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Sommario

TERRORISM, WARFARE, INTELLIGENCE, STRATEGIC COMMUNICATION, CRISIS MANAGEMENT AND TECHNOLOGICAL ADVANCEMENTS AT THE CROSSROAD

Invisible Arsenals. Developing a Medical Intelligence Capability to Understand Current Biosecurity Threats

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Abstract

Biological warfare and bioterrorism have a long history, ranging from ancient times to the present, in which they have maintained their appeal to superpowers and lone wolf terrorists alike. Throwing a rotten camel into a water well illustrates their most convincing features: low cost of development, potentially devastating and large-scale effect, limited traceability.

For a while, international efforts culminating in the Biological Weapons Convention (BWC) of 1972, kept a lid on the development, production, and stockpiling of biological weapons. But the post-Cold War period witnessed significant shifts in the landscape of biological warfare and bioterrorism threats. As the world becomes more multipolar, biological warfare moves back to center stage of global security threats.

The development of asymmetric warfare capabilities, including biological weapons is experiencing a new surge. Meanwhile, an increasingly interconnected and globalized world with rapid transportation networks and growing urbanization present a target far more vulnerable to the devastating potential of biological warfare and infectious diseases.

Western countries are lacking fully integrated intelligence networks to properly assess the threat. Starting with the systematic collection of relevant epidemiological and medical information to the systematic integration with civil and military intelligence to the deployment of trained rapid reaction task forces to deal with public health emergencies.

The COVID-19 pandemic exemplifies this new reality. Heated debate lingers four years after the outbreak. Was it a naturally occurring disease or a synthetic agent? Was the outbreak an accident or deliberate? Maybe even state-sponsored? Are we looking at the once-in-50-years pandemic or a persistent global threat?

Much too little was known about the pathology of the virus, even though it had been studied for over two decades. Equally no common understanding of the challenges it posed to public health systems, which, in many cases, collapsed locally. Speculation, political meandering and conspiracy dominated the public debate. Assessing and responding to the current and future threat environment will require quite the opposite: A professional and fully integrated medical intelligence practice and a structural shift in the approach to strategic threat assessment.

This article tries to convey a cursory understanding of the current threat environment through the eyes of an intelligence analyst, looking for the confluence of capability and intent. It dives deep into scientific research programs developing deadly biological agents and molecular delivery methods to understand existing and future capabilities for biowarfare and bioterrorism. It will end incomplete, missing a critical piece to understanding the threat and devising the strategies to counter it. At this stage, the article can only offer a few recommendations on how to build the missing piece.

La guerra biologica e il bioterrorismo hanno una lunga storia, che va dall'antichità ai giorni nostri, in cui hanno mantenuto il loro fascino sia per le superpotenze che per i terroristi. Gettare un cammello in putrefazione in un pozzo d'acqua illustra le loro caratteristiche più convincenti: basso costo di sviluppo, effetto potenzialmente devastante e su larga scala, tracciabilità limitata.

Per un certo periodo, gli sforzi internazionali, culminati nella Convenzione sulle armi biologiche (BWC) del 1972, hanno tenuto sotto controllo lo sviluppo, la produzione e lo stoccaggio di armi biologiche, ma il periodo successivo alla Guerra Fredda ha visto cambiamenti significativi nel panorama delle minacce di guerra biologica e bioterrorismo. Con un mondo sempre più multipolare, la guerra biologica torna al centro delle minacce alla sicurezza globale.

Lo sviluppo di capacità di guerra asimmetrica, comprese le armi biologiche, sta vivendo una nuova impennata, nel frattempo un mondo sempre più interconnesso e globalizzato, con reti di trasporto rapide e crescente urbanizzazione, rappresenta un bersaglio molto più vulnerabile al potenziale devastante della guerra biologica e delle malattie infettive.

I Paesi occidentali non dispongono di reti di intelligence pienamente integrate per valutare adeguatamente la minaccia. Questo a partire dalla raccolta sistematica di informazioni epidemiologiche e mediche rilevanti, all'integrazione con l'intelligence civile e militare, fino al dispiegamento di task force di reazione rapida addestrate per affrontare le emergenze di salute pubblica.

La pandemia di COVID-19 è un esempio di questa nuova realtà. A quattro anni da quest'ultima, il dibattito è ancora acceso. Si è trattato di una malattia naturale o di un agente sintetico? Un incidente o un'azione deliberata? Forse addirittura sponsorizzata dallo Stato? Siamo di fronte a una pandemia che si verifica una volta ogni 50 anni o a una minaccia globale persistente?
La conoscenza della patologia del virus era troppo limitata, nonostante fosse stato studiato per oltre due decenni; allo stesso modo è mancata una comprensione comune delle sfide poste ai sistemi di sanità pubblica, che in molti casi sono collassati a livello locale. La speculazione, i meandri politici e le cospirazioni hanno dominato il dibattito pubblico. Per valutare e rispondere all'ambiente di minaccia attuale e futuro sarà necessario il contrario: una pratica di intelligence medica professionale e pienamente integrata e un cambiamento strutturale nell'approccio alla valutazione strategica delle minacce.
Questo articolo cerca di trasmettere una comprensione di alto livello dell'attuale ambiente di minaccia attraverso la lente di un analista di intelligence alla ricerca della confluenza di capacità e intenzioni. Esso si immerge in profondità nei programmi di ricerca scientifica che sviluppano agenti biologici letali e metodi di somministrazione molecolare per comprendere le capacità esistenti e future per la guerra biologica e il bioterrorismo.
Il testo si conclude in modo incompleto, mancando di un tassello critico per la comprensione della minaccia e l'elaborazione delle strategie per contrastarla, per il quale, allo stato attuale, l'articolo fornisce raccomandazioni su come costruirlo.

Keywords

Hybrid warfare, biological warfare, bioterrorism, intelligence, medical intelligence, Covid-19

1. Developing the Agent

In Israel, a badly wounded IDF Soldier, who recently returned from action in Gaza, died with a strange fungal infection, a rare occurrence in non-immunocompromised – otherwise healthy – individuals. Reports from across Israeli hospitals show a significant percentage of wounded soldiers returning from the battlefield with serious antimicrobial-resistant infections, they likely picked up through contact with contaminated soil, among other factors.

Meanwhile, on the battlefields of Ukraine, resistance to antibiotic treatments has become a particularly alarming phenomena, where the resistance is likely a consequence of the indiscriminate, life-saving use of antibiotic treatments by combat medics and in field hospitals. However, the spread of resistant bacteria goes far beyond battlefields and field hospitals. Seemingly isolated medical phenomena occurring within the general fog of war have far-reaching consequences for civil societies removed from warfare. Experts still seem far from understanding what these immunological phenomena mean for public health and decision makers are in the dark on how to respond. How serious is this threat? We may know far less than we think.

At the onset of the COVID-19 pandemic in early 2020, decision makers and experts were in the dark on every angle of the impending disaster, from its origin to its vectors of diffusion and the potential effect on humans and their societies. Public attention focused on Wuhan's wet markets, bat caves and pangolins. But when looking for capability and intent, the attention quickly shifts to the laboratory. Two recent reports show startling levels of at least the capability to engineer deadly pathogens in the vicinity of Wuhan's wet markets. What are those laboratories working on?

1.1 High-Risk Research on Deadly Corona Virus Continues in Wuhan

In August 2023, a new study was published in the American Society of Microbiology's *Journal of Virology*, announcing that a new mouse-adapted coronavirus strain named SMA1901 was generated by the Wuhan Institute of Technology, under Dr. Shi Zheng-Li. 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.[1]

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 robust weight loss, inflammation, and increased viral titers in the respiratory tract, no mortality was observed.[2]

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). The pathogenicity of SMA1901 in aged mice is comparable to the effects of COVID-19 observed in older human patients.[3]

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 infect human cells. In this regard, it obviously warrants an experiment to study SMA1901's infectivity in transgenic mice that express human ACE2 receptors. This component of the

[1] 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.
[2] Ibid.
[3] Ibid.

examination is very critical, indicating the potentially enhanced pathogenicity in humans. Yet, it is entirely missing in Shi Zheng Li's study.

Four years after the outbreak of the global COVID-19 pandemic, researchers in a Wuhan laboratory are developing more deadly variants of the same virus that probably killed millions worldwide. They test these variants on mice but publish no data on the pathogenicity for humans. The involvement of international scientists or institutions in these studies has simultaneously dropped significantly. Finally, the Gain-of-Function[4] method used in these studies are heavily regulated in the United States and European Union, due to biosafety and biosecurity risks and their dual-use potential. The alarm bells of the intelligence analyst looking for bioweapons capability are ringing.

1.2 New Lethal Virus by Design Under Military-Civil Fusion[5] Project in Beijing

Shi Zheng-Li's studies are no rarity, despite the high-risk methods used and international pressure to keep a lid on pathogen experiments in the aftermath of the COVID-19 pandemic. In fact, to the diligent observer it almost appears like a new competitive field of research. Another report recently surfaced on the pre-publication platform bioRxiv (bio-archive), offering a peak into a project involving similar levels of capability. The platform provides researchers the opportunity to receive initial feedback from the scientific community and make revisions to their reports before they are being published. Besides the alarming nature of the findings in this report, the revisions made shortly after it initially appeared are at least as concerning.

In January 2024, researchers from the Beijing Advanced Innovation Center for Soft Matter (BAIC-SM) Science and Engineering at Beijing University of Chemical Technology, the Research Center for Clinical Medicine at The Fifth

[4] 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.

[5] 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.

Medical Center of the PLA General Hospital (PLAGH), and State Key Laboratory of Pharmaceutical Biotechnology at Nanjing University claimed that a cell-culture passaged and adapted clone of a pangolin coronavirus isolate, GX_P2V C7, caused 100% mortality in a hACE2 transgenic mice model[6]. Lihua Song from the BAIC-SM was the lead and corresponding author for this shocking report. Very little is known about this researcher, which again raises suspicion for someone who is conducting such high-stakes research on a world-famous virus.

Based on previous studies conducted by Shi Zheng-Li from Wuhan Institute of Virology (WIV), prior to the COVID-19 outbreak, Lihua Song's group conducted further mouse model studies on the more deadly isolate, which may hint at the attempt to generate more viral mutants with higher pathogenicity for human infection.

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.[7] 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 is still a shocking result and has triggered international concern. What is more, the GX_P2V(short_3UTR) mutant 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.

Shortly after the report first appeared, it was revised and a new version appeared on the bioRxiv platform. The new version critically tunes down the 'lethal' tone of the initial report and gives it a new spin. The new narrative sells the study as an approach for vaccine or drug development. Yet, 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. In fact, many vaccine developers avoid doing serial passages of this novel virus, SARS-CoV-2, because still so little is known about this virus. The world continues to struggle with the challenges of its naturally generated variants. It is unclear as to why this research group decided to generate more risks with serial passages of this virus on animals that were not a natural reservoir for it. Given the level of protection against the development of severe disease provided by current vaccines, there is

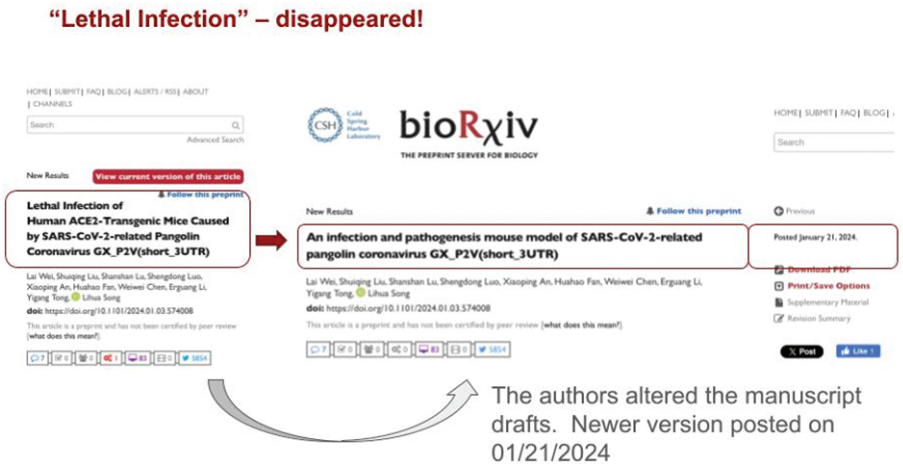
[6] Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)', *bioRxiv*, 4 January 2024.

[7] 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.

no clear civilian scientific justification to develop additional vaccines that protect against artificially enhanced SARS-CoV-2 viruses.

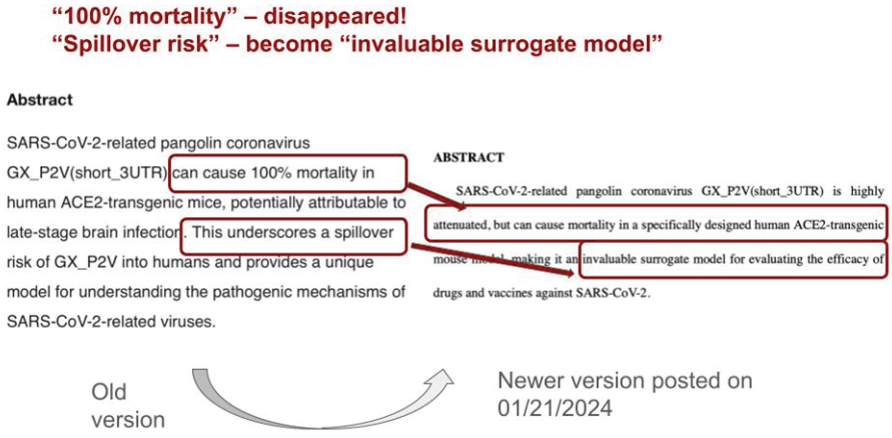
The following snapshots from the study show the contentious changes in Lihua Song's January 2024 report.

Figure 1



Screenshots from bioRxiv, accessed on 4 January and on 21 January 2024 respectively, showing Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)'. The revised version omits the lethality of the infection with SARS-CoV-2.

Figure 2



Screenshots from bioRxiv, accessed on 4 January and on 21 January 2024 respectively, showing Lai Wei, et. al., 'Lethal Infection of Human ACE2-Transgenic Mice Caused by SARS-CoV-2-related Pangolin Coronavirus GX_P2V(short_3UTR)'. References to the 100% mortality and the serious spillover risk of the research are omitted in the revised version.

The point of sharing a report on the bioRxiv platform is to receive feedback from the scientist community prior to publication. Whatever the feedback the authors received on the initial version of the report, omitting spillover risks into humans and 100% lethality of a laboratory-engineered virus that was based on SARS CoV-2 clearly are not cosmetic changes.

Finally, the advances made by Dr. Shi Zheng-Li and a range of collaborators in reverse genetic engineering, render synthetic lab-created coronaviruses indistinguishable from coronaviruses originally found in nature. The implications of these developments are difficult to overstate.

For one, this injects a fundamental degree of uncertainty and unreliability into the countless investigations that are occurring across the world that seek to determine the origins of SARS-CoV-2, the virus that causes COVID-19.

Secondly, these advanced technologies enable a strong degree of plausible deniability in the event of a lab leak when engineering synthetic coronaviruses, conducting Gain-of-Function experiments on previously natural coronaviruses, and other high-risk pathogen research. The use of these technologies in laboratory settings has traditionally been confined to a relatively finite number of research groups in China and several Western countries.

1.3 BAIC-SM Emerges as a New Bioweapons Player in China

The bioweapons capability alarms are still ringing, even more so as these Chinese scientists seem to outcompete each other, using high-risk methods to develop deadly pathogens. The questionable revisions and obfuscation attempts raise a new level of concern to the intelligence analyst who tries to identify a threat. What are the reasons for the changes made to Song's study and ultimately, what is the true motivation of his research?

A closer look at the scientists' host institution may reveal just that. The mission statement of BAIC-SM Science and Engineering Center at the Beijing University of Chemical Technology explicitly lists 'novel research is at the core of our mission, and as such, high-risk research is encouraged wherever possible'.[8] It is questionable how a thorough bioethical review process can coexist with such a mission.

In addition, the Beijing University of Chemical Technology (BUCT) is completely committed to the Military-Civilian Fusion program that has been driven by the Chinese Communist Party (CCP) under Xi Jinping's leadership. A 2021 BUCT overseas talent recruitment program announcement stated that BUCT is 'treating industrial-academic fusion and military-civil

[8] '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.

fusion as key development opportunities, and to establish the BAIC-SM for Soft Matter Science and Engineering'.[9] This advertisement directly states that the BAIC-SM program could be an outcome of BUCT's engagement in the Military-Civil Fusion program.

Meanwhile, it is surprising that 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.[10] A chemical engineering and technology institute being chosen to develop core competence for 'Biosafety' is definitely unusual, especially considering that Beijing has many other institutions that have stronger biotechnology talent pools.

So far, the intelligence analyst confirms the existence of animate – if not competitive – research activity on lethal pathogens that have already wreaked havoc on humans worldwide. The reports are an unequivocal show of dual-use capability, encouraged and conducted under the scope of a Military-Civil Fusion, high-risk research program. This is far from a smoking gun but a clear indication of intent to accept high biosafety risks in the development of what turned out to be a deadly pathogen with devastating potential for public health. The attempts to frame it as an effort to develop a vaccine, years after several effective vaccines against the naturally occurring mutations are available on an industrial scale, only corroborates the analyst's suspicions.

2. Deploying the capability: Nanotechnology and the Weaponization of Deadly Agents

To get a better understanding of the intent, it often helps to investigate the sponsorship of these programs – ideological and pecuniary. Exactly what does a military-civil fusion program do? What does it fuse? And what are its objectives? As the intelligence analyst broadens the scope, a vast array of dual-use studies appear. The military research and development programs of the CCP and the People's Liberation Army (PLA), which is the armed wing of the CCP and the core military force in China, cover a range of advanced weaponry projects, distinctly focused on asymmetric warfare. This includes biological, biochemical and neurobiological weapons.[11]

[9] '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.

[10] Ibid.

[11] For more in-depth analysis of these programs, please see Ryan Clarke, Xiaoxu Sean Lin and LJ Eads, *China's International Military-Civilian Virology Fusion: High-Risk Pathogen Re-*

2.1 Nanotechnology Platforms: A Transformative Capability?

The convergence of nanotechnology with various scientific disciplines offers particularly interesting options in the realm of asymmetric warfare, from nanoscale drugs to nanorobots using communication systems based swarm intelligence.

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 defenses. This is not a hypothetical concern.

Researchers from the Hefei Institute of Physical Science, Chinese Academy of Sciences, have made a 'breakthrough' in DNA nanotechnology, developing 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.[12]

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.

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 deadly precision could be exploited for harmful purposes. It could be used to deliver biological agents with precision, making it a potential threat for biological warfare. Additionally, the close collaboration between the Hefei Institute of Physical Science and the PLA raises concerns about potential dual-use applications of this technology for military purposes.[13]

The nanorobot study is far from evidence of a credible threat. It is one amongst countless examples of research projects that will produce credible

search, Global Linkages and Strategic Implications, Broad Publishers, Taipei, March 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. In+the+Shadows+of+Science+-+Unravelling+Chinas+Invisible+Arsenals+of+Nanoweapons.pdf (squarespace.com), accessed on 22 January 2024.

[12] 'The Chinese scientific research team proposes a model of intelligent nano-robots gathered to "siege" biological targets', *China News Network*, 19 May 2023. 中国科研团队提出云集"围攻"生物靶标智能纳米机器人模型-中新网 (chinanews.com.cn), accessed on 17 January 2024.

[13] Ibid.

dual-use applications for asymmetric warfare. There may not be a ready-to-deploy nanoplatform that can be weaponized with biological agents today and tomorrow. However, the immense challenge with fusion programs is that until the actual point of fusion its components are inconspicuous or seemingly benign. At the point of fusion these programs can generate an existential threat potential overnight. The intelligence analyst must therefore develop a muscle for cognitive fusion. Capabilities must be assessed in terms of their exponential fissile power when combined with other next-generation projects.

Through this lens, the intelligence analyst will see a vast invisible arsenal of deadly biological agents and untraceable delivery methods with molecular precision. What are these capabilities being developed for? What is the end game? The only thing that becomes clear from the evidence is that these developments occur independently of international cooperation or involvement of any sort. This reality has major strategic implications.

3. Strategic Implications

While the CCP and the PLA previously required intensive and targeted international connectivity to obtain the technology and specialized knowledge required to make advancements in fields such as bioweapons and nanoplatforms, recent evidence suggests that this is no longer the case. China now has robust domestic capabilities that provide Beijing with a range of asymmetric options against perceived adversaries. 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 and rocket forces. However, when arrayed against aggregated American and Western capabilities, the PLA has virtually no prospect for establishing any form of strategic parity, let alone overmatch. As such, Chinese advancements in the unconventional domain areas of bioweapons and nanoplatforms assume an even greater degree of relevance and criticality.

3.1 From Critical International Dependency to Domestic Self-Sufficiency

When the Chinese Communist Party (CCP) began its ambitious programs to become a world leader in strategic dual-use technology domain areas such as bioweapons and nanoplatforms, 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, South Korea and even Russia. However,

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

In 2024, the CCP no longer requires international connectivity and access to continue to development its virology and nanoplatform dual-use research programs. China has absorbed the technology, knowhow and has trained and developed 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.

The CCP's continued high-risk pathogen research on SARS-CoV-2 is particularly problematic and 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 in spite of the fact that the SARS-CoV-2 virus is directly responsible for the deaths of millions of people across the world. 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.

Chinese advancements in nanoplatforms also generates a new set of risks and strategic uncertainties. Nanoplatforms serve as a 'horizontal layer' that can miniaturize, massively decentralize and obfuscate origins across the full range of asymmetric capabilities of the CCP and the PLA. 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

The above domain areas have the potential to fundamentally and irreversibly transform the nature of next-generation medical intelligence collection, integration and distribution and the threat assessments. The CCP's deliberate decision to dedicate resources, personnel and national prioritization to the fields of bioweapons and nanoweapons provides insight into where Beijing as-

sesses its own unique strengths to lie and, possibly, where Beijing has assessed its adversaries to have weaknesses in their own intelligence and emergency response systems.

Two elements of this conclusion must not be overlooked. First, cutting-edge research in next-generation technology, including bio or nanotechnology are no longer the exclusive domain of Western countries. The establishment of independent domestic capabilities in China create a level of intransparency and uncertainty that complicates realistic threat assessments. Second, the fusion programs combining the capabilities of bio-engineering, neuroscience and nanotechnology will produce unimaginable novel offensive capabilities. The application of artificial intelligence to these research programs will potentiate their outcomes and erode the last shred of predictability on these domains.

4. Conclusion and Policy Recommendations

It is essential to recalibrate and refocus capabilities on the demonstrably highest probability source of the next pandemic: synthetic viruses that are increasingly being created in labs in China. American and other Western scientists were fundamental in the early stages of this process, but they have now been relegated to the sidelines. This structural shift needs to be broadly recognized and directly acted upon immediately.

Genetic engineering technologies, as seen in the SARS CoV-2 studies discussed earlier, introduce a compounding challenge to the strategic threat environment. Synthetic and naturally occurring pathogens become indistinguishable. Consequently, weaponized biological agents become practically untraceable. This makes current forensic assessment and attribution capabilities and tracking systems almost obsolete. Early warning and detection systems as well as rapid response and monitoring teams must broaden their scope and engage in intelligence fusion. True protective capability can no longer rely on bio forensics but must develop the muscle to integrate previously disparate pieces of information and data from various fields of scientific and military expertise.

In response to the outbreak of the COVID-19 pandemic, vast amounts of public resources were spent with countless dedicated clinicians, scientists, and others working tirelessly to protect public health. However, we do not presently have a pandemic risk surveillance system or rapid diagnostic tools commensurate to the current threat level, let alone a new and rapidly emerging one. This is not to suggest that the infectious disease surveillance and control work done for example by the U.S. Agency for International Development (USAID) and others is futile. However, it must be noted that the

majority of zoonotic pathogens that infect humans with the highest statistical frequency, such as malaria, dengue, scrub typhus, melioidosis, leptospirosis, and others are not transmissible between humans. Therefore, they don't pose a high risk of causing a global, or even regional, pandemic.

Key scientists and medical technicians were indispensable in fighting the devastating effect of the pandemic, they will also play a crucial role in building, operating and protecting biosecurity systems. Instead of leading government task forces and delivering press statements for political purposes they must build and operate the medical and epidemic intelligence networks, governed by rigorous intelligence processes.

Epidemic Intelligence (EI) primarily focuses on the surveillance and early detection of infectious disease outbreaks, whether they arise naturally or as a result of deliberate actions, such as bioterrorism. EI involves the systematic collection, analysis, and interpretation of health data from diverse sources, including hospitals, laboratories, public health agencies, media reports, and social media platforms. By monitoring trends in disease incidence, geographic spread, and population susceptibility, EI aims to identify potential outbreaks promptly and facilitate rapid response efforts to contain and mitigate their impact. Key components of Epidemic Intelligence include epidemiological surveillance systems, disease modelling techniques, and information-sharing networks.

Medical Intelligence (MI) encompasses a broader range of health-related threats, including infectious diseases, chemical and radiological exposures, bioterrorism, and other public health emergencies. MI integrates information from diverse sources, such as medical and scientific literature, intelligence reports, open-source data, and expert analysis, to assess the nature, magnitude, and implications of health threats for national security and public health preparedness. MI analysts evaluate the capabilities and intentions of adversaries, assess vulnerabilities in health infrastructure, and provide policymakers with timely and actionable insights to support decision-making and resource allocation. MI also encompasses medical surveillance, which involves monitoring the health status of key personnel, high value targets, persons of interests, military personnel, travelers, and populations at risk of exposure to health threats in operational settings, conflict zones or other zones of interests.

While Epidemic Intelligence focuses primarily on infectious disease surveillance and response, Medical Intelligence adopts a broader perspective, encompassing a wide range of health threats and vulnerabilities, including those related to chemical, radiological, and unconventional weapons. Both fields play complementary roles in safeguarding public health and national security. They must closely collaborate and integrate with national security

and intelligence agencies to assess the threat of emerging infectious diseases and the invisible arsenals of bioweapons.

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