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OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

(U) Potential Links Between the Wuhan Institute of Virology and the Origin of the COVID-19 Pandemic

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(U) EXECUTIVE SUMMARY

(U) This report responds to the COVID-19 Origin Act of 2023, which called for the U.S. Intelligence Community (IC) to declassify information relating to potential links between the Wuhan Institute of Virology (WIV) and the origin of the COVID-19 pandemic. This report outlines the IC's understanding of the WIV, its capabilities, and the actions of its personnel leading up to and in the early days of the COVID-19 pandemic. This report does not address the merits of the two most likely pandemic origins hypotheses, nor does it explore other biological facilities in Wuhan other than the WIV. A classified annex to this report includes information that was necessary to exclude from the unclassified portion of this report in order to protect sources and methods, but the information contained in the annex is consistent with the unclassified assessments contained in this report.

(U) This report was drafted by the National Intelligence Officer for Weapons of Mass Destruction and Proliferation and coordinated with the IC.

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(U) IC ASSESSMENTS ON COVID-19 ORIGINS

(U) In March, the IC updated its analysis on core intelligence questions related to COVID-19 origins, to include whether the first human infection with SARS-CoV-2—the virus that causes COVID-19—was the result of natural exposure to an infected animal or a laboratory-associated incident. Variations in IC analytic views on the origins of the COVID-19 pandemic largely stem from differences in how agencies weigh intelligence reporting and scientific publications and intelligence and scientific gaps. All agencies continue to assess that both a natural and laboratory-associated origin remain plausible hypotheses to explain the first human infection.

- [redacted] The National Intelligence Council and four other IC agencies assess that the initial human infection with SARS-CoV-2 most likely was caused by natural exposure to an infected animal that carried SARS-CoV-2 or a close progenitor, a virus that probably would be more than 99 percent similar to SARS-CoV-2.
- [redacted] The Department of Energy and the Federal Bureau of Investigation assess that a laboratory-associated incident was the most likely cause of the first human infection with SARS-CoV-2, although for different reasons.
- [redacted] The Central Intelligence Agency and another agency remain unable to determine the precise origin of the COVID-19 pandemic, as both hypotheses rely on significant assumptions or face challenges with conflicting reporting.
- [redacted] Almost all IC agencies assess that SARS-CoV-2 was not genetically engineered. Most agencies assess that SARS-CoV-2 was not laboratory-adapted; some are unable to make a determination. All IC agencies assess that SARS-CoV-2 was not developed as a biological weapon.

(U) WIV ACTIVITIES PERFORMED WITH OR ON BEHALF OF THE PEOPLE'S LIBERATION ARMY

[redacted] The WIV is a civilian research institute founded in the 1950s by the Chinese Academy of Sciences (CAS). Although the WIV is independent of the People's Liberation Army (PLA), the IC assesses that WIV personnel have worked with scientists associated with the PLA on public health-related research and collaborated on biosafety and biosecurity projects. Information available to the IC indicates that some of the research conducted by the PLA and WIV included work with several viruses, including coronaviruses, but no known viruses that could plausibly be a progenitor of SARS-CoV-2. For example, PLA researchers have used WIV laboratories for virology and vaccine-related work.

- [redacted] Between 2017 and 2019, the WIV funded and some of its personnel conducted research projects to enhance China's knowledge of pathogens and early disease warning capabilities for defensive and biosecurity needs of the military.
- (U[redacted] Prior to collaborating on a vaccine for SARS-CoV-2, the WIV collaborated with the PLA on other vaccine and therapeutics relevant to coronaviruses. The IC assesses that this work was intended for public health needs

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and that the coronaviruses known to be used were too distantly related to have led to the creation of SARS-CoV-2.

(U) CORONAVIRUS RESEARCH AND RELATED ACTIVITIES PERFORMED AT THE WIV

[redacted] Prior to the pandemic, we assess WIV scientists conducted extensive research on coronaviruses, which included animal sampling and genetic analysis. We continue to have no indication that the WIV's pre-pandemic research holdings included SARS-CoV-2 or a close progenitor, nor any direct evidence that a specific research-related incident occurred involving WIV personnel before the pandemic that could have caused the COVID pandemic.

(U) WIV Coronavirus Research and Holdings

[redacted] The WIV probably maintains one of the world's largest repositories of bat samples, which has enabled its coronavirus research and related public health support. Information available to the IC indicates that the WIV first possessed SARS-CoV-2 in late December 2019, when WIV researchers isolated and identified the virus from samples from patients diagnosed with pneumonia of unknown causes.

- [redacted] In 2013, the WIV collected animal samples from which they identified the bat coronavirus RaTG13, which is 96.2 percent similar to the COVID-19 virus. By 2018, the WIV had sequenced almost all of RaTG13, which is the second closest known whole genome match to SARS-CoV-2, after BANAL-52, which is 96.8 percent similar. Neither of these viruses is close enough to SARS-CoV-2 to be a direct progenitor.
- [redacted] Since 2019, some WIV researchers analyzed pangolin samples to better understand disease outbreaks in these animals.
- [redacted] By the end of 2019, the WIV maintained distinct teams focused on MERS and SARS-related coronaviruses. Both teams separately used transgenic mouse models to better understand how the viruses infect humans as well as related vaccine and therapeutics research. The WIV then shifted to support broader public-health efforts related to the COVID-19 pandemic in early 2020.

(U) WIV Genetic Engineering Capabilities

[redacted] We assess that some scientists at the WIV have genetically engineered coronaviruses using common laboratory practices. The IC has no information, however, indicating that any WIV genetic engineering work has involved SARS-CoV-2, a close progenitor, or a backbone virus that is closely-related enough to have been the source of the pandemic.

- [redacted] Scientists at the WIV have created chimeras, or combinations, of SARS-like coronaviruses through genetic engineering, attempted to clone other unrelated infectious viruses, and used reverse genetic cloning techniques on SARS-like coronaviruses.

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- [redacted] Some of the WIV's genetic engineering projects on coronaviruses involved techniques that could make it difficult to detect intentional changes. A 2017 dissertation by a WIV student showed that reverse genetic cloning techniques—which are standard techniques used in advanced molecular laboratories—left no traces of genetic modification of SARS-like coronaviruses.

(U) Biosafety Concerns at the WIV

[redacted] Some WIV researchers probably did not use adequate biosafety precautions at least some of the time prior to the pandemic in handling SARS-like coronaviruses, increasing the risk of accidental exposure to viruses. Before the pandemic, the WIV had been working to improve at least some biosafety conditions and training. We do not know of a specific biosafety incident at the WIV that spurred the pandemic and the WIV's biosafety training appears routine, rather than an emergency response by China's leadership.

- (U[redacted] Nearly a year after the accreditation of the WIV's BSL-4 laboratory in 2017, China's decisions of which pathogens required higher biocontainment protocols remained opaque, while the facility had a shortage of appropriately trained personnel.
- [redacted] In mid-2019, WIV officials were evaluating and implementing biosafety improvements, training, and procurements in the context of a growing body of broader biosecurity PRC legislation. In November 2019, the WIV, in cooperation with other CAS entities, hosted a biosafety training course for WIV and non-WIV personnel that included speakers from the China Centers for Disease Control and Prevention. Given the timing of the event, this training appears routine, rather than a response to a specific incident.
- [redacted] As of January 2019, WIV researchers performed SARS-like coronavirus experiments in BSL-2 laboratories, despite acknowledgements going back to 2017 of these virus' ability to directly infect humans through their spike protein and early 2019 warnings of the danger of this practice. Separately, the WIV's plan to conduct analysis of potential epidemic viruses from pangolin samples in fall 2019, suggests the researchers sought to isolate live viruses.
- [redacted] An inspection of the WIV's high-containment laboratories in 2020—only months after the beginning of the COVID-19 outbreak's emergence—identified a need to update aging equipment, a need for additional disinfectant equipment, and improvements to ventilation systems. As this inspection occurred in the midst of the WIV's crisis response to the COVID-19 outbreak, these findings are not necessarily indicative of WIV's biosafety status prior to the outbreak.

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(U) WIV RESEARCHERS WHO FELL ILL IN FALL 2019

[redacted] Several WIV researchers were ill in Fall 2019 with symptoms; some of their symptoms were consistent with but not diagnostic of COVID-19. The IC continues to assess that this information neither supports nor refutes either hypothesis of the pandemic's origins because the researchers' symptoms could have been caused by a number of diseases and some of the symptoms were not consistent with COVID-19. Consistent with standard practices, those researchers likely completed annual health exams as part of their duties in a high-containment biosafety laboratory. The IC assesses that the WIV maintains blood samples and health records of all of their laboratory personnel—which are standard procedures in high-containment laboratories.

- [redacted] We have no indications that any of these researchers were hospitalized because of the symptoms consistent with COVID-19. One researcher may have been hospitalized in this timeframe for treatment of a non-respiratory medical condition.
- [redacted] China's National Security Commission investigated the WIV in early 2020 and took blood samples from WIV researchers. According to the World Health Organization's March 2021 public report, WIV officials including Shi Zhengli—who leads the WIV laboratory group that conducts coronavirus research—stated lab employee samples all tested negative for SARS-CoV-2 antibodies.

[redacted] While several WIV researchers fell mildly ill in Fall 2019, they experienced a range of symptoms consistent with colds or allergies with accompanying symptoms typically not associated with COVID-19, and some of them were confirmed to have been sick with other illnesses unrelated to COVID-19. While some of these researchers had historically conducted research into animal respiratory viruses, we are unable to confirm if any of them handled live viruses in the work they performed prior to falling ill.

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(U) APPENDIX A: DEFINITIONS

(U) **Antibody:** A protein produced during an immune response to a part of an infectious agent called an antigen.

(U) **Backbone:** A genetic sequence used as a chassis upon which to build synthetic constructs, such as those used for cloning, protein expression, and production.

(U) **Biosafety:** The application of knowledge, techniques, and equipment to prevent personal, laboratory, and environmental exposure to potentially infectious agents or biohazards. Four **Biosafety levels (BSL)** define the containment conditions under which biological agents can be safely manipulated. These standards range from moderate safety requirements for low-risk agents (BSL-1), to the most stringent controls for high-risk agents (BSL-4). China's standards range from P1–4.

(U) **Biosecurity:** The protection, control of, and accountability for biological agents, toxins, and biological materials and information to prevent unauthorized possession, loss, theft, misuse, diversion, and accidental or intentional release.

(U) **Coronavirus:** A family of common viruses that can infect humans and/or animals. The human illness caused by most coronaviruses usually lasts a short time and presents symptoms consistent with the "common cold," such as a runny nose, sore throat, cough, and fever.

(U) **COVID-19:** An infectious disease caused by the **SARS-CoV-2** virus, which is a betacoronavirus.

(U) **Diagnostic Information:** Information that allows IC analysts to distinguish between hypotheses—in this case, the laboratory origin and natural origin theories.

(U) **DNA (deoxyribonucleic acid):** A molecule that carries an organism's genetic blueprint for growth, development, function, and reproduction.

(U) **Gain-of-function:** The IC considers this as a research method that involves manipulating an organism's genetic material to impart new biological functions that could enhance virulence or transmissibility (e.g., genetically modifying a virus to expand its host range, transmissibility, or severity of illness). The IC assesses that genetic engineering, genetic modification, and laboratory-adaptation can all be used for gain-of-function experiments, but are not inherently so.

(U) **Genetically engineered or genetically modified viruses** are intentionally altered, created, or edited using biotechnologies, such as Clustered Regularly Interspaced Short Palindromic Repeat (CRISPR), DNA recombination, or reverse genetics. These viruses have intentional, targeted edits to the genome designed to achieve specific results, but unintentional genomic changes may also occur.

(U) **Genome:** The genetic material of an organism. It consists of DNA (and sometimes RNA for viruses).

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(U) **Genome sequencing:** The process of determining the DNA or RNA sequence of an organism's genome, or its "genetic code." An organism's genetic code is the order in which the four nucleotide bases—adenine, cytosine, guanine, and thymine—are arranged to direct the sequence of the 20 different amino acids in the proteins that determine inherited traits.

(U) **Intermediate species/host:** An organism that can be infected with a pathogen from a reservoir species and passes the pathogen to another host species; infection is not sustained in this population.

(U) **Laboratory-adapted viruses** have undergone natural, random mutations through human-enabled processes in a laboratory—such as repeated passage through animals or cells—that put pressure on the virus to more rapidly evolve. Specific changes to the viral genome are not necessarily anticipated in these processes, though the virus can be expected to gain certain characteristics, such as the ability to infect a new species. This is a common technique used in public health research of viruses. We consider directed evolution to be under laboratory adaptation.

(U) **Laboratory-associated incidents** include incidents that happen in biological research facilities or during research-related sampling activities.

(U) **Naturally occurring viruses** have not been altered in a laboratory. Viruses commonly undergo random mutations as part of the evolutionary process and can continue to change over time; mutations may enable a virus to adapt to its environment, such as evading host immune responses and promoting viral replication.

(U) **Outbreak:** A sudden increase in occurrences of a disease in a particular time and place. Outbreaks include **epidemics**, which is a term that is reserved for infectious diseases that occur in a confined geographical area. **Pandemics** are near-global disease outbreaks.

(U) **Pangolin:** An African and Asian mammal that has a body covered in overlapping scales. Pangolins are a natural reservoir of coronaviruses and researchers are investigating their potential role as an intermediate host for the COVID-19 virus.

(U) **Pathogen:** A bacterium, virus, or other microorganism that can cause disease.

(U) **Progenitor Virus:** A virus that is closely related enough—more than 99 percent–to SARS-CoV-2 to have been its direct ancestor or plausible immediate origin of the outbreak. The closest known relative to SARS-CoV-2 is only about 96 percent similar; to put this into context, humans and chimps are about 99 percent similar, demonstrating the significant differences even at this similarity.

(U) **Reverse genetics**: A process for determining the natural function of genes by introducing mutations and studying the effect of those mutations.

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(U) **RNA (ribonucleic acid):** A molecule essential for gene coding, decoding, regulation, and expression. The genome of certain viruses, including coronaviruses, is made of RNA rather than DNA.

(U) **Virus:** A replicating piece of genetic material—DNA or RNA—and associated proteins that use the cellular machinery of a living cell to reproduce.

(U) **Zoonosis:** An infection or a disease that is transmissible from animals to humans under natural conditions. A **zoonotic pathogen** may be viral, bacterial, or parasitic, and can sometimes be transmitted through insects, such as mosquitoes.

(U) **Zoonotic spillover:** An initial infection or disease that is caused by contact between an animal and human under natural conditions.