Research Report

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Recent Advances in Dual-Use Virology and Nanotechnology Research in China

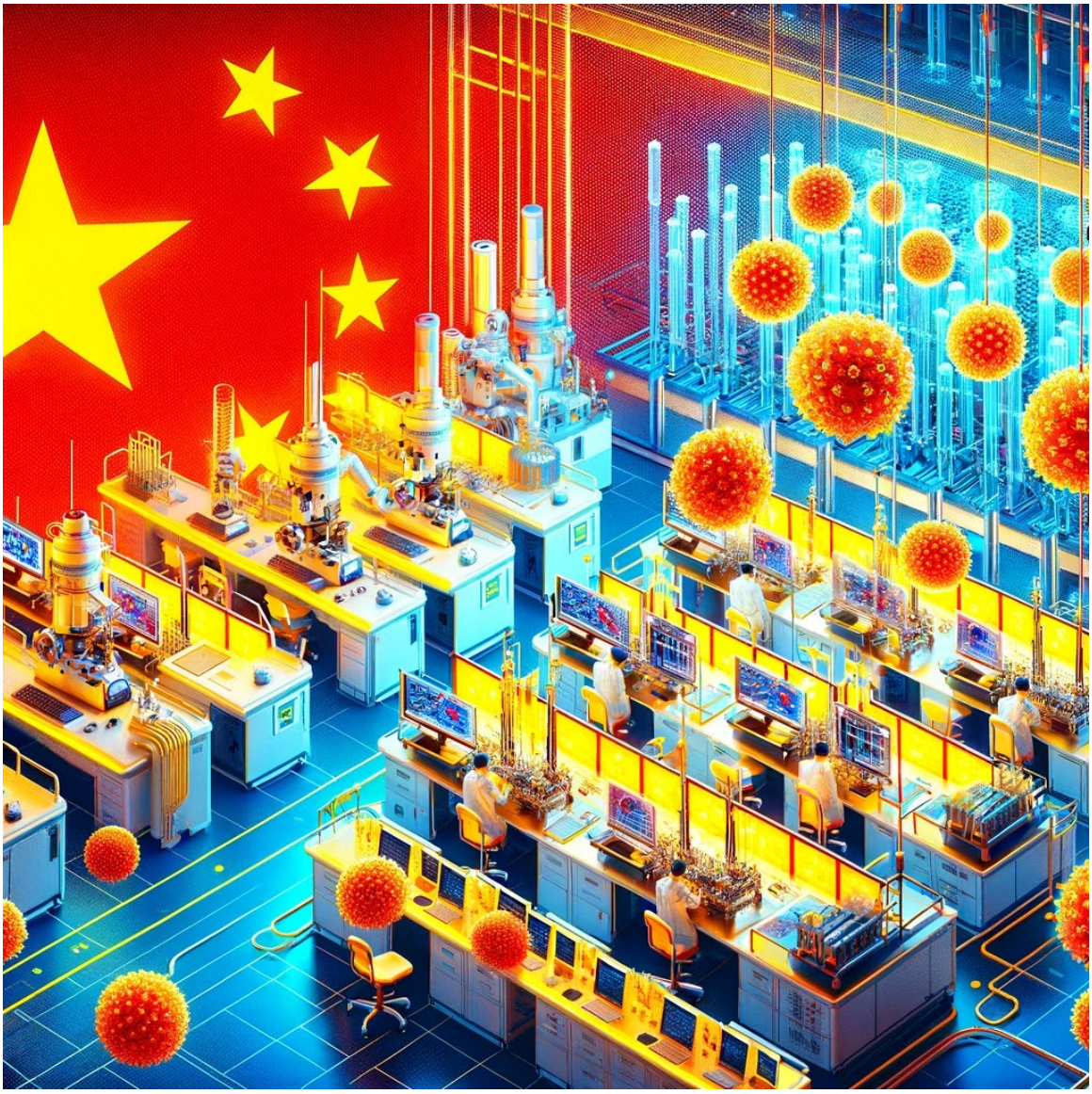

Table of Contents

Synopsis

Since 2020, the Frontier Assessments Unit and CCP BioThreats Initiative has produced now open-sourced intelligence reports[1], a 2021 monograph[2] as well as a 2023 book[3] on China's dual-use virology research programs, key international linkages and their strategic implications. There has been a recent observed shift away from Chinese reliance on uninterrupted international access to expert knowledge and technical knowhow from the West and the United States in particular. Recent virology studies surfaced in this Research Report demonstrate that China is now able to operate its own dual-use virology research agenda on-shore and without international inputs or considerations. A trend that can trace its origins back to the late 1970s appears to have ceased. These developments in virology have recently been fused with domestic advancements in dual-use nanotechnology research in China. Previously, dual-use nanotechnology research in China was a distinct and separate area with its own infrastructure and personnel that did not 'cross react' with virology research. However, recently identified studies demonstrate that this is also no longer the case. The dual-use technology advancements in virology and nanotechnology generates a range of new strategic considerations, especially considering the continued involvement of China's People's Liberation Army (PLA) and, inexplicably, some leading American institutions.

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[1] For example, see Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, 'Current State of Key Active Bioweapons Programs of the Chinese Communist Party and People's Liberation Army', CCP BioThreats Initiative, January 2024.
LJ Eads, Ryan Clarke and Xiaoxu Sean Lin, 'Biosecurity, Military Entanglements, and Ethical Dilemmas: Unraveling the Complexities of BGI Genomics in the Global Arena', CCP BioThreats Initiative, December 2023.
Robert McCreight, Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, 'Malevolent Matrix: Forging a Coherent National Biodefense Strategy: Mission Functionality and Four Calibrated Approaches to Scenario Readiness to Address a Shifting Biodefense International Threat Environment', CCP BioThreats Initiative, October 2023.
LJ Eads, Ryan Clarke and Xiaoxu Sean Lin, 'In the Shadows of Science: Unravelling China's Invisible Arsenals of Nanoweapons', CCP BioThreats Initiative, August 2023.
LJ Eads, Ryan Clarke and Xiaoxu Sean Lin, 'Guardians of the Invisible Arsenal: Unveiling the CCP's Weapons Research at the Research Institute of Chemical Defense', CCP BioThreats Initiative, August 2023.
Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, 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', CCP BioThreats Initiative.
Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, 'Precision Targeting Bioweapons Facilities in a Post-CCP Regime Collapse Scenario: Key Assets and Locations, Mission Options, and Strategic Execution Plan', CCP BioThreats Initiative.
Ryan Clarke 'Is China Converting COVID-19 Into a Strategic Opportunity?', EAI Background Brief No. 1545, 9 July 2020.
Ryan Clarke, Li Yao and Lam Peng Er, 'High-Risk Pathogen Research Networks in China: Historical Origins, Current Dynamics and Near-Term Directions', EAI Background Brief No. 1569, 3 December 2020.
Ryan Clarke, Li Yao and Lam Peng Er, 'China's Biosafety Level 4 Laboratories and Their International Linkages in Pathogen Research', EAU Background Brief No. 1570, 3 December 2020.
Ryan Clarke, 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.
Ryan Clarke, Lam Peng Er, Lin Xiaoxu, Richard Yarrow and LJ Eads, 'Conditions And Prospects For Virology Research At China's Academy Of Military Medical Sciences And Other Domestic Institutes', EAI Background Brief No. 1679, 9 December 2022.
[2] Ryan Clarke and Lam Peng Er, 'Coronavirus Research in China: Origins, International Networks and Consequences', Centre for Non-Traditional Security Studies, 20 May 2021.
[3] Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, *China's International Military-Civilian Virology Fusion: High-Risk Pathogen Research, Global Linkages and Strategic Implications*, Broad Publishers, Taipei, March 2023.

Executive Summary

1. While China previously required intensive and targeted international connectivity to obtain the technology and specialized knowledge required to make advancements in fields such as virology and nanotechnology, recent evidence suggests that this is no longer the case.

2. On January 4, 2024 arguably the most high-risk SARS-CoV-2 experiment to date involving a pangolin virus was carried out by the Beijing Advanced Innovation Center for Soft Matter (BAIC-SM) Science and Engineering, which is part of the Beijing University of Chemical Technology (BUCT).

3. These researchers claimed that a new pangolin coronavirus isolate, GX_P2V C7, caused 100% mortality in a humanized mice model. The researchers then tried to take the 'lethal' tone out of their report with a new January 24, 2024 version that attempted to justify their study as an approach for vaccine or drug development studies.

4. On a 2021 BUCT overseas talent recruitment program announcement, it clearly stated that BUCT is 'treating industrial-academic fusion and military-civil fusion as key development opportunities, and to establish the BAIC-SM Science and Engineering'.

5. In August 2023, a study conducted by a team at the Wuhan Institute of Technology (WIT) was published in the American Society of Microbiology's *Journal of Virology*. This study generated a new coronavirus that has very high lethality in aged mice and has strong potential to effectively use human ACE2 receptor.

6. The data about the pathogenicity of this new pathogen in humanized mice is intentionally omitted in this new report, or just cannot be revealed.

7. This type of high-risk research has its recent historical origins in the United States. An April 19, 2002, U.S. patent filing (**U.S. Patent Number US7279327B2**) clearly demonstrates that American researchers at the University of North Carolina at Chapel Hill literally engineered the first SARS virus. The first officially identified case of the alleged SARS outbreak in China was in Guangdong Province in November 2002.

8. Researchers from the Hefei Institute of Physical Science (HIPS), Chinese Academy of Sciences (CAS), recently developed a smart DNA molecular nanorobot model. This model innovatively proposes a non-linear gathering 'siege' of biological targets, allowing for advanced signal amplification and intelligent targeted drug delivery.

9. The study suggests that this technology has potential applications in biosensing, bioimaging and drug delivery. However, there are risks associated with this advancement.

10. The ability of nanorobots to transport biological agents directly to target cells with such precision could also have dual-use applications, especially when considering the established linkages between HIPS and China's People's Liberation Army (PLA).

From Critical International Dependency to Domestic Self-Sufficiency

1.1 When China began its ambitious programs to become a world leader in strategic dual-use technology domain areas such as virology and nanotechnology, Beijing had critical dependency on continuous access to intellectual property, specialized knowledge and technical guidance from international sources. China's own domestic research and development and technology operationalization capabilities lagged far beyond key Western countries, Japan, Taiwan, South Korea and even Russia.

1.2 However, through continuous targeted engagement with specific international research institutes, scientists, engineers and companies, China has been able to discreetly establish itself as a world leader with 'first-mover advantage' across several strategic technology domain areas.

1.3 In 2024, the China no longer requires international connectivity and access to continue to development its virology and nanotechnology dual-use research programs. China has absorbed the technology, knowhow and has trained an adequate number of personnel domestically to have achieved self-sufficiency. China will of course still absorb international inputs if and when they become available but there are no longer the critical dependencies of the past.

1.4 Given this new strategic reality, multiple substantial advances have been observed across Chinese research institutes, including many that are overtly part of the People's Liberation Army (PLA) or have discoverable links to the PLA. In addition to this domestic acceleration in individual technology domains, there are new convergences between previously distinct and separate technology areas, namely virology and nanotechnology.

New Lethal Virus by Design Under Military-Civilian Fusion[4] Project in Beijing

2.1 In January 2024, arguably the most high-risk SARS-CoV-2 experiment to date was carried out. This involved researchers from:

- Beijing Advanced Innovation Center for Soft Matter (BAIC-SM) Science and Engineering (Beijing University of Chemical Technology)
- Research Center for Clinical Medicine (The Fifth Medical Center of PLA General Hospital)
- State Key Laboratory of Pharmaceutical Biotechnology (Nanjing University) carried out a controversial study.

2.2 The lead Principal Investigator for this study was Lihua Song from BAIC-SM. These researchers claimed that a cell-culture passaged and adapted clone of pangolin

[4] 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 on 28 January 2024.

coronavirus isolate, GX_P2V C7, caused 100% mortality in a hACE2 transgenic mice model.[5]

2.3 According to previous studies conducted by Shi Zheng-Li from Wuhan Institute of Virology (WIV), there were two SARS-CoV-2-related pangolin coronaviruses, GD/2019 and GX/2017, isolated prior to the COVID-19 outbreak. Shi's cell culture isolates were named pCoV-GD01 and GX_P2V, respectively.[6] The pCoV-GD01 isolate, which has higher genome-wide homology (genetic similarity) with SARS-CoV-2, can infect and cause disease in both golden hamsters and humanized mice.[7]

2.4 In contrast, while GX_P2V can also infect both species, it did not appear to cause severe disease in these animals. What is noteworthy is that the early serial passaged[8] GX_P2V isolate generated cell-culture adapted mutant, named GX_P2V(short_3UTR), possesses a 104-nucleotide 21 deletion at the 3'-UTR. In this study done by Lihua Song's group, these researchers cloned this mutant, and then conducted further mouse model studies which may embed the purpose of generating more viral mutants with higher pathogenicity for human infection.[9]

2.5 Critically, they found that the GX_P2V(short_3UTR) clone can infect humanized mice with high viral loads detected in both lung and brain tissues. This infection resulted in 100% mortality in the humanized mice with these researchers assessing that the cause of death may be linked to the occurrence of late brain infection.[10]

2.6 Although the high lethality in the human ACE2-transformed mice model might be due to high number of inserted copies of the hACE2 gene in the genome of this particular mouse model, the total killing within 8 days was still a surprisingly result and has triggered international concern. Consequently, the authors tried to take the 'lethal' tone out of the report with a new January 24, 2024 version and attempted to justify their study as an approach for vaccine or drug development studies (See **Figure 1**).

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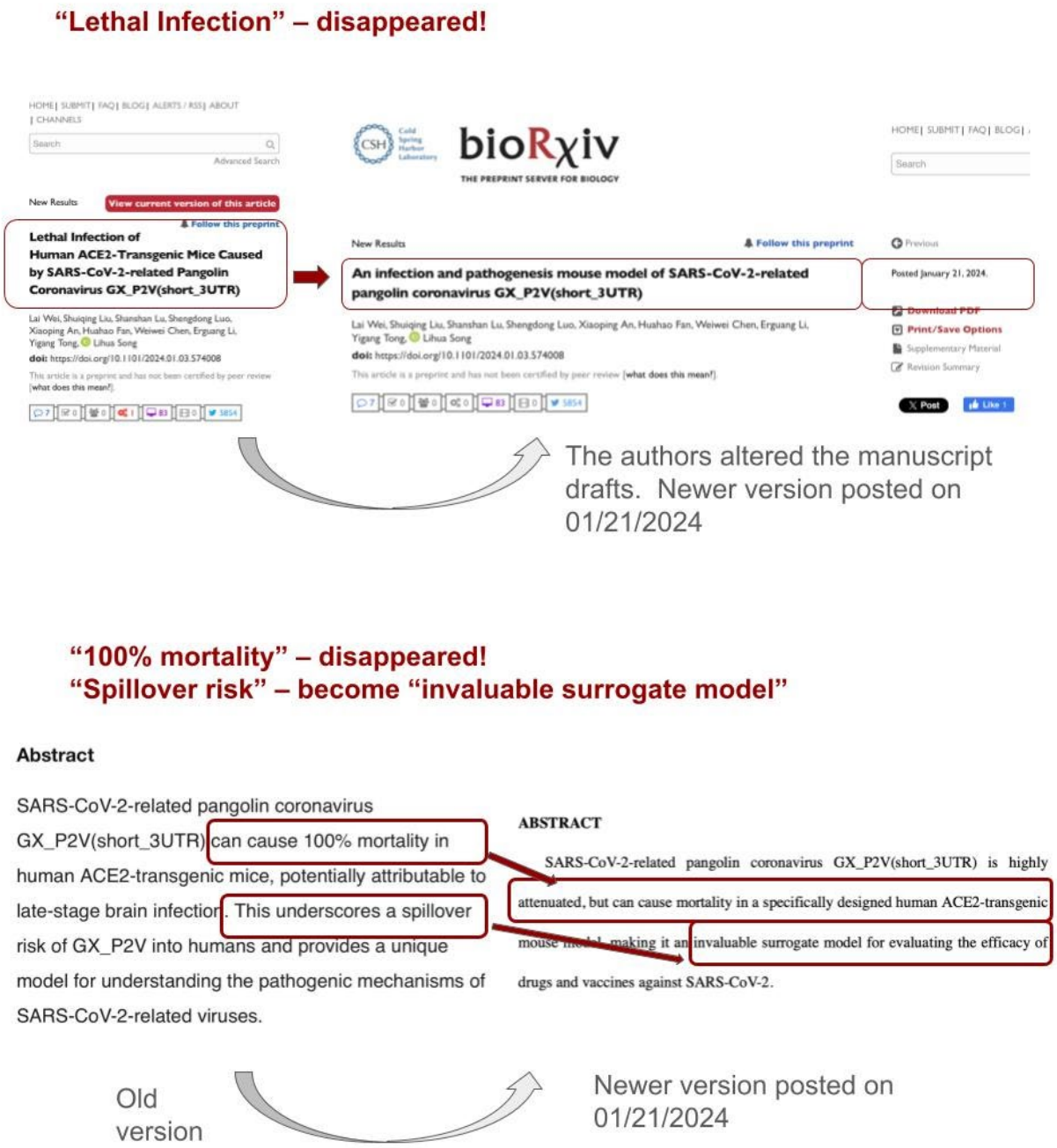
[5] Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)', *bioRxiv*, 4 January 2024.
[6] Mei-Qin Liu, et. al., 'A SARS-CoV-2-Related Virus from Malayan Pangolin Causes Lung Infection without Severe Disease in Human ACE2- Transgenic Mice', *Journal of Virology*, Vol. 97, Iss. 2, February 2023.
[7] Humanized mice used in this study were 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.
[8] 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.
[9] Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)', *bioRxiv*, 4 January 2024.
[10] Ibid.

Figure 1: Direct Comparison Between January 4 and January 24 Versions



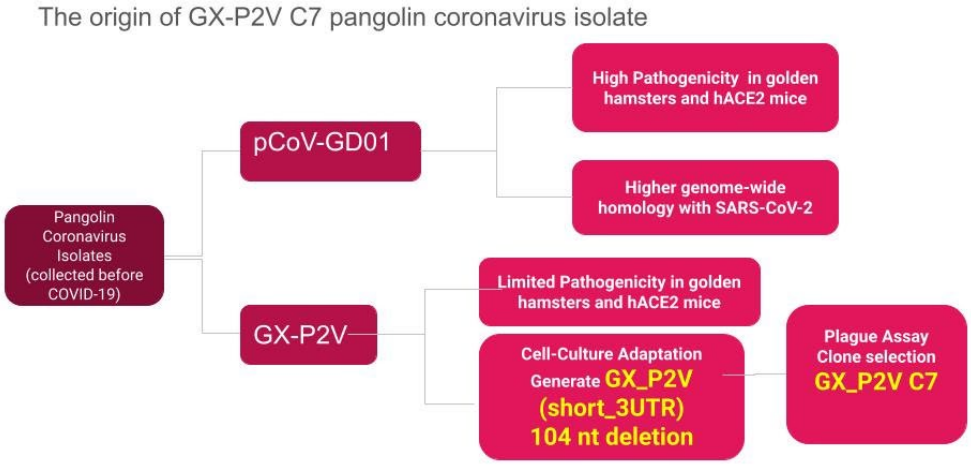
2.7 No scientific justification or reasoning was given for the serial passaging experiment that led to this new GX_P2V(short_3UTR) clone in the original January 4 study. There are no overt references to vaccine, therapeutic, or prophylactic development.

2.8 The GX_P2V(short_3UTR) mutant, which was initially isolated from the early passages of the GX_P2V sample (and the GX_P2V virus itself), had not been previously studied to determine its adaptive mutations in cell cultures. To obtain a genetically homogenous clone for animal experiments, they cloned the serial passaged

mutant through two successive plaque assays, a high-risk operation that is banned in the West.[11]

2.9 Eight viral clones were subsequently chosen for next-generation sequencing at the National Genomics Data Center of China. These clones, when compared with the genome of the original mutant, all shared four identical mutations: 34 ORF1ab_D6889G, S_T730I, S_K807N, and E_A22D. Clone 7, named as GX_P2V C7, was claimed by these researchers to have been randomly selected for the evaluation of viral pathogenicity in humanized mice.[12] See **Figure 2** for additional description.

Figure 2: Non-Natural Evolutionary Pathways of GX-P2V C7



2.10 The humanized mouse model in this study was developed using technology platforms developed by Beijing SpePharm Biotechnology Company, although no detailed information about Beijing SpePharm Biotechnology could be found.[13] It is also not clear whether this Beijing SpePharm Biotechnology company has any association with the pharmaceutical company-- SpePharm Holding BV from Amsterdam, Netherlands.[14]

[11] Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)', *bioRxiv*, 4 January 2024.
[12] Ibid.
[13] Ibid.
[14] Ibid.

BAIC-SM Emerges as a New Dual-Use Virology Research Institute in China

3.1 The lead authors for this study are from BAIC-SM Science and Engineering (Beijing University of Chemical Technology). What is alarming is that the mission statement of BAIC-SM clearly stated that 'novel research is at the core of our mission, and as such, high-risk research is encouraged wherever possible'. See **Figure 3** for additional information. [15]

3.2 This represents a fundamental shift from the China's decades-long practice of conducting this type of research in secret (or near-secret). Even more high-risk experiments are now being done overtly with no ethical scrutiny. This is open encouragement of high-risk studies indicates that the bioethical review process might be completely negligent at BAIC-SM thereby generating new global security risks.

Figure 3: Encouragement of High-Risk Research at BAIC-SM

3.3 In addition, the Beijing University of Chemical Technology (BUCT) is demonstrably committed to the Military-Civilian Fusion program that has accelerated under Xi Jinping's leadership. On a 2021 BUCT overseas talent recruitment program announcement, it clearly stated that BUCT is 'treating industrial-academic fusion and military-civil fusion as key development opportunities, and to establish the BAIC-SM Science and Engineering'.[16] This advertisement directly states that the BAIC-SM program could be an outcome of BUCT's engagement in the Military-Civilian Fusion

[15] 'About Us', Beijing Advanced Innovation Center for Soft Matter Science and Engineering (BAIC-SM), Beijing.
<https://en-baicsm.buct.edu.cn/388/list.htm>, accessed on 28 January 2024.
[16] 'Notice of the Beijing Municipal Education Commission on Announcing the List of High-tech Disciplines in Beijing Colleges and Universities', Beijing Institute of Petrochemical Technology, 11 November 2021.
<https://www.bipt.edu.cn/pub/graduate/xkjs/xkjsdt/228207.htm>, accessed on 28 January 2024.

program. This information was only available from the Chinese version of the advertisement. See **Figure 4** for additional information.

Figure 4: BUCT Established BAIC-SM Under Military-Civilian Fusion Rationale

3.4 Interestingly, BUCT was actually selected to develop 'Biosafety' as a core competence in the list of Advanced Academic Programs to be established among higher education institutes in Beijing in 2021.[17] A chemical engineering and technology institute being chosen to develop core competence for 'Biosafety' is unusual, especially considering that Beijing has many other institutions that have stronger biotechnology talent pools. This information was also only available in Chinese and can be seen in **Figure 5**.

Figure 5: Beijing University of Chemical Technology as a New National Biosafety Leader

[17] Ibid.

3.5 Song Lihua's group from BAIC-SM obtained the pangolin virus MpCoV-GX strain from Shi Zheng-li's group at WIV. Subsequently, Song's group cloned the MpCOV-GX and obtained the GX-P2V(short_3UTR) clone. Song's group also conducted study on this clone and found that this clone can effectively stimulate neutralizing antibodies against the coronavirus.

3.6 Song's group subsequently used a mouse model that utilizes the CAG-promoter to drive human ACE2 receptor expression and that unique model actually has a random insertion of 15 copies of CAG-promoter-driven hACE2 gene. Therefore, it was a very unique humanized mouse model that express high level hACE2 gene. There are many other ordinary humanized mouse models with much less hACE2 gene expression and Shi Zheng-Li's group also has those.

3.7 What is the reason for using this high level hACE2 expression mouse model? One clear motivation could be to use this model to intentionally select those pangolin coronavirus isolates that have higher affinity for hACE2 receptor binding for their S proteins. This is because any S protein mutation that can favor better hACE2 receptor binding could have its advantages significantly amplified in this mouse model.

3.8 Therefore, it is likely that this study is designed to select pangolin coronavirus strains that have better affinity with hACE2 receptor. This is a high-risk study in nature. Song and has team then went even further in this in this experimentation process and obtained a virus isolate that can generate strong pathogenicity in the brain and lung, and resulted in 100% lethality.

3.9 In aggregate, Song's group at BAIC-SM has a lethal virus in hand and a mechanism to obtain neutralizing antibodies against this lethal virus. Therefore, this newly identified pangolin virus has the objective potential for other applications as well.

3.10 Since WIV and BAIC clearly have approval to conduct high-risk studies, other high-risk experiments could easily be conducted at BAIC-SM or WIV:

- Using this new pangolin coronavirus clone (GX_P2V C7) in other animal models and then test as to whether this strain can lead to similar pathogenicity. Some other animal model studies with this dangerous clone might have been done in the same group or in WIV.

- This GX_P2V C7 clone clearly poses an unacceptably high risk to have a spill-over infection into human populations. The key question is whether it can lead to high pathogenicity when infected through respiratory route and whether it can result in a serious brain infection. Additional experiments could be conducted along this line on enquiry.

- Additional studies with GX_P2V C7 could be conducted to gain enhanced cell tropism for brain cell infection through serial passage of the virus in certain types of brain cells.

3.11 This study also highlighted the risk of simply doing serial passage in culture cells. None of the most effective SARS-CoV-2 vaccines produced globally have been developed through serial passaging, or any other Gain-of-Function (GoF)

techniques.[18] 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.

3.12 One of the reasons that many vaccine developers avoid doing serial passages of the SARS-CoV-2 virus is because still so little is reliably known about it. The world is still facing the challenges of its naturally generated variants. It is unclear as to why Song's research group decided to generate more risks with serial passages of this virus on animals that were not a natural reservoir for it.

Bat Coronavirus Research Accelerates in Wuhan

4.1 In August 2023, a study was published in the American Society of Microbiology's *Journal of Virology* that announced that a new mouse-adapted coronavirus strain named SMA1901 was generated by the Wuhan Institute of Technology (WIT), under Dr. Shi Zheng-Li of WIV. SMA1901 was generated by serial passaging the original virus strain (bat SARSr-CoV rRsSHC014S) in young and aged mice for 19 times and intentionally selecting more pathogenic strains at every passage.[19]

4.2 In this study, the young mice infected with SMA1901 showed a rapid loss of body weight (up to 10% of their body weight) 4 days post-infection. Viral RNA was detected in multiple organs, primarily in the lungs, trachea, and turbinates, but also in the heart, liver, spleen, kidneys, intestine and brain. While the young infected mice demonstrated substantial weight loss, inflammation, and increased viral titers in the respiratory tract, no mortality was observed.[20]

4.3 However, aged mice infected with SMA1901 exhibited significant body weight loss starting at 2 days post-infection. Most of the aged mice demonstrated a 25% reduction in body weight. Within 3 days post-infection, the mice showed mortality and by 7 days post-infection, only about 15% of the aged mice survived (2 out of 15). High numbers of viral RNA were also found in the respiratory tract with the mice exhibiting signs of severe pneumonia.[21]

4.4 Additionally, the aged SMA1901-infected mice showed higher levels of inflammation when compared to their younger counterparts, including increased levels of IL-2, IL-

[18] Gain-of-Function (GoF) experiments are a controversial domain within biomedical science, defense and security fields. They are distinct from other scientific methods and approaches. These experiments are deliberately designed to enable pathogens to acquire and develop new properties including increased transmissibility, increased lethality, and resistance to drugs. It can also involve modifying pathogens to enable them to be transmitted between humans asymptomatically and/or to evade the human immune system response. Such lab-made chimera viruses are potentially more dangerous than viruses found in nature. GoF research has been subjected to episodic bans in the West while it has continued uninterrupted and virtually unregulated in China. During these prohibition periods in the West, some Western scientists have continued their GoF research with partners in China.

[19] HF Lin, Zheng-Li Shi, et. al, 'Characterization of a mouse-adapted strain of bat severe acute respiratory syndrome-related coronavirus', *Journal of Virology*, Vol. 97, No. 9, 28 September 2023.

[20] Ibid.

[21] Ibid.

6, IL-9, IL-10, and tumour necrosis factor (TNF-α). The pathogenicity of SMA1901 in aged mice is like the effects of COVID-19 seen in older human patients.[22]

4.5 This study appears to be just a study for bat coronavirus. However, the bat SARSr-CoV rRsSHC014S strain used to generate SMA1901 was known to strongly interacted with both human ACE2 and mouse ACE2 receptors. That is to say that the original virus before SMA1901 has the potential to directly infect human cells.

4.6 Considering that inoculation of SMA1901 in aged mice has already been shown to generate severe respiratory distress and mice death (nearly 85%), it would not be surprising to see an increase in SMA1901's binding capacity in transgenic mice expressing human ACE2 receptors. Mutations in spike proteins and other non-structural proteins (including ORFX protein) have been also identified in SMA1901.

4.7 What is curious about this study is that it studies the individual spike mutations in a pseudovirus setting without showing the data of pseudovirus with full length spike gene from SMA1901. In addition, there was no data about the study of the mutations in ORFX gene in this study while Shi's team is fully aware that this ORFX protein was demonstrated by their own 2016 study to modulate host immune response capacity by suppressing interferon gamma expression.[23]

4.8 In aggregate, Shi's study generated a new coronavirus that has very high lethality in aged mice and has strong potential to effectively use human ACE2 receptor. The data about the pathogenicity of this SMA1901 variant in humanized mice is intentionally omitted in this new report, or just cannot be revealed. No matter the actual reason, the international pressure to track the origin of COVID-19 its relationship with WIV did not generate enough pressure to stop Shi Zheng-Li's group from performing any more bat coronavirus GoF studies at WIT.

American Historical Origins? COVID-19 Relevant Patent Filings Since 1998[24]

5.1 Dr. David Martin is the founder and chairman of M-Cam, the world's leading international intangible asset underwriter that specializes in innovation finance, trade finance, and intangible asset finance. Since 1998, Martin and his team have developed a unique database and other related data assets focused on patent activity that is directly related to coronaviruses. The M-Cam team conducted a disciplined and comprehensive study that reviewed coronavirus-related patent filings since 1998.

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[22] Ibid.

[23] Ibid.
Shi Zhengli, Peter Dazsak, et. al., 'Bat Severe Acute Respiratory Syndrome-Like Coronavirus WIV1 Encodes an Extra Accessory Protein, ORFX, Involved in Modulation of the Host Immune Response', *Journal of Virology*, Vol. 90, No. 14, July 2016.

[24] For more detailed information regarding the following three sections, please see Ryan Clarke, 'Emerging Pandemic Risks Come From Engineered Viruses in Chinese Labs, Not the Jungle or Bat Caves', Epoch Times, September 4, 2021.
<https://www.theepochtimes.com/opinion/emerging-pandemic-risks-come-from-engineered-viruses-in-chinese-labs-not-the-jungle-or-bat-caves-3980204>, accessed on 21 January 2024.

5.2 Martin's findings[25], all of which can be independently verified through publicly available patent databases, are astonishing. Fundamentally, Martin has clearly demonstrated that the virus that causes COVID-19 is neither genetically nor clinically novel in any sense and has not been so in more than 20 years.

5.3 He and his team also identify, isolate, and assess an April 19, 2002, U.S. patent filing (**U.S. Patent Number US7279327B2**) that clearly demonstrates that American researchers at the University of North Carolina at Chapel Hill literally engineered the first SARS virus.[26] For some historical context, the first officially identified case of the alleged SARS outbreak in China was in Guangdong Province in November 2002. What does this suggest or signify?

5.4 The patent record itself shows that SARS is not a natural progression of a zoonotic (animal origin) modification of coronavirus. In other words, Martin's research suggests that the patent record demonstrates that the first SARS virus may not have originated in nature. The April 2002 U.S. patent describes the bioengineering work as producing an infectious, replication-defective coronavirus that was specifically targeted for human lung epithelium—that is a literal description of SARS. Knowing this element of disease identification may have been overlooked is serious.

5.5 Martin notes that 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 utilize computer code to turn this genetic sequence into a pathogen or an intermediate host of a pathogen.

5.6 This work was funded in its critical early stages in the United States under the scientific rationale that this SARS virus could be a vector to distribute a universal HIV vaccine, the lifelong (and still unrealized) goal of Dr. Anthony Fauci, the longtime director of the National Institute of Allergy and Infectious Diseases (NIAID). However, it was also noted by these scientists that this same exact research had bioweapon applications as well.

Recently Surfaced Nanotechnology Studies in China: Dual-Use Potential?

6.1 The report '**Core-shell quantum dot-nano-gold particle assembly for efficient detection of nerve agent mimics**' discusses the development of a core-shell quantum dot-nano-gold particle assembly for the efficient detection of nerve agent mimics. The study was conducted by researchers from the:

- Institute of Chemical Defense, Chinese Academy of Military Sciences
- State Key Laboratory of National Nuclear, Biological and Chemical Protection
- Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

[25] Powerful information revealed about COVID ft. Dr. Reiner Fuellmich & Dr. David Martin | The last 16 months have been a rollercoaster of fears and facts, and we have seen the narrative behind COVID-19 change constantly, it was novel after... | By Randy Hillier | Facebook

[26] Kristopher M. Curtis, Boyd Yount, Ralph S. Baric, Methods for producing recombinant coronavirus, US Patent US7279327B2, 2002-04-19.

The research aimed to establish a simple and fast detection method for nerve agent mimics, which are highly toxic organophosphates with potential threats to human health and security.[27]

6.2 The experimental design involved creating a composite structure of 12 layers of zinc sulfide-coated cadmium selenide core-shell quantum dots (CdSe/12ZnS QDs) and gold nanoparticles (Au NPs). The fluorescence resonance energy transfer (FRET) between QDs and Au NPs was utilized for detection purposes. The hydrolysis of thioacetylcholine chloride (ATC) by acetylcholinesterase (AChE) generated thiocholine, which replaced the quantum dots, leading to the restoration of fluorescence.[28]

6.3 The presence of the nerve agent mimic diethyl cyanophosphate (DCNP) inhibited AChE activity, resulting in reduced fluorescence recovery efficiency of QDs. By measuring the fluorescence recovery efficiency of quantum dots, DCNP could be detected within a concentration range of 5.0×10–9 to 5.0×10–4 mol/L, with a detection limit of 5.0×10-9mol/L.[29]

6.4 The core-shell structure of CdSe/12ZnS QDs offered improved luminous efficiency and stability, enhancing the fluorescence recovery rate. The coordination effect between quantum dots and Au NPs improved the FRET fluorescence quenching efficiency. The system demonstrated good anti-interference properties, showing potential for practical applications in detecting nerve agent mimics. Additionally, the aggregation degree of gold particles under different DCNP concentrations caused observable color changes in the solution, providing a possibility for naked eye detection of DCNP.[30]

6.5 Overall, the study presents an approach to detect nerve agent mimics using nanotechnology, showcasing the potential of core-shell quantum dot-nano-gold particle assemblies for efficient and sensitive detection of toxic agents. This research has potential applications not only in defense and counterterrorism but also in offensive capabilities. Some offensive ways this research could be utilized include:

- **Advanced Chemical Warfare**: The research findings could be used to develop more efficient and sophisticated chemical weapons. By understanding the mechanisms of fluorescence quenching and recovery, chemical agents could be designed that inhibit acetylcholinesterase activity, leading to severe nerve agent-like effects on the nervous system of the targeted individuals or populations.

- **Covert Surveillance and Assassination**: The development of core-shell quantum dot-nano-gold particle assemblies could enable the creation of highly sensitive detection systems. These systems might be used for covert

[27] Li Shengsong, et. al, 'Core-shell quantum dot-nano-gold particle assembly for efficient detection of nerve agent mimics (**核壳型量子点**-纳米金颗粒组装体高效检测神经性毒剂模拟剂)', *Journal of Inorganic Materials*, Issue 8, 12 September 2019.
[28] Ibid.
[29] Ibid.
[30] Ibid.

surveillance, detecting trace amounts of nerve agent mimics or other chemical substances associated with enemy activities. Additionally, the technology could facilitate targeted assassinations as the detection systems might be used to identify and track specific individuals or groups exposed to toxic agents.

- **Non-Conventional Attacks**: The research's focus on nanoscale detection and advanced stealth materials could open up possibilities for unconventional attacks. Invisible delivery methods, such as drones or other nanoscale devices, could be equipped with nerve agent mimics and used to infiltrate enemy territories without detection.

- **Cyber-Biological Attacks**: The combination of nanotechnology with cyber and biological domains could lead to the creation of sophisticated hybrid weapons. Nanoscale devices could be deployed to infiltrate computer systems, disrupt communication networks, and remotely control biological agents, blurring the lines between traditional military and cyber warfare.

- **Targeted Biological Warfare**: While the research primarily focuses on nerve agent mimics, it could also provide insights into the manipulation of biological data and the creation of genetically modified organisms. The development of genetically engineered pathogens with specific virulence or drug resistance profiles could be explored, allowing for targeted biological attacks against enemy forces or populations.

6.6 The research's primary intent might be focused on defence and civilian applications. At present there are no reliable sources of evidence that suggest any of these offensive applications are being actively pursued in China. However, given the dual-use nature of this type of nanotechnology, offensive applications should also be continuously investigated and assessed.

Nanorobot-Driven Biological Sieges at the Chinese Academy of Sciences: Beyond Dual Use?

7.1 With China’s rapid strides in nanotechnologies, concerns rise over their potential dual-use, especially when paired with biological or chemical agents. The convergence of nanotechnology with various dual-use domains presents new challenges. These technologies could be exploited to enhance precision targeting, potency and overall sophistication.

7.2 Nanoparticles integrated into traditional chemical agents could increase their stability and dispersal, while nanoscale drug delivery systems might transport biological agents directly to target cells with deadly precision. Moreover, nanorobots could navigate the human body, delivering lethal payloads while evading conventional biological defences.

7.3 This is not a hypothetical concern. Researchers from the Hefei Institute of Physical Science (HIPS), Chinese Academy of Sciences (CAS), have made a substantial advancement in DNA nanotechnology. These researchers developed a smart DNA molecular nanorobot model. This model innovatively proposes a non-linear gathering

'siege' of biological targets, allowing for advanced signal amplification and intelligent targeted drug delivery.[31]

7.4 The nanorobot model consists of multifunctional robotic arms with optional accessories (such as drugs and signal tags), target validators, intelligent swarm path controllers and self-assembling motors. It responds only to specific biological targets, forming a large aggregate through cooperative operations and achieving nonlinear cascade amplification or amplification of target signals.[32]

7.5 The study suggests that this technology has potential applications in biosensing, bioimaging and drug delivery. However, there are risks associated with this advancement. The ability of nanorobots to transport biological agents directly to target cells with such precision could also objectively have other applications.

7.6 This new technology has the ability to deliver biological agents on a specific target across a range of scenarios. Additionally, the close collaboration between the Hefei Institute of Physical Science and the PLA raises concerns about potential applications of this technology for military purposes.[33]

7.7 Nanosensors can be leveraged for covert monitoring and detecting even minute traces of chemical and biological agents to assess the success of their attacks. The integration of nanotechnology with cyber capabilities can lead to the development of hybrid nanobots capable of infecting both computer systems and biological organisms simultaneously.

7.8 Through genetic engineering using nanotechnology, it also becomes possible to create pathogens that are more virulent, resistant to treatments, or tailored to target specific genetic traits. In December 2022 a joint Sino-US team from State Key Laboratory of Virology at Wuhan University, University of Washington and the Howard Hughes Medical Institute in Seattle conducted experiments with SARS-CoV-2 to determine which specific protein–glycan interactions have the highest viral binding affinity and pathogenicity in individual humans.[34]

7.9 Glycans vary considerably by race and the analysis of gylcans can enable a researcher to make a reliable determination of the ethnicity of an individual. This joint Sino-US determined which specific SARS-CoV-2 variants were the most effective at infecting which specific racial groups. There is no credible public health application for this research and this study raised serious concerns in international biomedical and security circles.

7.10 When the ability to precisely deliver an engineered biological agent to a specific target (even a specific individual) though a nanotechnology platform, this objectively generates a new set of risks for which there is little (if any) historical precedent.

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[31] 'The Chinese scientific research team proposes a model of intelligent nano-robots gathered to "siege" biological targets', *China News Network*, 19 May 2023. https://www.chinanews.com.cn/sh/2022/05-19/9758568.shtml, accessed on 17 January 2024.
[32] Ibid.
[33] Ibid.
[34] Qing Xiong, David Vessler, et. al., 'Close relatives of MERS-CoV in bats use ACE2 as their functional receptors', *Nature*, December 2022.

However, strategic intent to utilise such a combined capability in an offensive manner has not been identified.

Strategic Implications

8.1 While China previously required intensive and targeted international connectivity to obtain the technology and specialized knowledge required to make advancements in fields such as virology and nanotechnology, recent evidence suggests that this is no longer the case. China now has robust domestic capabilities that potentially provide Beijing with a range of asymmetric options against perceived adversaries.

8.2 These developments have occurred while many strategic and intelligence analysts have focused more heavily on China's conventional military assets such as its aircraft carriers, submarine fleet, rocket forces and space assets.

8.3 However, when arrayed against aggregated American and Allied capabilities, the PLA has virtually no prospect for establishing any form of strategic parity, let alone overmatch. As such, Chinese advancements in the unconventional and dual-use technology areas of virology and nanotechnology assume an even greater degree of criticality.

8.4 China's continued high-risk pathogen research on SARS-CoV-2 is particularly problematic. This demonstrates that Beijing assigns a high degree of strategic importance to serial passaging experiments continuing to be done in China despite being banned across the West. This is also in spite of the fact that the SARS-CoV-2 virus is directly responsible for the deaths of millions of people across the world.

8.5 No SARS-CoV-2 serial passaging experiment has been credibly linked to any existing vaccine, therapeutic, prophylactic or diagnostic. The fact that this work continues, including in Wuhan itself, likely demonstrates that there is a broader strategic logic underpinning this continued high-risk pathogen research.

8.6 Chinese advancements in nanotechnology also generates a new set of risks and strategic uncertainties. Nanotechnologies serve as a 'horizontal layer' that can miniaturize, massively decentralize and obfuscate origins across the full range of asymmetric capabilities. This includes, but is not limited to:

- Nanomedicine as a Weapon
- Nanorobotics and Autonomous Weapons
- Nano-Bioinformatics for Biowarfare
- Nano-Scale Chemical Sensors
- Nano-Cyber Biological Weapons
- Advanced Chemical Warfare
- Covert Surveillance and Assassination
- Non-Conventional Attacks

- Cyber-Biological Attacks
- Targeted Biological Warfare

8.7 The above areas have the potential to fundamentally and irreversibly transform the nature of the next generation of dual-use research in China. The deliberate national prioritization of dual-use pathogen research and nanotechnology provides insight into where Beijing assesses its own unique strengths to lie and, possibly, where Beijing has assessed its adversaries to have weaknesses in their own systems.