

# COVID-19 Pandemic Origins: Bioweapons and the History of Laboratory Leaks

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To date, the coronavirus disease 2019 (COVID-19) pandemic has taken more than 3.5 million lives. Many of these deaths have been attributed to misleading information that fragmented a coordinated effort to mitigate loss of life. Future pandemics will continue to be a threat, so it is important to lay bare the true cause of this devastation. From the beginning, the origins of the pandemic have been debated, even though a natural zoonotic transfer to humans has been determined as the likely cause; however, speculation around a viral bioweapon and laboratory leaks remains. The evidence for the origins of this current pandemic can be found in the science and history behind biological outbreaks and the signs of bioweapon use. This knowledge will help minimize the harm of future pandemics.

One microbe has just devastated our world. Severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), the cause of COVID-19, has shattered economies, upended patterns of life globally, and already killed >3.5 million people. More than 85 million cases were documented worldwide in <1 year,<sup>1</sup> and many people want to know how this happened and where the virus originated. The first reports in late 2019 indicated that an epidemic caused by a zoonotic virus was spreading from Wuhan, China, believed to have been transmitted from an animal reservoir at a live-animal market. Speculation remains that the blame lies elsewhere, however, which seems surprising to scientists. For the public, the truth is easy to question because of the vast amounts of circulating misinformation.

From the early stages, wild speculation existed regarding the origins of the virus. In March 2020, the US Department of State summoned the Chinese ambassador to protest statements of a Chinese spokesperson, who suggested that the virus was brought to Wuhan by the US military, allegedly as a bioweapon.<sup>2</sup> Then, a US senator suggested that the virus resulted from a

botched Chinese bioweapons program.<sup>3</sup> Palestinian media argued that SARS-CoV-2 was a biological weapon being used by the US and Israel against China and Iran.<sup>4</sup> Other US officials suspected that the virus came from a Wuhan laboratory that was performing legitimate viral research because safety concerns had been previously identified at this laboratory.<sup>5</sup> As time went on, concern grew because China was found to be censoring the results of research into the origins of the pandemic.<sup>6</sup> It would not be the first time that modern research in China drew attack. In late 2018, the announcement of gene editing of babies resulted in criminal charges against a Chinese biophysicist and his two colleagues.<sup>7</sup> These issues have served to maintain alternative possibilities for the origin of COVID-19, based mostly on conspiracy theories and rumors that spread quickly through social media and remain difficult to stop. The virus as a bioweapon and the possible laboratory leak from legitimate research are the two most common remaining theories about the origins of SARS-CoV-2. The aim of this perspective is to show that the current pandemic is unlikely to have resulted from either bioweapons or a laboratory leak.

## Bioweapons and Natural Disease Outbreaks

On the surface, similarities exist between bioweapons and viral pandemics that may have allowed this conspiracy theory to seem plausible. As nonconventional, nonkinetic weapons of mass destruction, bioweapons can create the same havoc as pandemics. As with a pandemic, if a bioweapon attack spreads widely, healthcare systems could be overwhelmed, perpetuating societal panic as well as frustration, despair, and psychological casualties among healthcare workers, adding to the panic. This cycle would only change when a pathogen weakens or natural immunity is strengthened.

Natural outbreaks and bioweapons can affect animal populations in ways similar to that for humans. Rabinowitz et al showed that for certain bioweapons, animals stricken with disease could help identify exposure risks to humans—so much so that the authors implored public health officials to transition from passive to active surveillance of animal populations for biosecurity.<sup>7,8</sup> Worldwide during this pandemic, animals of various species have been infected with SARS-CoV-2, including animals at the Bronx Zoo in New York City.<sup>8–11</sup>

Throughout history, viral agents have been studied for use as weapons of disease. Dr Ken Alibek, former director of the bioweapons program of the Union of Soviet Socialist Republics, provides insight in his memoir<sup>10</sup> regarding the most highly developed bioweapons program in history. He described the production of a Marburg viral weapon that was ready to be manufactured in large amounts and placed into missile payloads with several warheads. Fortunately, Marburg missiles were never used, but other bioweapons have been used, such as ceramic bombs filled with plague-infested fleas that were used by Japan against a Chinese city during World War II and *Salmonella* used in the Rajneeshee bioterror attack in 1984 that contaminated Oregon salad bars.<sup>12</sup> The effects of such attacks are fatal at worst and drive panic at best.

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Despite similarities between bioweapons and natural outbreaks of viral diseases, the bioweapon conspiracy theories are easily invalidated. Biowarfare as imagined by the public is different from biowarfare that has been deployed in real life. Casualty from a successfully deployed bioweapon has never been remotely close to the devastation caused by this pandemic, and most likely, never will. International laws have limited all known bioweapons production, and developing a weaponized form of a virus would require months of complete secrecy using gene-editing technology. With advanced CRISPR-Cas systems, weapons development could be shortened to weeks, but this is virtually impossible with the current controls in place. The Biological Weapons Convention of 1972 declared the development, production, and stockpiling of bioweapons a war crime. As of August 2019, 183 countries ratified or acceded to the treaty, including China, Russia, Iran, and the United States. Some countries have expressed reservations because the Biological Weapons Convention allows for stockpiling of biological agents and toxins for “prophylactic, protective, or other peaceful purposes.”<sup>13,14</sup> For example, smallpox virus is still stored for these reasons at the Centers for Disease Control and Prevention in Atlanta, Georgia, and the Vector Institute in Russia.

Although the United States, Russia, United Kingdom, Syria, Japan, and Iraq have had bioweapon programs in the past, China and Iran have never admitted to a developed program,<sup>12,13,15</sup> although small-scale production is certainly possible. The US Department of State’s 2020 Compliance Report notes, “The United States does not have sufficient information to determine whether China eliminated its assessed biological warfare program, as required under Article II of the Convention.”<sup>14</sup> Still, the historical effect of bioweapons pales in comparison to the devastation of COVID-19.

Epidemiologic indicators can be used to differentiate between bioweapon attacks and natural outbreaks of disease. The clues include exceptions to geographic or seasonal distribution and unusual presentation of illness for certain populations or age groups. Influenza outbreaks during winter months in northern latitudes are not unusual, but pulmonary anthrax in populated areas of the US East Coast is alarming. COVID-19 does not fit any unnatural indicators. Coronaviruses (and all respiratory viruses) are most common in winter months, as was the case in China in late 2019. Mostly, this results from large numbers of people gathering in enclosed spaces, breathing the same air. In addition, coronaviruses are common in China and derive from animal reservoirs. For SARS-CoV-2, the virus most likely evolved from bats, a finding reported in *Nature Medicine*.<sup>16</sup> In western China, horseshoe bats are abundant, and consumption of wild animals—part of the region’s culture—is a \$76 billion industry;<sup>17</sup> therefore, finding zoonotic diseases is not unusual, as the population interacts regularly with wildlife.

## Laboratory Leaks

The second major theory on the origin of the pandemic is that it resulted from a leak at a laboratory performing legitimate

research. Considering China’s lack of transparency, concerns about an accidental release of a deadly microbe are understandable, and it has happened before. In 1977, the H1N1 virus was thought to have leaked from a Chinese laboratory.<sup>18</sup> During the first outbreak of SARS in 2004, two accidental releases from a Beijing laboratory were reported to have occurred.<sup>19</sup> In 1979, anthrax spores were released accidentally from a Soviet research facility near Sverdlovsk, Russia.<sup>20</sup> These events provide some background for accidental-release theories for SARS-CoV-2. As reported in *Nature Medicine*, had there been genetic manipulation, it would have been done with a reverse-genetic system used for betacoronaviruses.<sup>16</sup> The study conclusively showed from genetic data, however, that SARS-CoV-2 did not derive from any previously used viral framework. The authors proposed two explanations for the origin of SARS-CoV-2: “natural selection occurred in an animal host *before* zoonotic transfer; and natural selection in humans occurred *after* zoonotic transfer.” Either way, the results effectively eliminated the possibility of a laboratory leak with a genetically manipulated or “enhanced” virus. With an evidence-based approach, the authors described that if this virus came from a laboratory, then it would have signs of human manipulation; however, this virus does not.

## Conclusions

From the beginning, the COVID-19 epidemic quickly became a pandemic. The damage still has no end in sight, but there is hope from the early successes of vaccination programs. Ironically, vaccine development received a head start from the same laboratory studying coronaviruses in Wuhan that was suspected of leaking the virus. This laboratory had already sequenced the viral genome and shared its code, thus eliminating months of standard vaccine research.<sup>21</sup> Ultimately, the country where the pandemic started could help to end it.<sup>22</sup> More than ever, experts—physicians, healthcare workers, and community leaders—must continue to acknowledge the threat and encourage calm until the vaccine is available to everyone. Science must guide in a manner that maintains hope and attains the shortest path to normalcy. This will permit coordinated efforts to minimize the current devastation and, in establishing where this pandemic came from, allow for the first step toward preventing such a pandemic from occurring again.

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## References

1. Johns Hopkins University Medicine. Coronavirus resource center. <https://coronavirus.jhu.edu/map.html>. Accessed December 3, 2020.
2. Pamuk H, Brunnstrom D. U.S. summons Chinese envoy over Beijing’s coronavirus comments. <https://www.reuters.com/article/us-health-coronavirus-china-diplomacy-idUSKBN2102XW>. Updated March 13, 2020. Accessed December 1, 2020.

3. Stevenson A. Senator Tom Cotton repeats fringe theory of coronavirus origins. <https://www.nytimes.com/2020/02/17/business/media/coronavirus-tom-cotton-china.html> Updated February 18, 2020. Accessed December 1, 2020.
4. Palestinian writers: the coronavirus is a biological weapon employed by U.S., Israel against their enemies. <https://www.memri.org/reports/palestinian-writers-coronavirus-biological-weapon-employed-us-israel-against-their-enemies>. Updated March 24, 2020. Accessed December 1, 2020.
5. Rogin J. State Department cables warned of safety issues at Wuhan lab studying bat coronaviruses. <https://www.washingtonpost.com/opinions/2020/04/14/state-department-cables-warned-safety-issues-wuhan-lab-studying-bat-coronaviruses/>. Updated April 14, 2020. Accessed December 1, 2020.
6. Barnes JE. C.I.A. hunts for authentic virus totals in China, dismissing government Tallies. <https://www.nytimes.com/2020/04/02/us/politics/cia-coronavirus-china.html>. Updated April 16, 2020. Accessed Dec 1, 2020.
7. Cohen J, Normille D. China delivers verdict on gene editing of babies. *Science* 2020;367:130.
8. Rabinowitz P, Gordon Z, Chudnov D, et al. Animals as sentinels of bioterrorism agents. *Emerg Infect Dis* 2006;12:647–652.
9. Bartlett SL, Diel DG, Wang L, et al. SARS-COV-2 infection and longitudinal fecal screening in Malayan tigers (*Panthera tigris jacksoni*), Amur tigers (*Panthera tigris altaica*), and African lions (*Panthera leo krugeri*) at the Bronx Zoo, New York, USA. *J Zoo Wildl Med* 2021;51:733–744.
10. Alibek K, Handelman S. *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told from the Inside by the Man Who Ran It*. New York: Random House; 1999.
11. Koopmans M. SARS-CoV-2 and the human-animal interface: outbreaks on mink farms. *Lancet Infect Dis* 2021;21:18–19.
12. Riedel S. Biological warfare and bioterrorism: a historical review. *Proc (Bayl Univ Med Cent)* 2004;17:400–406.
13. United Nations Office for Disarmament Affairs. Biological weapons convention. [https://www.un.org/disarmament/biological-weapons/#:~:text=The%20Biological%20Weapons%20Convention%20\(BWC,of%20mass%20destruction%20\(WMD\)](https://www.un.org/disarmament/biological-weapons/#:~:text=The%20Biological%20Weapons%20Convention%20(BWC,of%20mass%20destruction%20(WMD).). Accessed June 1, 2021.
14. US Department of State. Executive Summary of the 2020 Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments (Compliance Report). <https://2017-2021.state.gov/2020-adherence-to-and-compliance-with-arms-control-nonproliferation-and-disarmament-agreements-and-commitments-compliance-report/index.html>. Accessed June 1, 2021.
15. Arms Control Association. Chemical and biological weapons status at a glance. <https://www.armscontrol.org/factsheets/cbwprolif>. Accessed December 7, 2020.
16. Andersen KG, Rambaut A, Lipkin WI, et al. The proximal origin of SARS-CoV-2. *Nat Med* 2020;26:450–452.
17. Zhang L, Yin F. Wildlife consumption and conservation awareness in China: a long way to go. *Biodivers Conserv* 2014;23:2371–2381.
18. Nakajima K, Desselberger U, Palese P. Recent human influenza A (H1N1) viruses are closely related genetically to strains isolated in 1950. *Nature* 1978;274:334–339.
19. Walgate R. SARS escaped Beijing lab twice. *Genome Biol* 2004;4:spotlight-20040427–03.
20. Meselson M, Guillemin J, Hugh-Jones M, et al. The Sverdlovsk anthrax outbreak of 1979. *Science* 1994;266:1202–1208.
21. Thanh Le T, Andreadakis Z, Kumar A, et al. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov* 2020;19:305–306.
22. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 2020;395:565–574.