

Did a Review of Samples Collected from a Mineshaft Cause the COVID-19 Pandemic?

Abstract

The origin of the COVID-19 pandemic caused by SARS-CoV-2 has been hotly debated. Proponents of the natural spillover theory allege that the virus jumped species, possibly via an intermediary host, to cross over to humans via the wildlife trade or by other means. Proponents of a rival theory allege that the virus escaped from a laboratory in Wuhan. This research presents circumstantial evidence of a transmission route via a late 2019 review of samples collected from a mineshaft in Mojiang, Yunnan Province, China. It examines the activity at the Wuhan Institute of Virology in late 2019, when samples from a mineshaft associated with a suspected SARS outbreak were being reviewed. It proposes that spillover occurred during this review of samples including of a virus (BtCoV/4991) only 1% different to SARS-CoV-2 in its RNA-dependent RNA polymerase (RdRp). It also proposes that the chance of identifying the outbreak may have been reduced by the issuance of new influenza guidance in November 2019.

Introduction

Several Wuhan laboratories conducted research into SARS or SARS-related coronaviruses in the years prior to the pandemic. These include facilities at Huazhong University, the Wuhan Center for Disease Control (WHCDC), the Wuhan Institute of Virology (WIV) and Wuhan University (WU). This research focuses on a program connecting these institutions and presents information supporting a potential spillover event due to mishandling of a sample or specimen stored at the WIV in late 2019. This is proposed to have taken place during a well-documented review of samples and specimens collected under the multiyear program that identified the closest known virus to SARS-CoV-2.

Much initial focus was on the wild animal trade at the Huanan Seafood Market, where the first reported cases were publicly confirmed. However, the earliest publicly reported case using unclassified data had no exposure to the Huanan Seafood Market¹ and developed symptoms on 1 December 2019, nine days before the first patient connected to the Market developed symptoms. The virus strains sampled in the market were shown to be already adapted to human transmission², indicating that the virus had jumped species earlier.

The theory of infected lab animals being sold at the market has been proposed, as some species listed on a board as for sale at the market³ were the same as those used for

¹ Huang et al. "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China." *The Lancet*, 24 January 2020. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)

² Zhan et al. "SARS-CoV-2 is well adapted for humans. What does this mean for re-emergence?" *bioRxiv*, 2 May 2020. <https://doi.org/10.1101/2020.05.01.073262>

³ Jansen, Chiu-Ti. "China must outlaw the trade and consumption of exotic animals, not only to protect endangered species, but also for the health of mankind." *South China Morning Post*, 2 February 2020. <https://www.scmp.com/comment/opinion/article/3048426/china-must-outlaw-trade-and-consumption-exotic-animals-not-only>

virology experiments in Wuhan. There has been no public confirmation of lab animals being sold at the Huanan Seafood Market.

The pangolin theory relies on data made public by the State Key Laboratory of Pathogen and Biosecurity, under the Beijing Institute of Microbiology and Epidemiology, under the People's Liberation Army (PLA)'s Academy of Military Sciences, on 22 January 2020⁴. This lab was the single source of pangolin data used in multiple research papers, without this single source being disclosed⁵. While the data from this lab was reportedly from smuggled pangolins, no evidence has been found of coronaviruses in Sunda pangolins entering the wildlife trade via Malaysia⁶. Additionally, as the pangolin ACE2 receptor has a low binding affinity for the SARS-CoV-2 Receptor Binding Domain (RBD)⁷, it appears unlikely to be the intermediary host.

The remaining prevalent theories are of zoonotic transfer of the virus⁸ by perhaps an unidentified intermediary species during serial passage, or of a leak from a Wuhan laboratory⁹. This research provides a compilation of circumstantial evidence in support of the theory that the virus leaked from a Wuhan laboratory, and a brief summary of research into seroprevalence of SARS antibodies in South China.

Part 1 describes the evidence of an outbreak before December 2019, the guidance that appears to have made it less likely to be detected, relevant 2005 International Health Regulations (IHR) notification requirements and social media data showing discussion of a novel coronavirus.

Part 2 examines the program that the first published SARS-CoV-2 sequence was reportedly identified under, and identification of the closest match to SARS-CoV-2 under a similar program involving sampling bat coronaviruses and performing experiments with them.

Part 3 covers the activity at the WIV in late 2019 and early 2020, including a review of samples from the program that identified the closest match to SARS-CoV-2 and self-isolation procedures.

Part 4 briefly addresses the natural zoonotic spillover theory.

⁴ Guangdong Institute of Applied Biological Resources. "Viral diversity and pathogens of dead Malay pangolin samples." *NCBI*, 22 January 2020. <https://archive.is/tKRG0#selection-1839.0-1839.10>

⁵ Yujia, Alina Chan and Shing, Hei Zhan. "Single source of pangolin CoVs with a near identical Spike RBD to SARS-CoV-2." *bioRxiv*, 7 July 2020. <https://doi.org/10.1101/2020.07.07.184374>

⁶ Lee et al. "No evidence of coronaviruses or other potentially zoonotic viruses in Sunda pangolins (*Manis javanica*) entering the wildlife trade via Malaysia." *bioRxiv*, 19 June 2020. <https://doi.org/10.1101/2020.06.19.158717>

⁷ Frutos et al. "COVID-19: Time to exonerate the pangolin from the transmission of SARS-CoV-2 to humans." *Infection, Genetics and Evolution*, 5 August 2020. <https://doi.org/10.1016/j.meegid.2020.104493>

⁸ Andersen et al. "The proximal origin of SARS-CoV-2." *Nature*, 17 March 2020. <https://doi.org/10.1038/s41591-020-0820-9>

⁹ Sirotkin Karl and Sirotkin, Dan. "Might SARS-CoV-2 Have Arisen via Serial Passage through an Animal Host or Cell Culture?" *BioEssays*, 12 August 2020. <https://doi.org/10.1002/bies.202000091>

1. Evidence of a COVID-19 outbreak before December 2019

1.1 Evidence suggests that SARS-CoV-2 had been circulating in Wuhan months before the outbreak was reported publicly

- i. Satellite images show that Wuhan hospitals had been overcrowded from September 2019¹⁰, supported by anecdotal evidence in November¹¹.
- ii. One Wuhan PhD student was warned of a pneumonia outbreak in September 2019¹², followed by a major pneumonia outbreak in November that was concealed.
- iii. The earliest independently verified classified Chinese government data showed that one patient contracted the virus on 17 November¹³, weeks before the earliest identified cases from the Huanan Seafood Market.
- iv. Evidence within the virus itself indicates that it had already adapted to human-human transmission before being detected in December¹⁴.
- v. Athletes competing in the October Wuhan Military Games reportedly fell ill after arriving in Wuhan¹⁵, and six later tested positive for SARS-CoV-2 antibodies¹⁶.

1.2 Hospitals were told to stop isolating virus specimens from respiratory disease patients testing negative for influenza in November 2019

The below analysis of influenza guidance seeks to partly explain why the virus was not reportedly detected until December 2019.

On 13 November 2019¹⁷, China's National Health Commission (NHC) issued new influenza guidance¹⁸ instructing hospitals to check the blood-oxygen levels¹⁹ of patients with respiratory disease-related pneumonia and to look for what are also COVID-19 symptoms. These included: pneumothorax and mediastinal emphysema; acute

¹⁰ Nsoesie, Elaine Okanyene, Benjamin Rader, Yiyao L. Barnoon, Lauren Goodwin, and John S. Brownstein. "Analysis of hospital traffic and search engine data in Wuhan China indicates early disease activity in the Fall of 2019." *Harvard Medical School*, 2020. <http://nrs.harvard.edu/urn-3:HUL.InstRepos:42669767>

¹¹ nicky511915. "武汉大学人民医院 Renmin Hospital of Wuhan University 湖北省人民医院 Hubei General Hospital." *Twitter*, 27 November 2019. <http://archive.is/Kyr1z>

¹² M. "International student stranded in Wuhan describes scene in coronavirus-hit city." *Arirang News*, 3 February 2020. https://www.youtube.com/watch?v=8uIVf_o9aXM&feature=youtu.be&t=214

¹³ Ma, Josephine. "China's First Confirmed Covid-19 Case Traced Back to November 17." *South China Morning Post*, 13 Mar. 2020, www.scmp.com/news/china/society/article/3074991/coronavirus-chinas-first-confirmed-covid-19-case-traced-back.

¹⁴ Zhan et al. (2020)

¹⁵ "Varios españoles enfermaron en los juegos militares de Wuhan y a su regreso." *EFE*, 8 May 2020. <https://archive.is/r0ICN>

¹⁶ "Seis de 138 militares que viajaron a los juegos de Wuhan dan positivo a anticuerpos del coronavirus." *EFE*, 19 June 2020. <https://archive.is/hz6vR>

¹⁷ The Author. "How Many COVID-19 Cases Were Misreported as Influenza in China?". *Telegram*, 2020. <https://graph.org/2019-Influenza-Plan-08-29>

¹⁸ "2019版流感方案公布 新添医院感染控制措施." *Sina Weibo News*, 14 November 2019. <https://archive.is/xOcdH>

¹⁹ National Health Commission of the People's Republic of China. "医务人员流感培训手册 (2019年版)." *Government of Shanghai*, 2019. <https://archive.is/XrRUV>

necrotizing encephalopathy²⁰; and multifocal brain damage, including of the bilateral thalamus and white matter around the ventricle.

The 2019 plan reversed previous guidance on testing by telling hospitals that isolating virus specimens from patients who test negative for influenza was no longer recommended, and said that a negative antigen test cannot rule out influenza.

The statement that a negative antigen test cannot rule out influenza is consistent with the equivalent US CDC guidance²¹, but the change to not recommending virus specimen isolation in China's 2019 plan is not. This US CDC recommends virus specimen isolation for novel virus identification²²²³.

China's 2018 and 2019 medical guidance both state that virus specimen isolation is used to identify novel viruses and for virus mutation analysis²⁴. This research proposes that China's NHC appears to have discouraged detection of novel viruses and made clinical misdiagnosis of COVID-19 as influenza more likely by changing the guidance to say that virus specimen isolation is not recommended for respiratory disease patients testing negative for influenza.

The COVID-19 outbreak was made public by the isolation of virus specimens from patients testing negative for influenza²⁵, against the recommendation of the 2019 influenza guidance. The results of this specimen isolation were shared with Dr Li Wenliang, who shared the results with others who shared them with the world.

The influenza plan and medical staff handbook were drafted by an expert group under China's NHC, headed by Wang Chen with SARS expert Zhong Nanshan as a consultant²⁶. Other members include respiratory disease specialists from various institutes.

The social vaccination idea later encouraged by the WHCDC²⁷ was promoted at the group's press conference²⁸. It encourages frequent handwashing, avoiding touching the face and wearing a mask. This concept was supported by guidance from the Hubei CDC,

²⁰ “流行性感冒诊疗方案（2019年版）。” National Health Commission of the People's Republic of China, 2019. <https://archive.is/zup74>

²¹ “Rapid Influenza Diagnostic Tests.” *United States Centers for Disease Control and Prevention*, accessed 23 September 2020. <https://archive.is/U8HMg>

²² “Overview of Influenza Testing Methods.” *United States Centers for Disease Control and Prevention*, accessed 26 September 2020. <https://archive.is/4xabj>

²³ “Influenza Signs and Symptoms and the Role of Laboratory Diagnostics.” *United States Centers for Disease Control and Prevention*, accessed 26 September 2020. <https://archive.is/GY9NI>

²⁴ National Health Commission of the People's Republic of China. “医务人员流感培训手册（2019年版）。” *Government of Shanghai*, 2019. <https://archive.is/XrRUV>

²⁵ Page, Jeremy and Wei, Lingling. “China's CDC, Built to Stop Pandemics, Stumbled When It Mattered Most”. *The Wall Street Journal*, 17 August 2020. <http://archive.is/yvPO#selection-1203.0-1211.213>

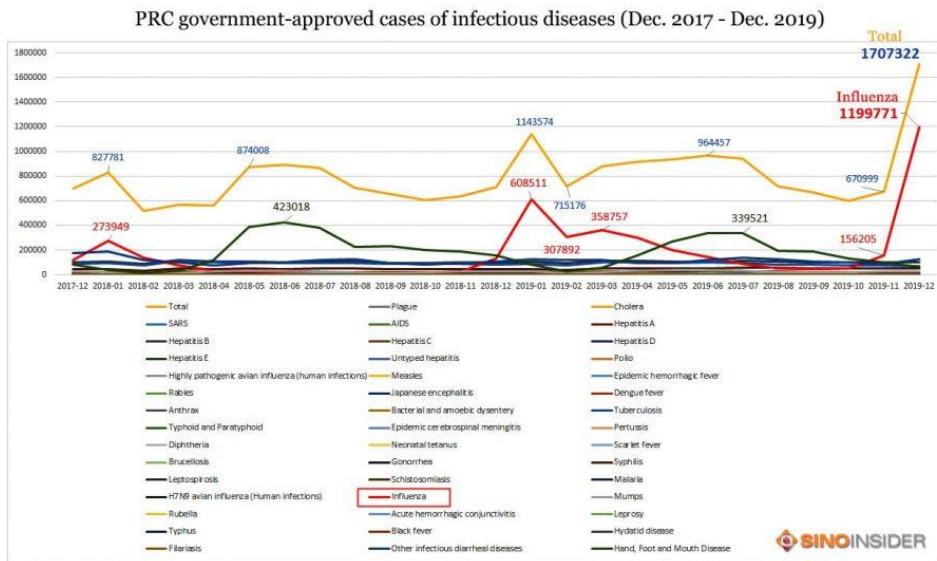
²⁶ “【重磅】全国流感医疗救治专家组专家名单公布！” *Health Daily News*, 21 October 2019. <https://archive.is/fLpKx>

²⁷ Jian, Jing Chu. “流感季防控处方：全民接种“社会疫苗”。 *KK News*, 20 December 2019. <http://archive.is/hEXwH>

²⁸ “国家卫生健康委举行新闻发布会 介绍我国流感防控工作有关情况。” *Government of the People's Republic of China*, 30 October 2019. <https://archive.is/Ze0Ww>

which on 20 December issued instructions²⁹ encouraging frequent handwashing, avoiding crowded places, outdoor physical exercise and advising those with flu-like symptoms to wear masks to prevent transmission to other family members, and seek medical attention if symptoms continue to develop.

Soon after this guidance was issued, pneumonic influenza outbreaks and overcrowded hospitals were reported in Hubei and across China³⁰ and the WHCDC publicly refuted rumours of an influenza outbreak on 20 December³¹. This was during an unusually large and early spike in officially reported influenza cases³².



Sino Insider, 2020

This change in influenza guidance is proposed to have increased the chance of misdiagnosis of COVID-19 cases as influenza. This is proposed to at least partly explain how SARS-CoV-2 may have spread undetected before December 2019.

1.3 2005 International Health Regulations

Knowing when authorities knew about the epidemic is important. As a signatory to the 2005 International Health Regulations, the Chinese government has an obligation under Article 6 to assess an event within 48 hours and then report it to the WHO within 24

²⁹ “流感进入冬春季活跃期 湖北疫情可防可控可治。” Government of Hubei, 22 December 2019.

<http://archive.is/pLDCv>

³⁰ The Author. “How Many COVID-19 Cases Were Misreported as Influenza in China?”. *Telegram*, 2020.

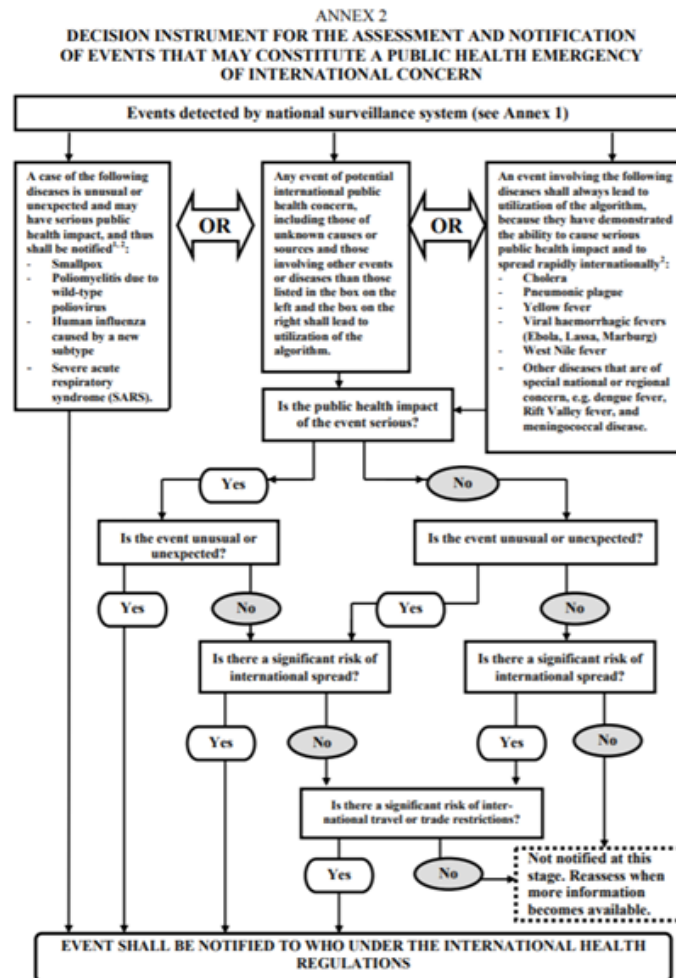
<https://graph.org/2019-Influenza-Plan-08-29>

³¹ “这张流感分布图在武汉家长群疯传！疾控中心回应。” *Changjiang Daily*, 20 December 2019.

<https://archive.is/zt5gc>

³² “Risk Watch: Atypical Influenza Data Hints at Earlier Transmission of Coronavirus in China.” *Sino Insider*, 14 June 2020. <https://archive.is/zsKvz>

hours³³. The WHO was informed of the outbreak on 31 December 2019 by its own country office, and by China's government on 3 January 2020³⁴.



¹ As per WHO case definitions.

² The disease list shall be used only for the purposes of these Regulations.

Notification decision making tool of the 2005 International Health Regulations

There are reasonable grounds to independently investigate a violation of the Regulations. The Chinese Communist Party (CCP) routinely covers up evidence of epidemics: Chinese censors had instructed social media platforms to cover up reports of a pneumonic plague outbreak on 12 November 2019³⁵, and discussion of the COVID-19 outbreak was censored from at the latest 31 December 2019³⁶, three days before China notified the WHO of the outbreak.

³³ "International Health Regulations (2005) Third Edition", *World Health Organization*, 2016.

<https://apps.who.int/iris/bitstream/handle/10665/246107/9789241580496-eng.pdf>

³⁴ "Timeline of WHO's response to COVID-19." *World Health Organization*, 29 June 2020.

<http://archive.is/fYNM9>

³⁵ Wee, Sui-Lee. "Plague Is Diagnosed in China, Prompting Fears of an Outbreak." *The New York Times*, 13 November 2019. <https://archive.is/N9P2p>

³⁶ Ruan et al., "Censored Contagion: How Information on the Coronavirus is Managed on Chinese Social Media." *The Citizen Lab*, 3 March 2020.

2. Viral pathogen programs in Wuhan

2.1 First publicly shared SARS-CoV-2 sequence collected under bat virus program

On 11 January 2020, a team of scientists led by Professor Zhang Yongzhen of the Shanghai Public Health Clinical Center published the full SARS-CoV-2 genome sequence. This had reportedly been collected by the team from the Wuhan Central Hospital and the WHCDC on 26 December 2019, but not delivered to the Shanghai lab until 3 January 2020³⁷. It was then fully sequenced and submitted to the Chinese NHC on 5 January. The WIV had submitted a similar sequence on 2 January. Another lab had reportedly submitted a SARS-CoV-2 sequence to the Chinese Academy of Medical Science's Institute of Pathogen Biology on 27 December³⁸.

After waiting for days without the authorities publishing the sequence, on 11 January Professor Zhang's team published it in full, allowing the world to begin research. China's government shut the Shanghai lab down the following day for "rectification"³⁹.

Professor Zhang had said that the samples were collected from patients as a part of the team's long term cooperation with the WHCDC and the Hospital under the program "Scientific survey of the principal natural viral pathogen resources in China"⁴⁰. One of Professor Zhang's team later said that this had been going on for many years⁴¹.

This Ministry of Science and Technology program had recently gone through a tendering process over 11 July-13 September 2019⁴². Winners were required to identify five major novel viral pathogens from wild animals including bats, and carry out biosecurity risk assessments by testing them on small animals. Its assessment indicators were to:

- 1) Submit a report on the lineage, genetic characteristics and geographical distribution of viral pathogen carriers such as bats, birds, mosquitoes, rodents and ticks in key regions of China;
- 2) Obtain genomes of more than 100 novel viruses / strains;
- 3) Isolate, identify, collect and preserve 50 major viral pathogens;

<https://web.archive.org/web/20200303141248/https://citizenlab.ca/2020/03/censored-contagion-how-information-on-the-coronavirus-is-managed-on-chinese-social-media/>

³⁷ Campbell, Charlie. "Exclusive: The Chinese Scientist Who Sequenced the First COVID-19 Genome Speaks Out About the Controversies Surrounding His Work." *Time*, 24 August 2020. <https://archive.is/l9F5p>

³⁸ "独家 | 新冠病毒基因测序溯源：警报是何时拉响的." *Caixin*, 26 February 2020. <https://archive.is/yJLzy>

³⁹ Zhuang, Pinghui. "Chinese laboratory that first shared coronavirus genome with world ordered to close for 'rectification', hindering its Covid-19 research." *South China Morning Post*, 28 February 2020. <http://archive.is/1bp3X>

⁴⁰ "中国应对新型冠状病毒获国际认可." *RMZXB*, 17 January 2020. <https://archive.is/BKCK4>

⁴¹ Ma, Danmeng and Di, Ning. "特稿 | 抗疫上海故事：先行者的经验与挑战." *Caixin*, 27 February 2020. <https://archive.is/OtpxF>

⁴² "科技部关于发布科技基础资源调查专项2019年度项目指南的通知 国科发基〔2019〕236号." *Ministry of Science and Technology of the People's Republic of China*, 11 July 2019. <http://archive.is/HA9ql>

4) Analyse the pathogenic characteristics of 10 major novel viruses / strains, including at least five major novel viral pathogens, based on a biosecurity risk assessment at the cellular and small animal level; and

5) Establish a standardised viral pathogen resource library and shared database.

The project was awarded to Professor Zhang's team and then suspended⁴³. As the project was not running at the time of the collection of these virus samples, Professor Zhang's team likely referred to another very similar project led by the WIV.

2.2 The WIV's viral pathogen program

The WIV had been running a program very similar to the program under which Professor Zhang's team obtained SARS-CoV-2 for years. The program, "Investigation of viral pathogens of major natural hosts and vector insects in China" (2013FY113500), launched in May 2013⁴⁴ and was being reviewed around the time of the outbreak.

It carried out extensive research into viral pathogen vectors and was already running a database very similar to that described in the new program, containing data on arthropod, bat and rodent viruses.

Under this program, the WIV investigated the main natural virus hosts and vectors in China, taking samples from bats, birds, mosquitoes, rodents and ticks⁴⁵. The WIV had collected over 15,000 such samples from bats, over 1,400 live viruses and over 60,000 strains⁴⁶. Data from over 20,000 samples and specimens collected on such trips were stored on an WIV database, and the samples themselves were stored at -80°C⁴⁷.

Research into ACE2 receptors and Spike proteins of SARS-related coronaviruses and vaccines was funded under the program⁴⁸. SARS vaccine research had been carried out at Wuhan University⁴⁹ and other institutions. However, exploring whether SARS-CoV-2 was created during WIV gain of function experiments in researching ACE2 receptor binding of SARS-related coronavirus Spikes for a vaccine is beyond the scope of this research.

⁴³ Zhuang, Pinghui. "Chinese survey and database on important new viruses 'delayed by red tape'." *South China Morning Post*, 1 July 2020. <https://archive.is/Lbemz>

⁴⁴ "我国重要自然宿主及媒介昆虫病毒病原调查"启动.' *Government of the People's Republic of China*, 24 June 2013. <http://archive.is/OIC5C>

⁴⁵ Yuan, Zhiming. "Investigation of Viral Pathogen Profiles in Some Natural Hosts and Vectors in China." *Virologica Sinica*, 8 March 2018. <https://dx.doi.org/10.1007/s12250-018-0021-6>

⁴⁶ Zheng, Qianli. "【中国科学报】江夏演新文 乘鹤奏悠曲——记中科院武汉病毒所P4实验室建设和研究团队." *Science China Press*, 8 January 2018. <https://archive.is/V3GHk>

⁴⁷ Shi et al., "野生动物携带病毒病原特色数据库 Wildlife-borne Viral Pathogen Database." *科学大数据工程*, 4 June 2019. <https://doi.org/10.11922/csdata.2019.0018.zh> | <https://archive.is/Sz1dO>

⁴⁸ The Author. "Research funded under 2013FY113500." *Extends Class*, 2020. <https://extendsclass.com/csv-editor.html#dfdddab>

⁴⁹ Luo et al. "Evaluation of Antibody-Dependent Enhancement of SARS-CoV Infection in Rhesus Macaques Immunized with an Inactivated SARS-CoV Vaccine." *Virologica Sinica*, 14 March 2018. <https://dx.doi.org/10.1007%2Fs12250-018-0009-2>



Viral pathogen vectors investigated by the Wuhan Institute of Virology, *Virologica Sinica* Volume 33 Issue 1, February 2018

2.3 Mojiang mine-related unknown pneumonia outbreak

The WIV collected samples containing BtCoV/4991, later known as RaTG13, under the program⁵⁰. The partial BtCoV/4991 sequence published in 2016 is a 98.9% match to SARS-CoV-2⁵¹. The complete RaTG13 genome published by the WIV after the COVID-19 outbreak is a 96.1% match to SARS-CoV-2⁵². This is by far the closest known match, and 87% of the difference may be explained by deamination in host⁵³. A comparison of top mismatches between the SARS-CoV-2 and RaTG13 reference genomes is below.

Blast Results				
SARS-CoV-2 Reference Genome	T	C	G	A
RaTG13 Reference Genome	C	T	A	G
Mismatches	350	331	136	127

The question of whether RaTG13 is a result of a passage experiment of SARS-CoV-2 or was created *in silico* and published after the outbreak as a diversion is beyond the scope of this research. The presence of weak matches to *mus musculus* in its amplicon sequences⁵⁴ may be explained by in-lab contamination as well as by passage or sequencing errors.

⁵⁰ Ge et al. "Coexistence of multiple coronaviruses in several bat colonies in an abandoned mineshaft." *Virologica Sinica* 2016 Feb;31(1):31-40, 18 February 2016. <https://doi.org/10.1007/s12250-016-3713-9> | <https://archive.is/ECxfX>

⁵¹ NCBI Blast result for BtCoV/4991, 31 May 2020 <https://archive.is/n1P0q>

⁵² NCBI Blast result for RaTG13, 31 May 2020 <https://archive.is/4MXsR>

⁵³ Li et al. "The divergence between SARS-CoV-2 and RaTG13 might be overestimated due to the extensive RNA modification." *Future Virology*, 24 March 2020. <https://doi.org/10.2217/fvl-2020-0066>

⁵⁴ The Author. "How Close is RaTG13 to SARS-CoV-2?" *Telegram*, 20 June 2020. <https://graph.org/RaTG13-07-06>

According to WIV research, similar SARS-related coronaviruses appear to cluster geographically⁵⁵. This means that SARS-CoV-2 would be more likely to be present in the same area that BtCoV/4991 was collected from.

BtCoV/4991 was identified from samples collected on trips to investigate a mineshaft associated with a deadly outbreak of unexplained pneumonia in Tongguan, Mojiang, Yunnan, China⁵⁶. The mine had been associated with an outbreak that killed three miners, whose deaths were suspected to be connected to a SARS-related coronavirus. The four tested miners were shown to have carried SARS antibodies⁵⁷.

These cases were not reported in China's unknown pneumonia statistics⁵⁸, despite the PhD thesis being supervised by now head of China's CDC George Gao, and samples being sent to SARS expert Zhong Nanshan's laboratory. The 2005 International Health Regulations state that the WHO should be notified of cases matching the clinical definition of SARS⁵⁹.

2.4 Inconsistent statements on BtCoV/4991 (RaTG13)

The sequence of events described by Shi Zhengli and colleagues in a 2020 paper implied that RaTG13 was sequenced after the WIV found that SARS-CoV-2 matched the short BtCoV/4991 RdRp⁶⁰. This was corroborated by EcoHealth's Peter Daszak, who said that the Wuhan team had worked on it in 2013, but did no more work on it until the COVID-19 outbreak because it had not been a close match to SARS⁶¹. He claimed that "We thought it's interesting, but not high-risk. So we didn't do anything about it and put it in the freezer"⁶².

This is contradicted by the 2017-18 dates present in the filenames of the RaTG13 amplicon and swab sequences^{63,64}. Shi Zhengli later issued a statement saying that the WIV fully sequenced RaTG13 in 2018⁶⁵. There appears to be no reason why the WIV would check

⁵⁵ Yu et al. "Geographical structure of bat SARS-related coronaviruses." *Infectious Genetic Evolution* 2019 Apr; 69: 224–229, 6 February 2019. <https://dx.doi.org/10.1016/j.meegid.2019.02.001>

⁵⁶ Rahalkar, Monali C. and Bahulikar, Rahul A. "Understanding the Origin of 'BatCoV RaTG13', a Virus Closest to SARS-CoV-2." *Preprints*, 2020 <https://www.preprints.org/manuscript/202005.0322/v2>

⁵⁷ Huang, Canping. "Novel Virus Discovery in Bat and the Exploration of Receptor of Bat Coronavirus HKU9." *Chinese Center for Disease Control and Prevention*, June 2016.

⁵⁸ "2012年度全国法定传染病疫情概况." *Chinese Center for Disease Control and Prevention*, 27 March 2013. <http://archive.vn/urMZY>

⁵⁹ "WHO Guidance for the Use of Annex 2 of the International Health Regulations (2005)." *World Health Organization*, 2010. <https://archive.is/MwqID>

⁶⁰ Zhou, P., Yang, X., Wang, X. et al. "A pneumonia outbreak associated with a new coronavirus of probable bat origin." *Nature* 579, 270–273 (2020), 3 February 2020. <https://doi.org/10.1038/s41586-020-2012-7>

⁶¹ Arbuthnott et al. "Revealed: Seven year coronavirus trail from mine deaths to a Wuhan lab." *The Times*, 4 July 2020. <https://archive.is/SJwtx>

⁶² Weiss, Sabrina. "Bats, snakes or pangolins? Inside the hunt for the animal behind the coronavirus outbreak." *Wired*, 16 February 2020. <https://archive.is/ssPlo>

⁶³ Wuhan Institute of Virology. "amplicon_sequences of RaTG13." *NCBI*, 19 May 2020. <https://trace.ncbi.nlm.nih.gov/Traces/sra/?run=SRR11806578>

⁶⁴ Wuhan Institute of Virology. "Bat coronavirus RaTG13 Genome sequencing" *NCBI*, 13 February 2020. <https://trace.ncbi.nlm.nih.gov/Traces/sra/?study=SRP249482>

⁶⁵ Shi, Zhengli. "Reply to Science Magazine." *Science Magazine*, 24 July 2020 https://www.sciencemag.org/sites/default/files/Shi_Zhengli_Q%26A.pdf

SARS-CoV-2 against the short BtCoV/4991 RdRp, then resequence RaTG13 after it had already been sequenced in 2018. Sequencing RaTG13 in 2020 would also not have been consistent with Shi Zhengli’s statement that there was “no more [RaTG13] sample after we finished genome sequencing” in 2018.

RaTG13 was initially uploaded accompanied by a statement saying that it had been extracted from bronchoalveolar lavage fluid⁶⁶, which is inconsistent with it being a bat faecal swab sample.

Despite the initially false claims, the data released by the WIV after the COVID-19 outbreak indicates that it continued to work on RaTG13 for years, publishing amplicon and swab sequences dated June 2017-October 2018. The RaTG13 amplicon sequences differ significantly from the full sequence also uploaded after the outbreak, possibly due to the sequencing method used.



A partial sequence of RaTG13 dated 14 October 2018

Anomalies in the RaTG13 swab have been discussed, including its bacteria concentration and other issues⁶⁷. Unusually, RaTG13 does not appear to be able to bind to the ACE2 receptor of its reported bat host⁶⁸ and binds to human ACE2 around a thousand times less well than SARS-CoV-2 does⁶⁹.

⁶⁶ Wuhan Institute of Virology, “RNA-Seq of *Rhinolophus affinis*:Fecal swab.” *NCBI*, 13 February 2020. <https://archive.is/CmLoh>

⁶⁷ Rahalkar, M.; Bahulikar, R. “The Anomalous Nature of the Fecal Swab Sample Used for RaTG13 Genome Assembly as Revealed by NGS Data Analysis.” *Preprints*, 2020. <https://www.preprints.org/manuscript/202008.0205/v2>

⁶⁸ Mou et al. “Mutations from bat ACE2 orthologs markedly enhance ACE2-Fc neutralization of SARS-CoV-2.” *bioRxiv*, 30 June 2020. <https://doi.org/10.1101/2020.06.29.178459>

⁶⁹ Wrobel et al. “SARS-CoV-2 and bat RaTG13 spike glycoprotein structures inform on virus evolution and furin-cleavage effects.” *Nat Struct Mol Biol* 27, 763–767, 2020. <https://doi.org/10.1038/s41594-020-0468-7>

As the swab sequence contains sequences that appear to be from another betacoronavirus⁷⁰, full disclosure of the sequencing methods would help assess its validity. The misleading statements on RaTG13 calls into question the reliability of any statements made by the WIV about its work. Sequencing methods and any statements made should be interrogated vigorously should the WIV ever publish its currently private viruses such as WIV6 and WIV15.

2.5 The missing WIV bat virus database containing unpublished virus sequences

Data on samples collected by the WIV on their trips to Yunnan were stored in a database that has been taken offline. The database was expanded as part of a long term effort to investigate the link between bat viruses and vectors for the Ministry of Science and Technology⁷¹.

Version 2 of the database was released in June 2019⁷². It improved on other databases like DBatVir by including information on seasonal epidemics of viruses crossing the species barrier into other wild animals, based on samples taken by the WIV in the field. This version had a password protected section for as yet unpublished novel virus sequences.

It presents a HKU9 virus as an example of its contents, sampled on WIV trips to Yunnan, including to Mojiang in 2013⁷³. BtCoV/4991 (RaTG13) was sampled by the WIV in Mojiang in 2013.

Its description was amended significantly in the update to Version 4 on 30 December 2019⁷⁴, replacing references to wild animals with those to bats and rodents. Dr Shi Zhengli was the database administrator and busy at a conference on that day until reportedly being informed of the novel coronavirus outbreak at 19:00.

While Shi Zhengli's public account of the events that day say that she panicked and thought it may have come from her laboratory⁷⁵, and that the WIV Director asked her to "Drop whatever you are doing and deal with it now", the account does not include the publication of an edited description of this bat virus sample database.

⁷⁰ The Author. "Were RaTG13 and SARS-CoV-2 in the same mineshaft?." *Telegram*, 23 July 2020.

<https://graph.org/RaTG13-Coinfection-07-23>

⁷¹ Yuan, Zhiming (2018)

⁷² "野生动物携带病毒病原特色数据库 Wildlife-borne Viral Pathogen Database." *CSDB*, 20 June 2020.

<http://archive.is/HLuio>

⁷³ Luo et al. "Longitudinal Surveillance of Betacoronaviruses in Fruit Bats in Yunnan Province, China During 2009–2016." *Virologica Sinica*, 2 March 2018. <https://dx.doi.org/10.1007/s12250-018-0017-2>

⁷⁴ Shi, Zhengli et al. "蝙蝠源和鼠源病毒病原数据库 Bat and rodent-borne viral pathogen database." *科学大数据工程*, 30 December 2019. <http://archive.is/jPPkB>

⁷⁵ Qiu, Jane. "How China's 'Bat Woman' Hunted Down Viruses from SARS to the New Coronavirus." *Scientific American*, June 2020. <https://archive.is/5ISpy>



Landing page of the Wuhan Institute of Virology's Wildlife-borne Viral Pathogen Database, June 2019

The database was accessed on a near daily basis from 10 April 2019⁷⁶ until it was taken offline in the early hours of 12 September 2019⁷⁷. The database does not appear to have been accessed via its portal since then, despite the 30 December 2019 edits removing keywords related to the COVID-19 epidemic from its description. Records show it being online intermittently without recorded visits from outside of the WIV until early 2020⁷⁸.

6.4GB was downloaded from the 61.5MB SQL database in June 2019 from within the China Science and Technology Network (CSTN)⁷⁹, mainly in Beijing⁸⁰. By September it was accessed almost entirely by the WIV and non-CSTN users⁸¹. This indicates that the WIV were accessing data on viral pathogens from the program that identified RaTG13 well into September 2019.

This fits with the proposed research direction recommended by WIV researchers in March 2019 to investigate cross-species transmission and human pathogenesis of bat

⁷⁶ “野生动物携带病毒病原特色数据库.” *Scientific database Service monitoring & Statistics system*, 2020. <http://archive.is/0y56t>

⁷⁷ “野生动物携带病毒病原特色数据库的状态明细 (2019年9月).” *Scientific database Service monitoring & Statistics system*, 2020. <https://archive.is/AGtFv>

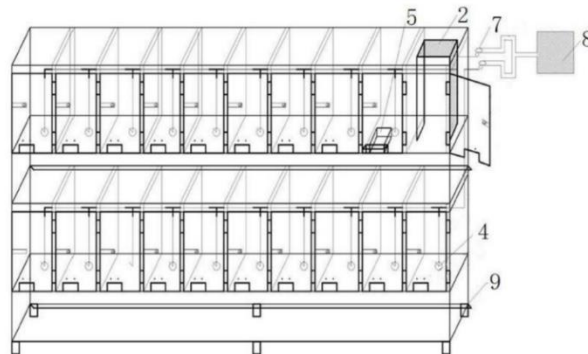
⁷⁸ “野生动物携带病毒病原特色数据库的状态明细 (2019年12月).” *Scientific database Service monitoring & Statistics system*, 2020. <https://archive.is/2A1cN>

⁷⁹ “主机IP 2019年6月.” *Scientific database Service monitoring & Statistics system*, 2020. <https://archive.is/EZIRv>

⁸⁰ “国内来源.” *Scientific database Service monitoring & Statistics system*, 2020. <http://archive.is/l1v6E>

⁸¹ “主机IP 2019年9月.” *Scientific database Service monitoring & Statistics system*, 2020. <https://archive.is/dgHqL>

SARS-related coronaviruses⁸². WIV job postings on 18 November⁸³ and 24 December 2019⁸⁴ indicate that such work was taking place. The WIV's patent for bat rearing cages⁸⁵ indicates that bats are kept on site for such studies.



Design for bat cages in patent filed by the Wuhan Institute of Virology on 15 June 2018

This database and its password protected section with unpublished virus sequences are no longer available publicly, and even the pages describing it have now been taken offline. Related Chinese virus databases have also been taken offline⁸⁶. These include a viral pathogen database also taken offline at approximately 19:00 on 23 September⁸⁷ until 10:00 on 8 October 2020.

The purpose of the WIV wild animal virus database is to provide information on the cross-species transmission of pathogens including bat SARS-related coronaviruses collected by the WIV in Yunnan. That the WIV published an updated version on the day the database administrator was told by the WIV Director to drop whatever she was doing and deal with the COVID-19 outbreak implies that the database was treated as important by the WIV. That its data on seasonal epidemics of bat viruses remains inaccessible during a bat SARS-related coronavirus pandemic calls into question the transparency of the WIV and its willingness to share factual information relating to its bat coronaviruses.

⁸² Fan, Yi et al. "Bat Coronaviruses in China." *Viruses* vol. 11,3 210, 2 March 2019.
<https://dx.doi.org/10.3390%2Fv11030210>

⁸³ "武汉病毒研究所周鹏学科组博士后招聘启事." *Wuhan Institute of Virology*, 18 November 2019.
<https://archive.is/QU22i>

⁸⁴ "武汉病毒所石正丽学科组博士后招聘启事." *Wuhan Institute of Virology*, 24 December 2019.
<http://archive.is/g4GQi>

⁸⁵ Wuhan Institute of Virology. "A kind of carnivorous bat rearing cage." *Google Patents*, 2018.
<https://patents.google.com/patent/CN208317981U/en>

⁸⁶ "病毒编目数据库 Database of Virus Taxonomy." *NSDC*, 2020.

<http://web.archive.org/web/20200420215702/http://www.viruses.nsd.cn/bdbm.jsp>

⁸⁷ "重要病毒性病原检测专业数据库." *Scientific database Service monitoring & Statistics system*, 2020.
<https://archive.is/7MkSA>

2.6 Inspections of samples from the program that identified RaTG13

To understand why the database may have been taken offline on 12 September 2019, it is worth examining what was happening at the WIV at that time, when the program that identified RaTG13 was being reviewed.

Such reviews include a financial and management audit by an approved auditor⁸⁸, spot checks⁸⁹ including on-site inspections of samples and specimens⁹⁰ collected under the program and a review of data accumulated under it, including that relating to samples and specimens⁹¹.

The WIV were told that spot checks of samples and specimens collected under the program such as those containing RaTG13 may occur at any time during the review. Inspections of the WIV had previously also looked at model animals used in experiments⁹².

On-site inspections of such projects across China were carried out by the Ministry of Science and Technology's Basic Research Department⁹³. The Department had visited the WIV in March 2019 and discussed construction of its biosafety level four (BSL-4/P4) lab, expressing hope that this would improve biosafety standards⁹⁴.

The WIV were instructed to ensure that samples and specimens including those collected from the Mojiang cave were stored appropriately ready for inspection.

The process of physically going through samples and specimens from this project is the proposed means by which a spillover event occurred.

That samples from the mineshaft had been accessed before the COVID-19 outbreak is corroborated by a paper published on 29 January 2020⁹⁵, which states that samples of bat coronaviruses collected during previous surveillance projects were extracted from bat swabs, referencing the Ge et al. (2016) paper discussing the discovery of BtCoV/4991 in the Mojiang mineshaft.

⁸⁸ ““十三五”期间国家科技计划资金审计会计师事务所入围名单。” *Ministry of Science and Technology of the People's Republic of China*, June 2016. <http://archive.is/METqp#selection-1933.0-1933.2>

⁸⁹ “科技部基础研究司 资源配置与管理司关于开展科技基础性工作专项项目综合绩效评价工作的通知 国科基函〔2019〕4号。” *Ministry of Science and Technology of the People's Republic of China*, 4 July 2019. <http://archive.is/plwh4#selection-655.74-655.121>

⁹⁰ “科技基础性工作专项项目综合绩效评价规范。” *Ministry of Science and Technology of the People's Republic of China*, 12 August 2019. <http://archive.is/du2dJ#selection-1325.0-1345.11>

⁹¹ “科技基础性工作专项项目 基本信息和元数据表。” *Ministry of Science and Technology of the People's Republic of China*, 7 August 2019. <http://archive.is/BMYx2#selection-1757.1-1757.5>

⁹² “科技部和湖北省科技厅领导到武汉病毒所调研实验动物工作。” *Wuhan Institute of Virology*, 25 January 2010. <http://archive.is/XMS1q>

⁹³ The Author. “Inspections.” *Telegram*, 3 June 2020. <https://graph.org/Inspections-06-03>

⁹⁴ “国家科技部基础司调研武汉病毒所。” *Wuhan Institute of Virology*, 15 March 2019, <http://archive.is/JZrh6>

⁹⁵ Li et al. “Discovery of Bat Coronaviruses through Surveillance and Probe Capture-Based Next-Generation Sequencing.” *mSphere*, 5(1), e00807-19, 29 January 2020. <https://doi.org/10.1128/mSphere.00807-19>

3. Poor safety record of institutions involved in the program that identified RaTG13

3.1 Problems found in inspections of labs of institutions involved in 2013FY113500

According to a September 2019 paper, biosafety-related supervision at laboratories studying pathogens is inadequate across China⁹⁶.

The WIV's high security BSL-4 lab has well-publicised safety issues⁹⁷. However, it is not the only Wuhan lab with such problems. Wuhan University (WU) also worked on the program that identified RaTG13. WU operates its own ABSL-3 facility, which inspired research into lab safety⁹⁸, for studying SARS coronaviruses in animals⁹⁹ and had been researching a SARS vaccine¹⁰⁰.

Along with Huazhong Agricultural University, which had also been involved in SARS research, and the Wuhan Institute of Technology, WU facilities were being inspected in late 2019¹⁰¹. The WU inspections were intended to check that problems announced on 12 June 2019 following inspections¹⁰² had been rectified. These problems included: hazardous waste being exposed; no separation of the experiment area; students not wearing lab coats; no eyewash; a crowded experiment area cluttered with cardboard boxes; and there being no laboratory-specific safety guidelines¹⁰³.

The issue of laboratory safety was particularly important in 2019. Several Wuhan universities issued strict guidelines on lab safety measures during the 18-27 October Military Games. WU labs were inspected again over 24-25 September¹⁰⁴, and again in October¹⁰⁵ to rectify problems before the Games.

The concern with lab safety at the time of the COVID-19 outbreak was part of an overall effort to improve the inadequate system. The Ministry of Education, responsible for the

⁹⁶ Pei et al. "实验室生物安全发展现状分析." *Research and Exploration in Laboratory* Vol. 38 No. 9, September 2019 <https://archive.is/BV6Jr#selection-2333.0-2599.13>

⁹⁷ Rogin, Josh. "State Department cables warned of safety issues at Wuhan lab studying bat coronaviruses." *Washington Post*, 14 April 2020. <https://archive.is/IUalv>

⁹⁸ Guo et al. "Biosafety and data quality considerations for animal experiments with highly infectious agents at ABSL-3 facilities." *Journal of Biosafety and Biosecurity Volume 1, Issue 1, March 2019, Pages 50-55*, March 2019. <https://doi.org/10.1016/j.jobb.2018.12.011>

⁹⁹ Ke, Cheng and Huang, Shifeng. "探秘武汉大学模式动物研究所：曾是抗击非典战场之一." *Chutian Metropolitan Daily*, 16 November 2019 <http://archive.is/hCJQA>

¹⁰⁰ Luo et al. "Evaluation of Antibody-Dependent Enhancement of SARS-CoV Infection in Rhesus Macaques Immunized with an Inactivated SARS-CoV Vaccine." *Virologica Sinica* 2018 Apr; 33(2): 201–204, 14 March 2018. <https://dx.doi.org/10.1007/s12250-018-0009-2>

¹⁰¹ "教育部科技司关于开展教育部重点实验室2019年度评估工作的通知 教技司〔2019〕193号." *Ministry of Education of the People's Republic of China*, 2019. <https://archive.is/8AR1P>

¹⁰² "关于开展2019年实验室安全检查工作的通知." *Wuhan University*, 6 September 2019. <https://archive.vn/sp7WR#selection-417.32-425.1>

¹⁰³ "附件1+2019年教育部安全检查发现问题汇总表." *Wuhan University*, 6 September 2019. <https://archive.is/SvJBA>

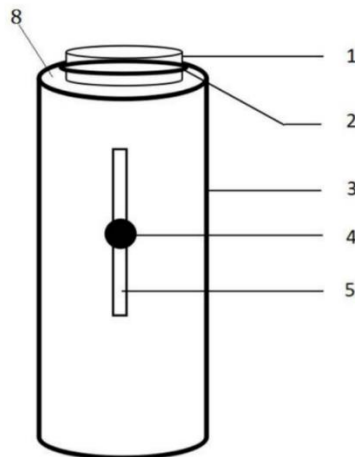
¹⁰⁴ "关于开展2019年实验室安全检查工作的通知." *National Demonstration Center for Experimental Library and Information Science Education*, 12 September 2019. <https://archive.vn/D1SR7>

¹⁰⁵ "关于军运会期间进一步加强实验室安全管理工作的通知." *Wuhan University*, 14 October 2019. <https://archive.vn/wsDJR>

WU inspections, had issued new guidelines on lab safety on 25 September¹⁰⁶. It had issued a circular on institutions inspecting their own labs on 18 April 2019¹⁰⁷, and another on 22 May on strengthening lab security¹⁰⁸. The Wuhan government had issued guidance on lab inspections in the healthcare industry on 5 September 2019¹⁰⁹.

The facts that WU staff worked on the same program that identified RaTG13, and WU had such a poor track record of lab safety adds to the plausibility of a WIV staff member on the program mishandling a sample or specimen.

The WIV filing their only patent for a device to protect against accidental virus transmission in a biosafety laboratory on 15 November 2019¹¹⁰ shows that accidental transmission was a concern at the time of the outbreak.



Design for a tourniquet for treating wounds to the finger in biosafety labs in a patent filed by the Wuhan Institute of Virology on 15 November 2019

Investigating the managerial competence of WIV Director Wang Yi and how she came to become Director of the WIV aged only 36-7¹¹¹ when the WIV specifies eligible ages in job postings¹¹² is beyond the scope of this research.

¹⁰⁶ “关于政协十三届全国委员会第二次会议第0204号（教育类028号）提案答复的函 教提案〔2019〕第82号。” *Ministry of Education of the People’s Republic of China*, 25 September 2019. <https://archive.is/bxbRW>

¹⁰⁷ “教育部科技司关于组织开展2019年度高等学校科研实验室安全自查自纠工作的通知 教技司〔2019〕136号。” *Ministry of Education of the People’s Republic of China*, 18 April 2019. <https://archive.is/njb3V>

¹⁰⁸ “教技函〔2019〕36号《教育部关于加强高校实验室安全工作的意见》。” *Zhengzhou Foreign Investment Service Center*, 4 June 2019. <https://archive.is/u1B5w>

¹⁰⁹ “市人民政府办公厅关于印发武汉市改革完善医疗卫生行业综合监管制度实施方案的通知。” *Government of Wuhan*, 5 September 2019. <http://archive.is/VZ0LT#selection-621.56-621.63>

¹¹⁰ Wuhan Institute of Virology, “A instrument that is used for in biological safety laboratory to indicate to tie up fast.” *Google Patents*, 15 November 2019. <https://patents.google.com/patent/CN110755127A/en>

¹¹¹ “武汉病毒所副所长王延轶当选致公党武汉市副主任委员。” Wuhan Institute of Virology, 23 October 2018.

https://web.archive.org/web/20181108051141/http://www.whiov.ac.cn/xwdt_105286/zhxw/201810/t20181023_5148932.html

¹¹² “2019中科院武汉病毒所第四季度集中招聘17人公告。” *Huatu*, 27 November 2019.

<https://archive.is/AMJod#selection-1253.8-1253.30>

3.2 Inadequate treatment of laboratory waste

WIV patents from 2018-19¹¹³ cover airlocks, autoclaves, doors, chemical showers, high pressure sterilisers, wastewater treatment and related equipment. Such equipment was not available to all facilities at institutions participating in program 2013FY113500. According to the WHCDC, its hazardous medical waste had not been treated effectively over 1994-2019¹¹⁴ as described in a late waste disposal 2019 procurement notice¹¹⁵. As such, the way in which waste from 2013FY113500 was disposed should be investigated.

Drainage system problems in Wuhan were being rectified in late 2019¹¹⁶¹¹⁷¹¹⁸¹¹⁹¹²⁰. The Zhifang Sewage Treatment Plant was shut down on 9 September 2019 and the waste transferred to the Jiangxia Sewage Treatment Plant¹²¹ adjacent to the WIV's Zhengdian Park facility for advanced treatment. Samples from the Jiangxia Plant may indicate whether SARS-CoV-2 had been present in the vicinity of the WIV before December 2019.

3.3 WIV disciplinary meetings and rectification

Criticism and disciplinary procedures are to be expected, though the WIV's records indicate that significant mistakes were made in 2019¹²²:

- 12 November 2019¹²³: The WIV Communist Party met to discuss a recent in-depth investigation of the Wuhan BSL-4 laboratory staff, the problems found and ways to improve the laboratory management team.

¹¹³ The Author. "The Wuhan Institute of Virology's Patents." *Telegram*, 24 July 2020. <https://graph.org/Patents-07-24>

¹¹⁴ "市疾控中心实验室危险化学废弃物处置采购项目单一来源采购方式公告." *Wuhan Center for Disease Control and Prevention*, 27 June 2019. <https://archive.is/ycUou#selection-703.2-707.148>

¹¹⁵ "市疾控中心实验室危险化学废弃物处置采购项目选择采用单一来源采购方式公告." *Wuhan Center for Disease Control and Prevention*, 6 December 2019. <https://archive.is/HhlqL#selection-707.90-707.157>

¹¹⁶ "市水务局召开全市混错接改造和隐患整改工作推进会." *Government of Wuhan*, 25 September 2019. <https://archive.is/8CJa1>

¹¹⁷ "市水务局认真开展水务系统安全整治 确保国庆和军运会期间安全稳定." *Government of Wuhan*, 27 September 2019. <https://archive.is/ufEOK>

¹¹⁸ "市作风督查组召开涉水类问题整改工作 专题工作督办会 --市委联合督办工作组第一站走进市水务局." *Government of Wuhan*, 27 September 2019. <https://archive.is/n8axN>

¹¹⁹ "市排水泵站管理处开展建设项目专项整治." *Government of Wuhan*, 30 September 2019. <https://archive.is/pjll7>

¹²⁰ "长江日报：整改164处·雨水污水“各走各路”，南湖水质持续好转." *Government of Wuhan*, 30 September 2019. <https://archive.is/apj73>

¹²¹ "关停纸坊污水处理厂 改善汤逊湖水质." *Government of Wuhan*, 20 September 2019. <https://archive.is/zFNOA>

¹²² The Author. "Wuhan Institute of Virology Late 2019 to Early 2020 Biosafety and Inspection Timeline." *Telegram*, 31 May 2020. <https://graph.org/WIV-Timeline-05-31>

¹²³ "牢记责任·坚守使命 做我国高等级生物安全领域的开拓者——中科院武汉病毒所郑店实验室党支部事迹." *Wuhan Institute of Virology*, 12 November 2019. <https://archive.is/gZQIN#selection-423.2-423.144>

- 19 November 2019¹²⁴: Training of all WIV safety officers to address common problems in the safety management of laboratories.

One WIV security officer presented on the problems found during the safety inspection of the WIV over the past year, and the serious consequences of safety hazards, emphasising that personnel should rectify the problems by implementing safety regulations.

A CAS representative presented on recent large-scale accidents in China and abroad, based on practical experience of the CAS.

The presentation covered instructions on safety from the CCP leadership. Proposals to implement such instructions involved taking responsibility, operational planning, emergency planning, in-depth analysis of hidden problems and an assessment of the complexity and danger involved.

It covered common problems in the management of laboratory safety, technology safety, student safety, campus safety and network safety. The CAS plan to improve safety management included: strengthening understanding of political doctrine; clarifying powers and responsibilities and promoting their implementation; coordinating as a unit and strengthening management and control; strengthening scientific and technological security risk research; and construction of an early warning monitoring system.

- 25 November 2019¹²⁵: The WIV Communist Party Disciplinary Committee discussed accountability and correcting mistakes, and measures to take after cadres make mistakes.
- 11 December 2019¹²⁶: WIV training for 20 new hires discusses confidentiality and safety, including recent cases of confidentiality violations.
- 19 December 2019¹²⁷: WIV Disciplinary Committee discusses identification of problems in audit.
- 3 January 2020¹²⁸: WIV disciplinary meeting discusses mistakes made when archiving materials in 2019. The discussion covered the importance of safety, ensuring a safe and accident free archiving process, strengthening the implementation of safety responsibilities, and strengthening the rectification of hidden hazards.

¹²⁴ “武汉病毒所开展安全工作培训。” *Wuhan Institute of Virology*, 21 November 2019.

<https://archive.is/SG6lu#selection-415.2-415.135>

¹²⁵ “武汉病毒所党委召开学习党的十九届四中全会精神专题中心组学习会议。” *Wuhan Institute of Virology*, 27 November 2019. http://www.whiov.ac.cn/xwdt_105286/zhxw/201911/t20191127_5443988.html

¹²⁶ “武汉病毒所举办2019年新进职工入所培训。” *Wuhan Institute of Virology*, 16 December 2019. https://web.archive.org/web/20200202191552/http://www.whiov.ac.cn/xwdt_105286/zhxw/201912/t20191216_5459259.html

¹²⁷ “武汉病毒所召开所纪委第四季度工作会议。” *Wuhan Institute of Virology*, 24 December 2019. <http://archive.is/oon5b#selection-881.2-911.164>

¹²⁸ “武汉病毒所召开安全、档案工作会议。” *Wuhan Institute of Virology*, 7 January 2020. <http://archive.is/Rnux6#selection-573.242-573.334>

- 14 January 2020¹²⁹: CAS and WIV issue 2020 guidelines for a project to improve biosecurity at the BSL-4 lab.
- 16 January 2020¹³⁰: WIV invites bids for artificial intelligence lab monitoring system to be installed at high level biosafety labs.

The meetings to discuss problems at the WIV, a recent large scale lab safety accident in China, confidentiality violations and mistakes made when archiving materials support the hypothesis that the WIV was responding to a leak of SARS-CoV-2 due to an incident. The urgent need to improve biosecurity and monitor staff implies that the WIV were well aware of the need to rectify safety failings.

Analysis of cell phone activity at the WIV shows that regular visitors to the BSL4 facility were not present over 7-24 October 2019¹³¹, indicating possible self-isolation due to exposure to a pathogen.

4. No evidence of natural exposure to BtCoV/4991-like virus

The rival theory of the COVID-19 pandemic emerging via natural zoonotic transmission uses seropositivity tests as evidence of natural spillover of SARS-related viruses. These include a study showing 6/218 people living close to Yunnan bat caves with bats known to host SARS-related viruses were seropositive for SARS antibodies¹³². The authors used patients in Wuhan as the control group, due to Wuhan's location over 1,000km away. Another study showed 9/1596 were seropositive¹³³. The four tested Mojiang miners were also seropositive for SARS antibodies, but local residents were seronegative for SARS antibodies when tested at an undisclosed time¹³⁴.

While these studies involving small sample sizes are evidence of some natural exposure to SARS-related viruses, the authors state that "The low seroprevalence observed in this study suggests that bat coronavirus spillover is a rare event."

¹²⁹ "关于发布2020年度中国科学院武汉国家生物安全实验室高端用户培育项目征集指南的通知." *Wuhan Institute of Virology*, 14 January 2020. https://web.archive.org/web/20200206112317/http://www.whiov.ac.cn/tzgg_105342/202001/t20200114_5486503.html

¹³⁰ "中国科学院武汉病毒研究所高等级生物安全实验室智能化监控机器人项目招标公告." *Wuhan Institute of Virology*, 16 January 2020. https://web.archive.org/web/20200531180047/http://www.whiov.ac.cn/tzgg_105342/202001/t20200116_5488924.html

¹³¹ "MACE E-PAI COVID-19 Analysis." *E-PAI ODIN*, 2020. <https://web.archive.org/web/20200818205957/https://www.documentcloud.org/documents/6884792-MACE-E-PAI-COVID-19-ANALYSIS-Redacted.html>

¹³² Wang et al "Serological Evidence of Bat SARS-Related Coronavirus Infection in Humans, China." *Virologica Sinica*, 33(1), 104–107, 2 March 2018. <https://doi.org/10.1007/s12250-018-0012-7>

¹³³ Li et al. "Human-animal interactions and bat coronavirus spillover potential among rural residents in Southern China." *Biosafety and Health Volume 1, Issue 2, September 2019, Pages 84-90*, 2019. <https://doi.org/10.1016/j.bsheal.2019.10.004>

¹³⁴ "Watch: Full interview With Director-General Of Wuhan Institute Of Virology | NBC News." *NBC News*, 10 August 2020. <https://youtu.be/IFkDFZBOM0U?t=477>

Such a rare event must be considered alongside the probability of spillover of a SARS-related virus with an RdRp only 1% different to BtCoV/4991, as well as the probability of this spreading undetected past China's extensive virus surveillance network and first being detected in the vicinity of the WIV while WIV staff were reviewing samples from the project that identified BtCoV/4991.

5. Conclusion

This research establishes the circumstances in which a spillover event may have occurred: the mishandling of a sample or specimen collected from Mojiang, Yunnan during the scheduled review.

This is based on the documentary evidence that WIV staff were handling samples and specimens containing BtCoV/4991 (RaTG13) and related viruses around the time of the outbreak.

Samples and specimens collected under the multi-year pathogenic bat virus research program that identified the virus closest to SARS-CoV-2 were being reviewed before a 30 September deadline, while applications for the successor program were due to be assessed. Labs at institutions involved in the program have a poor safety record, and the WIV's records indicate that there were problems at its facilities in 2019.

The updated influenza guidance issued by China's NHC in November 2019 is proposed to partly explain how the virus could spread reportedly undetected until December 2019.

Proving how SARS-CoV-2 managed to infect humans may be impossible, owing to the destruction of evidence¹³⁵ including orders to destroy samples¹³⁶ and strict control on the flow of information. Investigation by researchers not under the influence of the CCP is essential, as the Chinese government has decreed that all research into the origins of SARS-CoV-2 in China must be reviewed by the government before publication¹³⁷.

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¹³⁵ Leitenberg, Milton. "Did the SARS-CoV-2 virus arise from a bat coronavirus research program in a Chinese laboratory? Very possibly." *Bulletin of the Atomic Scientists*, 4 June 2020. <http://archive.is/5m1N0>

¹³⁶ "独家|新冠病毒基因测序溯源：警报是何时拉响的." *Caixin*, 26 February 2020. <http://archive.is/yJLzy>

¹³⁷ "关于新冠肺炎科研攻关成果的论文发表加强管理的通知." *School of Information Science and Technology, Fudan University*, April 2020. <http://archive.is/DbCt8>

¹³⁸ The Author. "Did a Review of Samples Collected from a Mineshaft Cause the COVID-19 Pandemic?." *Telegram*, 18 June 2020. <https://graph.org/Mineshaft-Sample-Review-06-18>