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The harms of promoting the lab leak hypothesis for SARS-CoV-2 origins without evidence

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ABSTRACT Science is humanity's best insurance against threats from nature, but it is a fragile enterprise that must be nourished and protected. The preponderance of scientific evidence indicates a natural origin for SARS-CoV-2. Yet, the theory that SARS-CoV-2 was engineered in and escaped from a lab dominates media attention, even in the absence of strong evidence. We discuss how the resulting anti-science movement puts the research community, scientific research, and pandemic preparedness at risk.

KEYWORDS SARS-CoV-2, COVID-19, pandemic, origin, lab leak, zoonosis, science policy, science advocacy, anti-science, spillover

On Monday, June 3, 2024, Dr. Anthony Fauci, former Director of the National Institutes of Allergy and Infectious Diseases and a dedicated public health professional for over 40 years, testified voluntarily before the House subcommittee investigating the COVID-19 pandemic. Among other topics, he was asked about the origin of SARS-CoV-2, the coronavirus that causes COVID-19. The hearing was often disrupted and marked by contentious, disrespectful, and unfounded calls for Dr. Fauci to be "prosecuted" and imprisoned for "crimes against humanity."

There are two broad competing hypotheses for the origins of SARS-CoV-2: (i) the **lab leak hypothesis**, the most discussed version of which posits that the virus was modified, or even created, in the Wuhan Institute of Virology (WIV) and, by some mechanism, escaped the laboratory; and (ii) the **zoonosis hypothesis**, wherein the virus emerged into the human population through a naturally occurring animal-to-human transmission. Viruses often spill over into humans, but these are typically dead-end events that rarely lead to sustained human-to-human transmission and rarely spark a pandemic. Wildlife coronaviruses have long been poised for emergence into humans (1). It is estimated that there are ~66,280 people infected with SARS-CoVs each year due to human-to-bat contact, most of which result in asymptomatic infections with limited or no human-to-human transmission (2). However, in the past 25 years, there have been at least 12 instances of zoonotic transfer of viruses into humans, including three coronaviruses, which resulted in epidemics or pandemics (3).

Dr. Fauci testified that, after examining the scientific data, most scientists have concluded that SARS-CoV-2 most likely emerged in humans as a zoonosis. The evidence supports the scenario that two distinct ancestral lineages of SARS-CoV-2 jumped from animals into humans, and that the Huanan Seafood Market in Hubei Provence, China, where wild animals were routinely present and slaughtered, was the epicenter of the pandemic (4–9). Importantly, Dr. Fauci acknowledged that he remains open to evidence

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supporting a lab leak if it were to become available. Indeed, all scientists must be open to this possibility. Factoring in new data that are sound and validated, even if a prevailing hypothesis were contradicted, is an essential aspect of scientific training. A critical guiding principle of science is that knowledge is continually revised and updated based on quality new evidence.

On the same day as Dr. Fauci's testimony, the *New York Times* published a guest essay entitled "Why the pandemic probably started in a lab, in 5 key points." It was authored by Dr. Alina Chan, a former postdoctoral fellow at the Broad Institute and a long-time proponent of the lab leak hypothesis. Dr. Chan presented the same points she has offered over the past four years, which have received significant attention in social media circles, by some politicians, and in the popular press. The arguments are based on conjecture, correlation, and anecdote. Dr. Chan's *New York Times* opinion piece misrepresents and underplays the existing scientific data supporting a zoonotic origin of SARS-CoV-2.

There is currently no verified scientific evidence to support the lab leak hypothesis. Moreover, the assertions in the Chan article have been challenged by a growing body of scientific data supporting the zoonosis hypothesis (4, 5, 8, 10–12). Dr. Chan's five key points are well refuted by the data, as discussed in publicly accessible platforms by Dr. Paul Offit, in the science-based podcast This Week in Virology (TWiV), and in the scientific literature (13, 14). Further, based on the scientific evidence and investigations described in a declassified report, the majority of the US Intelligence community concur with the zoonotic origin of SARS-CoV-2 being more likely. These reports do not identify high confidence evidence for a research-related incident, find no evidence that WIV possessed SARS-CoV-2 or a closely related virus before the end of December 2019, and conclude that it is unlikely that SARS-CoV-2 was engineered (6, 14, 15).

Many questions about the origins of SARS-CoV-2 remain unanswered and may never be fully resolved. We cannot currently disprove the lab leak hypothesis. Nevertheless, the lines of evidence needed to validate one hypothesis over another are not epistemically comparable (16). Validating the zoonotic origin is a scientific question that relies on history, epidemiology, and genomic analysis, that when taken together, support a natural spillover as the probable origin. This evidence is driven by scientific data that must be gathered and interpreted by experts. Much of the evidence that could have been obtained from animals at the Huanan Market was forever lost due to the clearance and cleansing of the market before any animals could be tested. Nonetheless, the available scientific evidence supports a zoonotic origin. Validating the lab leak hypothesis requires intelligence evidence that the WIV possessed or carried out work on a SARS-CoV-2 precursor virus prior to the pandemic. Neither the scientific community nor multiple western intelligence agencies have found such evidence.

Despite the absence of evidence for the escape of the virus from a lab, the lab leak hypothesis receives persistent attention in the media, often without acknowledgment of the more solid evidence supporting zoonotic emergence (17). This discourse has inappropriately led a large portion of the general public to believe that a pandemic virus arose from a Chinese lab. These unfounded assertions are dangerous. As discussed in detail below, they place unfounded blame and responsibility on individual scientists, which drives threats and attacks on virologists. It also stokes the flames of an anti-science, conspiracy-driven agenda, which targets science and scientists even beyond those investigating the origins of SARS-CoV-2. The inevitable outcome is an undermining of the broader missions of science and public health and the misdirecting of resources and effort. The consequence is to leave the world more vulnerable to future pandemics, as well as current infectious disease threats (17).

The lab leak theory in all its forms casts unsupported blame on scientists, many of whom had warned of the potential threat of, and need for effective countermeasures to prevent, zoonotic transfer of viruses into humans. Scientists who studied coronaviruses or led the response to the pandemic have been accused of engineering SARS-CoV-2 or allowing it to escape from a lab due to inadequate biosafety. Some have been unfairly

accused of being part of an international cover-up or accused of taking bribes from NIH. Yet more scientists have been attacked for using objectively gathered data to conclude that zoonosis is the most likely origin of the pandemic or for simply engaging in communication of the evidence with the media and the general public. The unsubstantiated claims of the lab leak theory have provoked harassment, intimidation, threats and violence towards scientists, which are often vile in the online space. An article in *Science* reported that, of 510 researchers who had published on SARS-CoV-2 or COVID-19, 38% acknowledged harassment ranging from personal insults to threats of violence, "doxing," and personal contact (18). A second survey, which included 1,281 scientists in a wide range of fields, found that 51% experienced at least one form of harassment, sometimes repeatedly for years.

Intimidation and threats have significant and long-term consequences as scientists have withdrawn from social media platforms, rejected opportunities to speak in public, and taken increased safety measures to protect themselves and their families. Some have even diverted their work to less controversial and less timely topics. We now see a long-term risk of having fewer experts engaged in work that may help thwart future pandemics, and of fewer scientists willing to communicate the findings of sophisticated, fast-moving research topics that are important for global health. Research that could prepare us for future pandemics has been deferred, diverted, or abandoned (3). Most worrisome for future preparedness, the next generation of scientists has well-founded fears about entering fields related to emerging viruses and pandemic science (19–21).

The lab leak narrative fuels mistrust in science and public health infrastructures. Scientists and public health professionals stand between us and pandemic pathogens; these individuals are essential for anticipating, discovering, and mitigating future pandemic threats. Yet, scientists and public health professionals have been harmed and their institutions have been damaged by the skewed public and political opinions stirred by continued promotion of the lab leak hypothesis in the absence of evidence. Anti-science movements are not new. However, anti-science has become more virulent and widespread in the internet and social media age. Rejecting evidence derived from independent and controlled studies grounded in the scientific method, while embracing spectacular and unevidenced claims, leaves us in a dangerous position for confronting future threats (17). If these narratives are left unchecked, we become a society that dismisses and vilifies those with expertise and experience relevant to the challenges we face. We then base decisions affecting large populations worldwide on speculation or chosen beliefs that have no grounding in evidence-based science.

While biosafety standards are critically important for research, the anxiety evoked by the lab leak hypothesis has resulted in some proposals for policies that, if adopted, would unnecessarily restrict research required for developing vaccines and antivirals in the US (20, 22). The US has one of the strongest and safest infrastructures for research globally. The policies aimed at virology research in the US will not protect against work with viruses of known pandemic potential occurring at inadequate biosafety containment (below biosafety level 3) in other countries, which poses the risk of lab exposures. Moreover, a looming threat for future pandemics is the illegal wildlife trade coupled with wet markets abroad. The US State Department and the United Nations (UN) estimate that the wildlife trade is the third largest illegal trafficking activity behind drugs and weapons, generating up to $20 billion annually. Animals slaughtered and sold in wet markets are a clear threat for zoonotic virus transmission to humans. Globally, policymakers have done little to curtail or effectively regulate the illegal wildlife trade and wet market practices. As well as the clear risk of future spillover events, these economic practices also undermine health security, destabilize habitats and communities, and fuel the spread of infectious diseases more generally. Further, high density commercial farming of animals (e.g., chickens, pigs, cattle) in the US and abroad also poses a major pandemic threat, as evidenced by the avian H5N1 influenza virus that is now spreading through dairy cows and other mammals with some transmission to humans. These wider dynamics underpin why our societal understanding about the origin of SARS-CoV-2 matters. This knowledge

informs focus and allocation of resources for research and preparedness efforts for the inevitable epidemics and pandemics to come. Outbreak preparedness is a topic that requires a coordinated, evidence-based, global effort (20), that relies on long-term global partnerships. Diverting attention, effort and resources in response to the unsupported lab leak hypothesis harms the mission of pandemic preparedness.

Science is humanity's best insurance against threats from nature, but it is a fragile enterprise that must be nourished and protected (23). What is now happening to virology is a stark demonstration of what is happening to all of science. It will come to affect every aspect of science in a negative and possibly a dangerous way, as has already happened with climate science. It is the responsibility of scientists, research institutions, and scientific organizations to push back against the anti-virology attacks, because what we are seeing now may be the tip of the proverbial iceberg. Universities and research institutions need policies for protecting scientists from anti-science attacks and a legal liability framework for research conducted in accordance with institutional biosafety frameworks.

For the health of scientific inquiry, the attacks on scientists should be a priority for national science institutions and foundations. Major scientific organizations must unite in developing programs to counter anti-science movements. It is imperative that we carefully prioritize threats and direct resources that allow us to strive to counter the most high-risk threats for future pandemics. If we fail to do this, then the next pandemic, like COVID-19, will largely be the result of failed policies for countering known and unknown viral threats.

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