library, Singapore, 1 July 2020. <https://biblioasia.nlb.gov.sg/vol-16/issue-2/jul-sep-2020/plague>, accessed 16 February 2022. Yu-lin Wu, *Memories of Dr. Wu Lien-teh, Plague Fighter*, World Scientific, 1995.

College. While the PUMC's overall medical curriculum was maintained, its medium of instruction was changed from English to Chinese.

- 1.4 The People's Liberation Army (PLA) assumed control of the PUMC in 1952 until 1956. During this time, the PLA reduced the duration of medical education to one year for those who aspired to become a medical officer in the Army.<sup>2</sup>
- 1.5 After regaining its autonomy in 1956 and its PUMC name restored, it merged with the Chinese Academy of Medical Sciences (CAMS) in 1957 and has operated as a single institution since. During the Cultural Revolution (1966-1976), PUMC was shuttered and renamed the Beijing Anti-Imperialism Hospital. In 1979, the institution reopened but under the name of Capital University of Medical Sciences before its original PUMC name was finally restored in 1985.<sup>3</sup>
- 1.6 This restoration of the PUMC name was interpreted by some at the time as being a core component of Beijing's re-engagement with the West in the domain of biomedical sciences.<sup>4</sup> Despite the name change, the Chinese government has maintained its direct control of PUMC, especially in high-risk pathogen research.
- 1.7 Presently, CAMS-PUMC operates a full-spectrum, nationwide infrastructure of laboratories, including Biosafety Level 3 and 4 (BSL3/4),<sup>5</sup> hospitals and educational facilities. CAMS is under the National Health Commission, a cabinet-level executive department of the State Council responsible for formulating national health policies.

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<sup>2</sup> Mary Augusta Brazelton, 'Western Medical Education on Trial: The Endurance of Peking Union Medical College, 1949–1985'. *Twentieth-Century China*, Vol. 40, Issue 2, 2015, pp. 126–145.

<sup>3</sup> Ibid.

<sup>4</sup> 'Peking Hospital Takes Back Pre-1949 Name', *New York Times*, 9 June 1985. <https://www.nytimes.com/1985/06/09/world/peking-hospital-takes-back-pre-1949-name.html>, accessed 16 February 2022.

<sup>5</sup> 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.

- 1.8 Many top PUMC alumni and PUMC professors were trained in the West in the past century. Although these linkages were temporarily severed during the Mao era, they were re-established during Deng's reform and opening. Some prominent doctors and scientists of PUMC were Wu Jieping: University of Chicago,<sup>6</sup> Huang Jiasi: University of Michigan,<sup>7</sup> Zhan Qimin: University of California (San Francisco), University of Texas, SW Medical Centre, University of Pittsburgh School of Medicine,<sup>8</sup> Tang Fei Fan: Yale and Harvard,<sup>9</sup> Xin Lu: Oxford,<sup>10</sup> Feng Chuanhan: orthopaedics training in the United Kingdom<sup>11</sup> and Lin Qiaozhi: Chicago Medical School.<sup>12</sup>
- 1.9 Current CAMS president, Dr Wang Chen, graduated from the Capital University of Medical Sciences, University of Texas.<sup>13</sup> The transnational links between CAMS-PUMC and the West past and present are evidenced by the many eminent PUMC alumni and professors trained abroad.
- 1.10 CAMS/PUMC not only conducts research, provides clinical care and performs clinical trials, it also advises the Chinese government on public health policy and serves a frontline function in the event of public health emergencies. For example,

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<sup>6</sup> 'An Introduction of Wu Jieping Fellow', Wu Jieping Medical Foundation, <https://www.wjpmf.org.cn/aboutwjpmf.html>, accessed 15 February 2022.

<sup>7</sup> 'U-M Chinese Alumni – Huang Jiasi', University of Michigan, <https://sites.lsa.umich.edu/chinese-alumni/huang-jiasi-%E9%BB%84%E5%AE%B6%E9%A9%B7/>, accessed 16 February 2022.

<sup>8</sup> 'ZHAN Qimin', Shenzhen Bay Laboratory, <http://www.szbl.ac.cn/en/scientificresearch/researchteam/371.html>, accessed 16 February 2022.

<sup>9</sup> 'Dr. Tang Fei-fan: The 'Louis Pasteur' of the East', Nspirement, <https://www.nspirement.com/2016/12/02/dr-tang-fei-fan-the-louis-pasteur-of-the-east.html>, accessed 16 February 2022.

<sup>10</sup> 'Xin Lu', Chinese Academy of Medical Sciences Oxford Institute, <https://www.camsoxford.ox.ac.uk/team/xin-lu>, accessed 16 February 2022.

<sup>11</sup> 'Awardee of Medical Sciences and Materia Medica Prize: Feng Chuanhan', Holeung Ho Lee Foundation, <http://www.hlhl.org.cn/english/showsub.asp?id=414>, accessed 16 February 2022.

<sup>12</sup> Guowei Wright, 'Lin Qiaozhi: The Steady Pulse of a Quiet Faith' in Carol Lee Hamrin, ed., with Stacey Bieler, *Salt and Light: Lives of Faith that Shaped Modern China* (Eugene, OR., Wipf and Stock Publishers, Pickwick Publications, 2008).

<sup>13</sup> 'Profile Chen Wang: new President of CAMS and PUMC', *The Lancet*, Vol. 391, 16 June 2018.

PUMC sent multiple technical assistance teams to Wuhan over the course of the COVID-19 outbreak in the city.<sup>14</sup>

- 1.11 CAMS has 19 research institutes, six hospitals and eight schools under its umbrella. Its expert team comprises 24 members from the Chinese Academy of Sciences and Chinese Academy of Engineering, 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.<sup>15</sup>
- 1.12 Within the field of virology at CAMS, the Institute of Medical Biology (Kunming), Institute of Medicinal Biotechnology (Beijing), Institute of Animal Laboratory Sciences (Beijing), Institute of Pathogen Biology (Beijing)<sup>16</sup> and Christophe Merieux Lab (part of the Institute of Pathogen Biology in Beijing) are significant.
- 1.13 The Institute of Animal Laboratory Sciences in particular engages in high-risk pathogen research using animal models, such as humanised mice, ferrets and non-human primates, to identify direct infection pathways to humans.<sup>17</sup>

### **How Does CAMS/PUMC Operate? – Structures and Principles**

- 2.1 CAMS/PUMC operates along an American-style biomedical research and hospital network system with interlinking research institutes, laboratories, clinical facilities,

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<sup>14</sup> Tang Bo, 'Coronavirus Pandemic: Last assisting medical team leaves Wuhan', CGTN, 16 April 2020. <https://news.cgtn.com/news/34497a4e78514464776c6d636a4e6e62684a4856/index.html>, accessed 4 February 2022.

<sup>15</sup> 'Chinese Academy of Medical Sciences and Peking Union Medical College are seeking global talents', NatureCareers, 2022. <https://www.nature.com/naturecareers/employer/79137>, accessed 3 February 2022. Please see Appendix One for the full organisational diagram.

<sup>16</sup> The Institute of Pathogen Biology (IPB) was established in 2006. IPB and other Chinese institutes and laboratories will be researched and assessed in future work.

<sup>17</sup> Interview with former senior biodefence officer, Washington DC, 23 December 2021.

medical education and technology commercialisation operations that are designed to be mutually reinforcing and beneficial across the entire network.

- 2.2 For example, specific Principal Investigators (PIs) within a specialised lab/s will be tasked with analysing samples and providing technical opinions on complex patient cases coming from clinical care. They may also be asked to develop new technologies to address these complex challenges, be it in the form of new drugs, diagnostic tests, vaccines, prophylactics, or bioinformatics software.
- 2.3 As part of these activities, CAMS/PUMC PIs will interact with and seek inputs or guidance from international collaborators who work in a similar domain area, especially in the United States and Europe. These activities are designed to enhance clinical activities and position CAMS as a world leader in both patient care, scientific knowledge generation and biomedical technology development.<sup>18</sup>
- 2.4 In addition, non-clinician scientists are enabled to be deeply embedded in the flow of clinical activities and to configure their own respective scientific research agendas around current and emerging clinical priorities within the CAMS/PUMC system. Under a CAMS-style system, virtually all research is applied and directly linked to clinical priorities and other national priorities set by the Chinese government. ‘Blue sky’, or more open-ended research without clearly pre-determined required outcomes, is largely absent within the CAMS system.
- 2.5 While the basic structure of CAMS/PUMC resembles an American-style system, material differences have emerged over time. First, like other leading biomedical research institutes in China, all members of the CAMS/PUMC leadership team and leading clinicians and scientists are strongly encouraged, if not outright required, to be CCP members and carry out party work in addition to their clinical/scientific work.<sup>19</sup> While Chinese government control over CAMS/PUMC is usual under

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<sup>18</sup> In the domain of biotechnology development, CAMS has extensive industry linkages, institutional holdings in various companies and a track record of commercialising research. In-depth research and analysis of these activities will be provided in future work.

<sup>19</sup> Ryan Clarke and Lam Peng Er, ‘Coronavirus Research Networks in China: Origins, International Linkages and Consequences’, Centre for Non-Traditional Security Studies, May 2020, 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>, accessed 9 February 2022



China's system of governance, this marks a substantial divergence from counterparts in other countries.

- 2.6 Second, under China's Civil-Military Fusion Law, there is a possibility that CAMS/PUMC can be repurposed and directly controlled by the Chinese government under specific contingencies, including lab accidents.<sup>20</sup> The Civil-Military Fusion Law is an overarching legal framework within which CAMS/PUMC must operate.
- 2.7 Third, international scientific collaborations appear to be more tenuous and vulnerable to immediate disruption due to external non-scientific factors, especially in more strategically sensitive fields. This is evidenced by the email conversations between Dr James LeDuc and his counterparts at Galveston/UTMB and the National Academy of Sciences (NAS) regarding their access to the BSL4 lab in Kunming being denied "due to the current US-China situation" and a new CCP Party secretary "recently arriving" in June/July 2019. These developments appear to have surprised LeDuc as these respective teams had been jointly engaging in scientific publications and conferences without any apparent issues.<sup>21</sup>
- 2.8 There was no specificity or rationale provided nor were there any timelines or conditions for BSL4 lab access being granted. This was also in spite of LeDuc and

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<sup>20</sup> Ibid. For additional analysis of the Civil-Military Fusion Law, please see 'Alibaba and Ant Group: Involvement in China's Military-Civilian Fusion Initiative', RWR Advisory Group, 2 October 2020. <https://www.rwradvisory.com/wp-content/uploads/2020/10/RWR-Report-Ant-MilCiv-Fusion-10-2020.pdf>, accessed 9 February 2022.

For a more in-depth discussion, please see Ryan Clarke, 'Emerging Global Pandemic Risks Come from Engineered Viruses in Chinese Labs, Not the Jungle or Bat Caves', *Epoch Times*, 4 September 2021. [https://www.theepochtimes.com/emerging-pandemic-risks-come-from-engineered-viruses-in-chinese-labs-not-the-jungle-or-bat-caves\\_3980204.html](https://www.theepochtimes.com/emerging-pandemic-risks-come-from-engineered-viruses-in-chinese-labs-not-the-jungle-or-bat-caves_3980204.html), accessed 9 February 2022.

<sup>21</sup> These email conversations were legally obtained via a Freedom of Information Request made by US Right to Know Executive Director Gary Ruskin and shared with Ryan Clarke. Additional documentation is available upon request.

For example, please see Pei-Yong Shi, 'Spike mutation D614G alters SARS-CoV-2 fitness', *Nature*, Vol. 592, 2021.

Qi Chen et al., 'Treatment of Human Glioblastoma with a Live Attenuated Zika Virus Vaccine Candidate', *mBio*, Vol. 9, Issue 5, 2018.

'CAS-NAS Workshop on Emerging Infections and Global Health Security Held', Beijing Institutes of Life Sciences, Chinese Academy of Sciences, 1 October 2015. [http://english.biols.cas.cn/news/news/201701/t20170109\\_173250.html](http://english.biols.cas.cn/news/news/201701/t20170109_173250.html), accessed 11 February 2022.

his colleagues jointly organising a lab safety and global health security conference with the Institute of Medical Sciences, CAMS in Kunming, Yunnan province.<sup>22</sup>

- 2.9 Last but not least, China’s National Security Law poses major challenges to international data sharing, especially in the field of virology. It is unclear whether researchers at CAMS/PUMC are able to freely share data and other related information regarding pathogens that have been recently discovered or are being analysed within CAMS/PUMC on a priority basis due to perceived acute public health risks.
- 2.10 Notably, Chinese companies are often expressly forbidden from ‘exporting’ even basic financial statements outside of China to foreign auditors, regulators, potential investors, or even existing shareholders. This even includes Chinese companies that are publicly listed on American or British stock exchanges.<sup>23</sup> While this example derives from a different domain, it nonetheless can be used to possibly infer how the Chinese government, which exerts direct control over CAMS/PUMC, would likely view international data sharing in the domains of virology research.

### **IMB: SARS-CoV-2 Vaccine Developer in Kunming**

- 3.1 IMB was established in 1958 and occupies a prominent position within the CAMS network. The institute houses a WHO Collaborating Centre of Enteroviruses and is the largest research and production base for live attenuated oral poliomyelitis vaccine (OPV) in China. The IMB is constructing a national key project, titled ‘Kunming National High-level Biosafety Research Centre for Non-Human

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<sup>22</sup> These email conversations were voluntarily shared with Ryan Clarke by Gary Ruskin.

<sup>23</sup> This assessment is based on Ryan Clarke’s direct experience covering the Chinese market during his time in the investment banking sector.

For additional analysis, please see ‘The Risk Exposure of U.S. Investors Holding Chinese Sovereign Bonds’, RWR Advisory Group, 28 October 2020. <https://www.rwradvisory.com/wp-content/uploads/2020/11/RWR-China-Sovereign-Bond-Report.pdf>, accessed 9 February 2022.

‘President’s Working Group on Financial Markets: Report on Protecting United States Investors from Significant Risks from Chinese Companies’, US Department of Treasury, 24 July 2020. <https://home.treasury.gov/system/files/136/PWG-Report-on-Protecting-United-States-Investors-from-Significant-Risks-from-Chinese-Companies.pdf>, accessed 9 February 2022.

Primates’.<sup>24</sup> This institute has also received funding from the Gates Foundation for research on polio vaccines.<sup>25</sup>

3.2 Approved by the National Development and Reform Commission (NDRC), this IMB initiative will become a critical fundamental research platform for discovering, monitoring, controlling and preventing infectious diseases in China. The IMB will serve as a national centre of excellence for high-level biosafety research lab (BSL3/4) governance and operations thereby enabling key studies in etiology,<sup>26</sup> epidemiology and pathogenesis of infectious diseases.<sup>27</sup>

3.3 Figure 1 shows IMB facility size and number of research staff. See Appendix 2 for a full organisational diagram.

**FIGURE 1 KEY IMB RESEARCH STAFF AND THEIR TRANSNATIONAL LINKAGES<sup>28</sup>**

Research Groups Listed	Head	Estimated Number of Staff	Is Group/Lab Head Western-Educated	If Yes, Which Institutions?
Central Lab	Yu Jiankun	16	Yes	University of Manitoba (Postdoc)
Vaccine Lab	Hu Yunzhang	13	No	N/A
Centre of Drug Safety Evaluation	Ma Kaili	8	No	N/A
Small Animal Trial Centre	Tang Donghong	14	No	N/A
Team of Primate Animal Experimental Models	He Zhanlong	10	No	N/A
Biological Product Room 5	Liao Guoyang	10	No	N/A

<sup>24</sup> For example, see ‘About Us, Institute of Medical Biology – Chinese Academy of Medical Sciences’, <https://www.imbcams.ac.cn/en/aboutus>, accessed 21 January 2022.

‘Homepage, Institute of Medical Biology – Chinese Academy of Medical Sciences’, <https://www.imbcams.ac.cn/en>, accessed 21 January 2022.

<sup>25</sup> ‘Committed Grants: Institute of Medical Biology, Chinese Academy of Medical Sciences’, Bill and Melinda Gates Foundation, November 2015 and April 2012. <https://www.gatesfoundation.org/about/committed-grants/2015/11/opp1130833> and <https://www.gatesfoundation.org/about/committed-grants/2012/04/opp1049425>, both accessed 21 January 2022.

<sup>26</sup> Etiology is the study of animal behaviour.

<sup>27</sup> For example, please see ‘About Us, Institute of Medical Biology – Chinese Academy of Medical Sciences’.

<sup>28</sup> ‘科学研究’, Institute of Medical Biology, <https://www.imbcams.ac.cn/kxyj/kydw>, accessed 15 February 2022.

Molecular Epidemiology Lab	Sun Qiangming	10	Yes	University of Maryland, College Park (Postdoc)
Molecular Immunity Lab	Ma Yanbing	14	Yes	University of Manitoba (Postdoc)
Virus Immunity Lab	Li Qihan	23	Yes	Massachusetts Institute of Technology (Postdoc)
Medical Genetics Lab	Yang Shaoqing	20	Yes	University of Birmingham and George Washington University
Biological Product Room 3	Cun Wei	11	Yes	University of Kentucky
Vaccine Diagnostic Technology Team	Xie Zhongping	7	No	N/A

Source: IMB website.

3.4 In June 2021 it was officially announced that the Chinese government had reportedly begun constructing a new SARS-CoV-2 vaccine factory that could produce between 500 million and one billion doses per year. The new vaccine development, called the IMBCAMS SARS-CoV-2 Vaccine, was credited to IMB. This vaccine was developed using human and non-human primate samples as opposed to the mRNA vaccines developed by Western companies that utilise synthetic genetic material.<sup>29</sup>

3.5 For a SARS-CoV-2 vaccine to clear Chinese patient safety and efficacy standards, IMB would have to conduct a large-scale exercise that involves (at least) accessing SARS-CoV-2 viral samples from across China, designing and executing clinical trials and structuring modalities for technology transfer for industrial-scale production. This information was not available from public sources.

<sup>29</sup> 'China builds new plant for IMBCAMS COVID-19 vaccine -state media', Reuters, 9 June 2021. <https://www.reuters.com/world/asia-pacific/china-builds-new-plant-imbcams-covid-19-vaccine-state-media-2021-06-09/>, accessed 21 January 2022

'COVID-19 vaccine reaches phase-2 trials in China', *Xinhua*, 22 June 2020. [http://english.nmpa.gov.cn/2020-06/22/c\\_502093.htm](http://english.nmpa.gov.cn/2020-06/22/c_502093.htm), accessed 21 January 2022.

'New Vaccine Industrial Base Project in Kunming High-tech Industrial Development Zone', Yunnan Investment Promotion, 21 January 2022. <https://invest.yn.gov.cn/ENArticleInfo.aspx?id=19069>, accessed 21 January 2022

For additional information on the methods used to develop the IBMCAMS vaccine, please see Heng Li, et. al., 'Self-Assembling Nanoparticle Vaccines Displaying the Receptor Binding Domain of SARS-CoV-2 Elicit Robust Protective Immune Responses in Rhesus Monkeys', *Bioconjugate Chemistry*, Vol. 32, 2021.

Qianhui Wu, et. al, 'Evaluation of the safety profile of COVID-19 vaccines: a rapid review', *BMC Medicine*, Vol. 19, Issue 173, 2021.

## **Galveston National Laboratory/UTMB: From American BSL4 Capacity Builder and Gain of Function (GoF)<sup>30</sup> Research Partner to Abrupt Access Denial in Kunming**

- 4.1 Recent legally obtained email communications between Dr James LeDuc at UTMB in 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.<sup>31</sup> Previously, many analysts assumed that China only had two BSL4 labs, one at the Wuhan Institute of Virology and the other at the Harbin Veterinary Research Institute (HVRI).
- 4.2 The point person between the Galveston lab and CAMS was Dr Shi Pei-Yong. Shi 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.<sup>32</sup> This may have represented a common interest with his counterparts in Kunming.
- 4.3 Shi has also worked extensively with the PLA's Academy of Military Medical Sciences (AMMS) and CAMS/PUMC on other infectious disease projects that involve the manipulation of viruses, such as chimeric Zika vaccine development and Zika GoF studies using mouse models.
- 4.4 One of Shi's key collaborators, Qi Chen, is the director of the Virology Lab at the Institute of Microbiology and Epidemiology (AMMS).<sup>33</sup> Despite these well-

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<sup>30</sup> GoF experiments are a controversial domain within biomedical science, defence 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.

<sup>31</sup> These email conversations were voluntarily shared with Ryan Clarke by Gary Ruskin. 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.

<sup>32</sup> For example, please see Pei-Yong Shi, 'Spike mutation D614G alters SARS-CoV-2 fitness'.

<sup>33</sup> 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.

established linkages, the UTMB team was shut out of the BSL4 lab in Kunming that they helped develop.

- 4.5 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<sup>34</sup> in neonatal mice and produced higher viral loads in the placenta and fetal heads in pregnant mice.
- 4.6 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 the reverse genetics techniques that had been used in the studies identified in Section 4.3.<sup>35</sup>
- 4.7 In addition to the conference discussion in Section 2, UTMB played a key technical role in the Chinese Academy of Sciences - National Academy of Sciences Workshop on the Challenges of Emerging Infections, Laboratory Safety and Global Health Security in October 2015.<sup>36</sup> LeDuc and the UTMB team also provided lab biosafety training to IMB staff working in BSL3 labs (which are also GoF-capable) and advised on biocontainment engineering.<sup>37</sup>

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<sup>34</sup> Neurovirulence refers to infection of the brain.

<sup>35</sup> 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.

<sup>36</sup> 'CAS-NAS Workshop on Emerging Infections and Global Health Security Held', Beijing Institutes of Life Sciences. [http://english.biols.cas.cn/news/news/201701/t20170109\\_173250.html](http://english.biols.cas.cn/news/news/201701/t20170109_173250.html), accessed 24 January 2022.

<sup>37</sup> James LeDuc and Thomas Ksiazek, National Biocontainment Training Centre, Annual Report, Grant Number: W81XWH-09-2-0053, US Army Medical Research and Materiel Command, Fort Detrick, Maryland 21702-5012, June 2014. <https://careersdocbox.com/87871061-Nursing/Prepared-for-u-s-army-medical-research-and-materiel-command-fort-detrick-maryland.html>, accessed 16 February 2022.

- 4.8 LeDuc viewed these activities as a major contribution to the Chinese BSL4 scientific ecosystem and utilised the example to support grant applications for additional funding for international BSL4 training and capacity building programmes.
- 4.9 In one such example, in October 2016 LeDuc obtained a grant from the US Army Medical Research and Materiel Command in Fort Detrick, Maryland to establish the National Biocontainment Training Centre for the primary purpose of providing international BSL4-related training, funding and capacity building.<sup>38</sup> It is unclear whether any US funding obtained by LeDuc has flowed to joint research with IMB. However, LeDuc did provide direct BSL4 management training to IMB staff in 2017.<sup>39</sup>
- 4.10 There has also been additional joint training between IMB and UTMB. In September 2014, Dr Curtis Klages (a veterinarian UTMB) and Miguel Grimaldo (also from UTMB) were invited to review the animal facilities at IMB in Kunming and advise on BSL4 technical specifications and performance requirements. They were also asked to provide training on laboratory management, facility operations and facility personnel training.<sup>40</sup>
- 4.11 Collaborations continued throughout 2014 with a focus on the specialised maintenance needs of high containment laboratories. IMB staff members from Kunming also travelled to UTMB in January 2015 for specialised engineering training.<sup>41</sup>
- 4.12 In 2013, Dr Liu Longding and Dai Qing travelled to UTMB to participate in an intensive two-week biocontainment engineering fellowship. Liu and Dai worked

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<sup>38</sup> James LeDuc, National Biocontainment Training Centre, Award Number: W81XWH-11-2-0148, US Army Medical Research and Materiel Command, Fort Detrick, Maryland 21702-5012, October 2016. <https://apps.dtic.mil/sti/pdfs/AD1022067.pdf>, accessed 16 February 2022.

<sup>39</sup> ‘Galveston National Lab Director LeDuc Provided Early Contact Between the NIAID and the Wuhan Lab; Fauci Invited by LeDuc to “Informal Discussions” with a Dozen Senior Chinese Scientists’, Mining Awareness, 24 October 2021. <https://miningawareness.wordpress.com/2021/10/24/galveston-national-lab-director-leduc-provided-early-contact-between-the-niaid-and-the-wuhan-lab-fauci-invited-by-leduc-to-informal-discussions-with-a-dozen-senior-chinese-scientist/>, accessed 16 February 2022.

<sup>40</sup> James LeDuc, National Biocontainment Training Centre, Award Number: W81XWH-11-2-0148.

<sup>41</sup> Ibid.

with UTMB biocontainment engineers to focus on critical components of facility operation and management. This was in preparation for the opening of the IMB BSL4 laboratory that was still under construction in Kunming at the time.<sup>42</sup>

4.13 The training programme was customised to the needs of Liu and Dai and included:

- Laboratory Facilities and Primary Containment Requirements;
- Primary Containment Equipment;
- Filtration Systems;
- Liquid and Solid Waste Decontamination;
- Mechanical Systems - Ventilation and Controls;
- Laboratory Facility Adjustment and Testing;
- Decontamination Methodologies and Procedures;
- BSL4 Specialised Equipment and Other Laboratory Equipment;
- BSL4 Suits - Setup, Maintenance and Usage;
- Annual Maintenance Shutdowns and Record Keeping; and
- Special Topics on Biocontainment Operation<sup>43</sup>

4.14 UTMB's collaboration with the IMB continued throughout 2013 when Dr Shi Jiandong and Dr Guo Lei participated in BSL-2 and BSL-3 training at the National Biocontainment Training Centre at UTMB. This training was also provided in preparation for the opening of the new biocontainment laboratory that was nearing completion in Kunming.<sup>44</sup>

### **Engineering Synthetic, Replicative SARS-CoV-2 Viruses at PUMC and the Christophe Merieux Laboratory**

5.1 While most of the daily flow of clinical, laboratory, research and educational activities within the CAMS/PUMC system can be classified as standard, there are arguably high-risk research being conducted, some of which with international cooperation.

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<sup>42</sup> Ibid.

<sup>43</sup> Ibid.

<sup>44</sup> Ibid.



- 5.2 In October 2021, researchers from the CAMS/PUMC-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’, with the logic that experimentation on this synthetic virus would more fully inform treatment options.<sup>45</sup> 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.<sup>46</sup>
- 5.3 While this work can clearly be classified as high-risk, the synthetic development of SARS viruses in laboratory settings is not unprecedented. This work on SARS-CoV-2 shares substantial similarities with some of the work that was done by Ralph Baric in 2002 when he was developing synthetic SARS-CoV-1 viruses in his lab at UNC - Chapel Hill. Baric filed US Patent Number US 7,279,327 B2 on 19 April 2002. The first case of the SARS-CoV-1 outbreak in China was in Guangdong province in November 2002.<sup>47</sup>
- 5.4 The April 2002 US patent describes the bioengineering work as producing an infectious, replication-defective coronavirus that was specifically targeted for human lung epithelium – a literal description of SARS-CoV-1. This patent lays out the fact that these researchers knew that the ACE receptor, ACE2 binding domain, the S1 spike protein and other elements could be synthetically modified in laboratory settings. This could be done using existing gene sequencing technologies (even back in 2002) to utilise computer code to turn this genetic sequence into a pathogen or an intermediate host of a pathogen.<sup>48</sup>

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<sup>45</sup> Bei Wang, Chongyang Zhang, Xiaobo Lei, Lili Ren, Zhendong Zhao and He Huang, ‘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/>, accessed 9 March 2022.

<sup>46</sup> Ibid.

<sup>47</sup> Ryan Clarke, ‘Emerging Global Pandemic Risks Come from Engineered Viruses in Chinese Labs, Not the Jungle or Bat Caves’. [https://www.theepochtimes.com/emerging-pandemic-risks-come-from-engineered-viruses-in-chinese-labs-not-the-jungle-or-bat-caves\\_3980204.html](https://www.theepochtimes.com/emerging-pandemic-risks-come-from-engineered-viruses-in-chinese-labs-not-the-jungle-or-bat-caves_3980204.html), accessed 9 March 2022.

Please also see Kristopher Curtis, Boyd Yount and Ralph Baric, United States Patent, Patent No: US 7,279,327 B2, Date of Application: 19 April 2002, Date of Patent Grant: 9 October 2007. <https://patentimages.storage.googleapis.com/a8/c0/6a/0584dd67435ef2/US7279327.pdf>, accessed 9 March 2022.

<sup>48</sup> Ibid.

- 5.5 This 2021 study conducted by PUMC and the Christophe Merieux Laboratory appears to have replicated the methods initially developed by Baric and may have also advanced them further by achieving synthetic viral replication.
- 5.6 The Christophe Merieux Laboratory was founded by the Merieux Family Foundation and gifted to CAMS/PUMC. The lab is formally part of the Institute of Pathogen Biology at CAMS and seeks to identify ‘emerging and infectious pathogens and conducts research on the etiology and epidemiology of acute viral respiratory infections’. In addition, the lab states that its primary ‘goal is to identify the viral and bacterial agents responsible for severe pneumonia in children under the age of five’.<sup>49</sup> Given this self-declared pediatric mission, it is unclear why this lab would be engineering synthetic SARS-CoV-2 viruses.
- 5.7 The Christophe Merieux Laboratory is also part of the GABRIEL Network of over 70 international scientists conducting joint research, education and training programmes. The GABRIEL network has three official objectives:
- to publish and share the expertise, tools and knowledge required for advanced applied research in emerging countries, particularly in the field of pathogenic agent identification and monitoring;
  - to conduct international, collaborative epidemiological studies in conjunction with people working in local healthcare and biomedical research and/or private partners; and
  - to help improve public health policies by introducing surveillance studies, and generating reliable and accurate epidemiological data.<sup>50</sup>
- 5.8 It is also unclear as to how this October 2021 study corresponds to or forwards any of these declared objectives.

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<sup>49</sup> ‘Christophe Merieux Laboratory’, Merieux Foundation. <https://www.fondation-merieux.org/en/what-we-do/enhancing-research-capabilities/research-laboratories/christophe-merieux-laboratories/>, accessed 9 February 2022.

<sup>50</sup> ‘GABRIEL Network, Merieux Foundation, <https://www.fondation-merieux.org/en/what-we-do/enhancing-research-capabilities/gabriel-network/>, accessed 9 February 2022

## Serial Passaging GoF Experiments on SARS-CoV-2 in Mice: A National Exercise with the PLA, CAMS/PUMC and the Beijing Institute of Lifeomics

- 6.1 In September 2020, He Yuxian from CAMS/PUMC and a joint team of researchers from the PLA's Academy of Military Medical Sciences, Beijing Institute of Lifeomics, and Institute of Military Cognition and Brain Sciences 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.<sup>51</sup>
- 6.2 Serial passaging involves continuously selecting for the most infectious viral strains, isolating them, and then combing 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.
- 6.3 Notably, none of the most effective SARS-CoV-2 vaccines produced globally have been developed through 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.
- 6.4 The CAMS/PUMC study suggests that GoF, methods that were being used at WIV<sup>52</sup> on bat coronaviruses continue to be used at CAMS, the Academy of Military Medical Sciences, Institute of Military Cognition and Brain Sciences and the Beijing Institute of Lifeomics.

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<sup>51</sup> 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/>, accessed 10 March 2022.

<sup>52</sup> 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.

## **CAMS/PUMC Researchers Create a Non-Human Primate Host for Previously Low-Risk Middle Eastern Respiratory Syndrome (MERS) with Dutch Assistance**

- 7.1 The MERS virus that emerged from Saudi Arabia's Eastern Province in 2012 generated modest outbreak clusters across the Middle East and limited clusters in Southeast and South Asia. As the MERS virus was not well adapted for continuous human-to-human transmission, its pandemic potential remained limited and, at present, does not represent a major international security risk. Critically, even during the early stages of the outbreak, Dromedary Camels were identified as the key intermediary animal species between bats (MERS is a bat-borne virus) and humans, which enabled controls and preventative measures to be put in place.<sup>53</sup>
- 7.2 MERS represents a well-understood virus that has effective surveillance and control programmes covering it. This is evidenced by the lack of any additional outbreaks of this specific bat-borne coronavirus in recent years. Despite the stable situation, a group of CAMS/PUMC researchers infected non-human primates with the MERS coronavirus in a study in 2014.
- 7.3 In the 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/PUMC set out to determine whether monkey models were effective to study the pathogenesis of MERS infections.
- 7.4 In this CAMS/PUMC study, the research team sourced its MERS samples from Fouchier in Erasmus and utilised 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 neutralising antibody production. They also reported that they could confirm that the monkey model supports viral growth, and manifests respiratory and generalised illness along with tissue pathology. These CAMS/PUMC researchers

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<sup>53</sup> For example, please see Chantal B E M Reusken, et. al., 'Middle East respiratory syndrome coronavirus neutralising serum antibodies in dromedary camels: a comparative serological study', *Lancet Infectious Diseases*, Vol. 13, No. 10, October 2013. [https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(13\)70164-6/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(13)70164-6/fulltext), accessed 10 March 2022.

N Nowotny and J Kolodziejek, 'Middle East respiratory syndrome coronavirus (MERS-CoV) in dromedary camels, Oman, 2013', *Euro Surveillance*, Vol. 19, No. 16, 24 April 2014. <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES2014.19.16.20781>, accessed 10 March 2022.

claim to have conducted similar experiments on mouse, ferret and guinea pig models but decided not to publish the data.<sup>54</sup>

7.5 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<sup>55</sup> in that both have engineered avian influenza (H7N9 and H5N1) viruses that could transmit between ferrets via droplets.<sup>56</sup> However, while Fouchier's research was criticised and has periodically ceased under EU regulations related to weapons of mass destruction, Bao's research has continued with no apparent restrictions.

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<sup>54</sup> 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.

<sup>55</sup> 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).

Martin Enserink, '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>, accessed 10 March 2022.

<sup>56</sup> For example, please see Linlin Bao, 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.

Linlin Bao, et. al., 'Transmission of H7N9 influenza virus in mice by different infective routes', *Virology Journal*, Vol. 11, Article No. 185, 2014.

Ron Fouchier, et. al., 'Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets'.

Ron Fouchier et. al., 'Gain-of-Function Experiments on H7N9', *Science*, 3 August 2013. <https://www.science.org/doi/full/10.1126/science.1243325>, accessed 10 March 2022.

Ron Fouchier, et. al., 'The Potential for Respiratory Droplet-Transmissible A/H5N1 Influenza Virus to Evolve in a Mammalian Host'.

Martin Enserink, '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>, accessed 10 March 2022.

Robert Roos, 'Fouchier study reveals changes enabling airborne spread of H5N1', Centre for Infectious Disease Research and Policy, University of Minnesota, 21 June 2012. <https://www.cidrap.umn.edu/news-perspective/2012/06/fouchier-study-reveals-changes-enabling-airborne-spread-h5n1>, accessed 10 March 2022.

Jocelyn Kaiser, 'EXCLUSIVE: Controversial experiments that could make bird flu more risky poised to resume: 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>, accessed 10 March 2022.

Martin Enserink, '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>, accessed 10 March 2022.

## Chinese Academy of Medical Sciences Oxford Institute (COI) – A Model of Governance

- 8.1 COI is a joint biomedical research and educational institute between CAMS/PUMC and the Nuffield Department of Medicine at Oxford University. In addition to Oxford, Nuffield runs the Mahidol Oxford Tropical Medicine Research Unit (MORU) in Bangkok with clinical facilities field sites across Thailand, Myanmar, Laos, Cambodia, Vietnam, Indonesia, Bangladesh and India.<sup>57</sup>
- 8.2 While COI and MORU are two officially separate organisations, they are organised under Nuffield. Traditionally, there has been regular interaction between scientists, especially related to research on tropical diseases. Interactions between MORU staff and their China-based COI counterparts had stopped during the SARS-CoV-2 period.<sup>58</sup>
- 8.3 The Oxford staff serve as the official leadership with Professor Tao Dong as the director, Professor Chris Conlon as clinical director, Darren Nash as finance director, Dr Ricardo Fernandes as the group leader of Cancer Immunology and Associate Professor Roman Fischer as the head of Discovery Proteomics. CAMS staff are not in official leadership positions and appear to be seconded to COI from other CAMS institutes.<sup>59</sup>
- 8.4 Contrary to many other Western countries, the United Kingdom appears to have avoided inadvertent funding to, jointly publishing with, or transferring sensitive dual-use technology or knowhow related to high-risk pathogen research to Chinese institutes. This contrasts sharply with practices of other countries such as the United States, Australia, Canada, France, Holland and even Japan.<sup>60</sup>

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<sup>57</sup> Dr Ryan Clarke is a former MORU staff member and has worked across the entire regional operation.

<sup>58</sup> Interview with multiple senior MORU staff on 1, 4 and 7 February 2022.

<sup>59</sup> ‘Principal Investigators in Oxford’, Chinese Academy of Medical Sciences Oxford Institute, <https://www.camsoxford.ox.ac.uk/Pis/principal-investigators-oxford>, accessed 10 February 2022.

‘Principal Investigators China’, Chinese Academy of Medical Sciences Oxford Institute, <https://www.camsoxford.ox.ac.uk/Pis/principal-investigators-china>, accessed 10 February 2022.

<sup>60</sup> Ryan Clarke and Lam Peng Er, ‘Coronavirus Research Networks in China: Origins, International Linkages and Consequences’, Centre for Non-Traditional Security Studies, May 2020, 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>, accessed 11 March 2022.

- 8.5 COI has remained focused on more standardised, analytical and classification tasks related to cancer screening and treatment as well as determining the efficacy of various treatment regimes for infectious diseases, including SARS-CoV-2. The focus of COI has remained focused on providing clinical and scientific descriptions in order to generate fundamental knowledge.<sup>61</sup>
- 8.6 This consistent focus can be largely attributed to a combination of a strong commitment by the British government, Oxford University and Wellcome Trust (the primary funder of Nuffield’s international public health activities) to serve low-income groups who are vulnerable to tropical diseases. International Nuffield operations, such as MORU, are not necessarily focused on leading in next generation technology development but rather validating innovative deployment models in low-resource settings.<sup>62</sup>
- 8.7 This same overall philosophy has traditionally been present within COI as well.<sup>63</sup> However, with recent governance challenges related to the inability to communicate with COI personnel, it is unclear as to how Nuffield will continue to exercise the same degree of oversight as during the period prior to the SARS-CoV-2 outbreak.

### **Strategic Implications: China as a World Leader in High-Risk Virological Research**

- 9.1 CAMS/PUMC represents a major component of China’s ambition to become the world’s leading virological centre 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.

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<sup>61</sup> For example, please see Tao Dong, et. al, ‘Clinical and epidemiological features of COVID-19 family clusters in Beijing, China’, *Journal of Infection*, Vol. 81, Issue 2, 1 August 2020.

Tao Dong, et. al., ‘Interferon-Induced Transmembrane Protein 3 Genetic Variant rs12252-C Associated With Disease Severity in Coronavirus Disease 2019’, *The Journal of Infectious Diseases*, Vol. 222, Issue 1, 1 July 2020.

Chi Zhang, ‘A Novel Scoring System for Prediction of Disease Severity in COVID-19’, *Frontiers in Cellular and Infection Microbiology*, Vol. 10, Issue 318, June 2020.

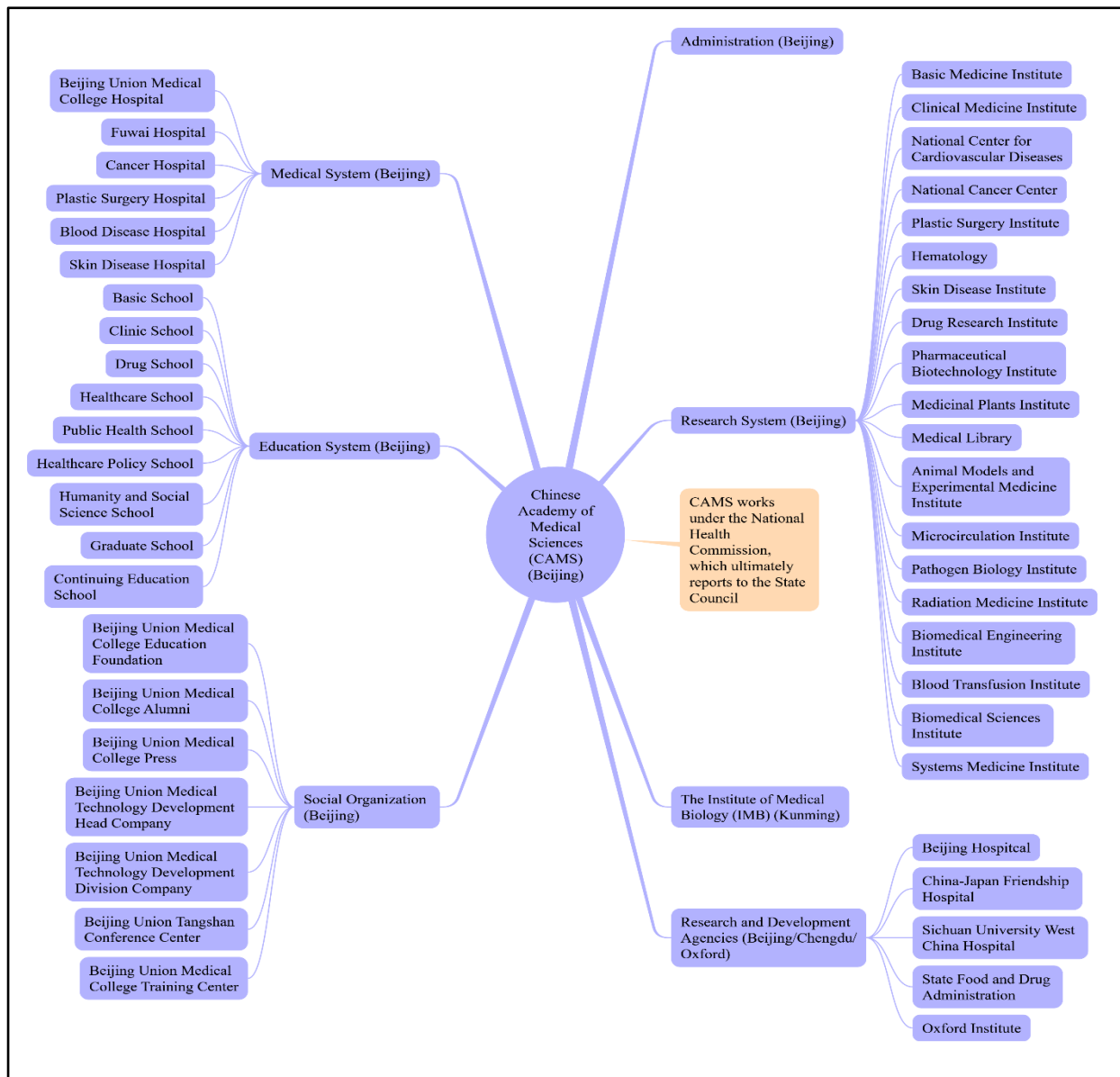
<sup>62</sup> Assessments based on Dr Ryan Clarke’s work with MORU across Southeast Asia.

<sup>63</sup> Ibid.

- 9.2 CAMS/PUMC has successfully absorbed American expertise to develop and operationalise its own BSL4 lab in Kunming. This lab is now able to independently conduct high-risk virological research.
- 9.3 CAMS/PUMC 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/PUMC 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/PUMC.
- 9.4 CAMS/PUMC researchers are capable of conducting high risk research on-shore and only with fellow Chinese domestic counterparts. They are no longer dependent on international expertise or knowhow to conduct this research. This is a recent development and is strategically significant. Simply put, China is emerging as a comprehensive leader with an autonomous capability in cutting edge virology research.

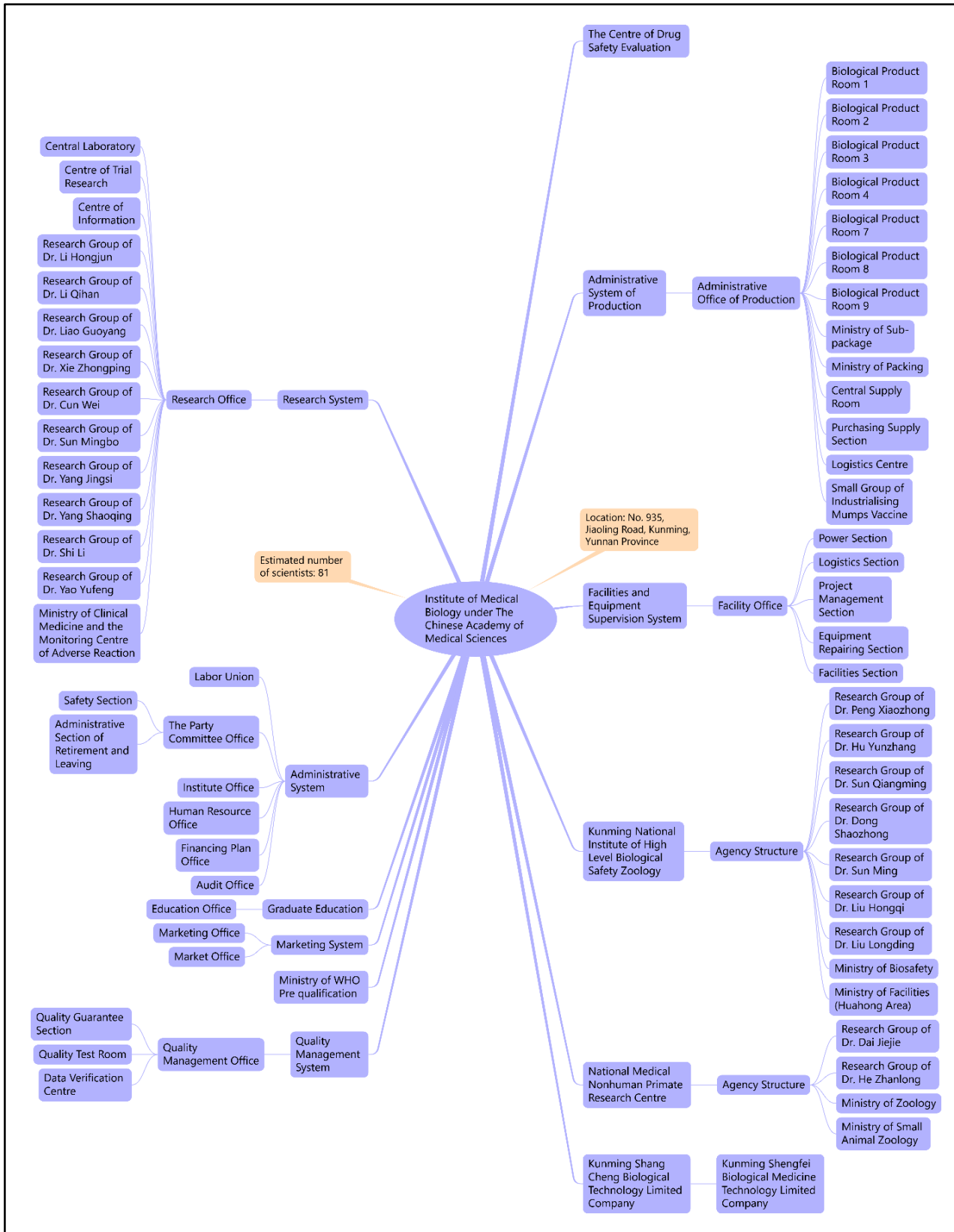


# APPENDIX 1 ORGANISATIONAL DIAGRAM OF THE CHINESE ACADEMY OF MEDICAL SCIENCES



Source: <http://www.cams.ac.cn/yxgk/zzjg/index.htm> (accessed 20 February 2022).

## APPENDIX 2 ORGANISATIONAL DIAGRAM OF THE INSTITUTE OF MEDICAL BIOLOGY



Source: <https://www.imbcams.ac.cn/> (accessed 20 February 2022).

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