FATAL LAB EXPLOSION IN CHINA HIGHLIGHTS WIDER SAFETY FEARS

Deaths caused by university lab blasts raise concerns among some scientists in China about safety protocols.

By Andrew Silver

The deaths of two people following a laboratory explosion at a Chinese university in October have raised alarm among researchers. The full circumstances that led to the deaths at the Nanjing University of Aeronautics and Astronautics (NUAA), in Jiangsu province, are not yet known — but they come amid wider concerns about safety in teaching labs in China.

The deaths are the latest in a series of fatalities caused by explosions in academic laboratories in the country — often involving students in chemistry departments — in recent years.

In the October incident, nine people were injured and two died as a result of an explosion just before 4 p.m. in the NUAA's College of Materials Science and Technology, according to a 24 October post by the university on the social-media network Weibo. The NUAA said in December that an investigation was ongoing, but declined to answer *Nature*'s questions about the safety of its laboratories.

On 31 March last year, a graduate student was killed following an explosion at the Institute of Chemistry of the Chinese Academy of Sciences in Beijing. Previous lab blasts led to the deaths of three students conducting a sewage-treatment experiment at Beijing Jiaotong University in December 2018; one death in the chemistry department at Tsinghua University in Beijing in December 2015; and one death in a chemistry lab at the China University of Mining and Technology in Xuzhou in April 2015.

It's not possible to pinpoint the cause of any individual explosion or death without a full investigation report — none of which have been made public, except for one relating to the incident at Beijing Jiaotong University — and some might not have been caused by negligence or lack of safety procedures.

But a study that focused on safety in graduate and undergraduate teaching labs, published online in November, claims that "the past two decades have seen a rise in university laboratory accidents in China" (M. Bai *et al. J. Loss Prev. Process Ind.* **74**, 104671; 2022).

Led by researchers at the China University of Petroleum in Qingdao, the team looked at 110 publicly reported lab accidents in China between 2000 and 2018, finding that they had led to 102 injuries and 10 fatalities.

The authors of the study note that the number of graduate students enrolled in laboratory-related disciplines in China ballooned from 90,000 in 2000 to about 5.3 million in 2019 — and the number of labs grew along with them, which the authors say might be one of the reasons there are more accidents.

After the Nanjing blast, Chinese state news outlet *Global Times* said the incident had triggered "renewed safety concerns", adding that "Chinese chemists have been calling for improvements to lab safety at research institutions following previous incidents, which reflect systematic negligence of safety".

Nature asked the Chinese Academy of Sciences, Beijing Jiaotong University, Tsinghua University and the China University of Mining and Technology if problems with safety might have been linked to the incidents at their institutions, and whether there is a wider problem with safety in university labs in China, but all either declined to answer or did not respond.

Few countries keep detailed records on university lab accidents, but in many places, deaths seem to be rare.

Safety is an issue globally

However, China has many more students than most other nations, so it's difficult to say whether it has a higher number of lab-related deaths per capita, and researchers note that lab safety is a problem in many countries. Some also question the idea that incidents are becoming more frequent in China, and argue that serious accidents were probably happening 15–20 years ago as well, but weren't reported publicly before the rise of the Internet and social media.

Still other researchers who spoke to *Nature* say that universities don't always place enough emphasis on lab experience and training for students. Some institutions "don't produce students with basic practical skills required to work in any research lab with hazards", says one experimental physicist in China, who didn't want to be named.

Yang Guang-Fu, a chemist who studies pesticides at Central China Normal University in Wuhan, agrees that there is a severe shortage of staff with safety expertise, that rules are poorly enforced and that the administrations of some Chinese universities don't attach enough importance to safety.

Jason Chruma, an organic chemist at the University of Virginia in Charlottesville, who was a professor and then an assistant dean at Sichuan University in Chengdu from 2012 to 2020, says that some government safety regulations are not clear, are interpreted differently from place to place and are difficult for the government to enforce.

Although he can't comment on current practices, Chruma says that during his time at Sichuan University, he sometimes saw safety issues at first hand, such as students conducting chemical reactions in hallways because there weren't enough fume cupboards in busy labs.

Sichuan University didn't respond to *Nature*'s questions about laboratory safety.

Firefighters at the site of an explosion at Beijing Jiaotong University in 2018.

NICOLAS ASFOURI/AFP/GETTY

According to the November study, the 2018 explosion at Beijing Jiaotong University – which led to the deaths of three students and destroyed a laboratory – was caused by the ignition of 66 kilograms of improperly stored magnesium dust. The authors say this was the first university lab accident in China for which the results of a detailed investigation were reported on a government website.

Some researchers are optimistic that the safety situation is improving, as it has in many countries in recent decades.

"Compared with 20 years ago, lab safety in China has definitely made significant progress," says Samuel Yu, director of the Health, Safety and Environment Office at the Hong Kong University of Science and Technology.

Denis Simon, who was executive vice-chancellor of Duke Kunshan University in Jiangsu province from 2015 to 2020, agrees that "this is a country that has come a tremendously long way in improving the protocols". But he says that China needs more specialists with a career focus on lab safety.

The concerns over safety in university teaching labs in China follow a debate about whether the COVID-19 pandemic might have started in a lab in China. But Gigi Gronvall, a biosecurity specialist at the Bloomberg School of Public Health at Johns Hopkins University in Baltimore, Maryland, who has visited labs in China, says that there is no reason to think that the problems flagged in student chemistry labs reveal anything about the biological-research labs that handle dangerous pathogens.

Even non-teaching biological-research labs that do quite advanced experiments don't use dangerous pathogens; to handle these, scientists typically require extensive training and follow stringent safety standards, she says.

Additional reporting by Smriti Mallapaty.

OMICRON MAKES A FEEBLE ATTACK ON THE LUNGS

Animal studies suggest that the variant's inability to multiply in lung tissue could make it less dangerous.

By Max Kozlov

Early indications from South Africa and the United Kingdom signal that the fast-spreading Omicron variant of the coronavirus SARS-CoV-2 is less dangerous than its predecessor Delta. Now, a series of laboratory studies offers a tantalizing explanation for the difference: Omicron does not infect cells deep in the lung as readily as it does those in the upper airways.

The observation "might explain what we see in patients", says Melanie Ott, a virologist at the Gladstone Institute of Virology in San Francisco, California. But she adds that Omicron's hyper-transmissibility means that hospitals are filling quickly – despite potential decreases in the severity of the disease it causes.

Authorities in South Africa announced on 30 December that the country had passed its Omicron peak without a major spike in deaths. And a 31 December UK government report said that people in England who were infected with Omicron were about half as likely to require hospitalization or emergency care as were those infected with Delta.

But the number of people who have gained immune protection against COVID-19 through vaccination, infection or both has grown over time, making it difficult to determine whether Omicron intrinsically causes milder disease than do earlier variants. For answers, researchers have turned to the laboratory.

Michael Diamond, a virologist at Washington University in St. Louis, Missouri, and his colleagues infected rodents with Omicron and other variants to track disease progression. The differences were staggering: after a few days, the concentration of virus in the lungs of animals infected with Omicron was at least ten times lower than in rodents infected with other variants[1]. Other teams have also noted that, compared with previous variants, Omicron is found at reduced levels in lung tissue[2,3].

Diamond was especially shocked to see that the Omicron-infected animals nearly maintained their body weight, whereas the others quickly lost weight – a sign that their infections were causing severe disease. The lungs are where the coronavirus does much of its damage, and lung infection can set off an inflammatory immune response that ravages both infected and uninfected cells. Fewer infected lung cells could mean milder illness.

Another group found that Omicron is much less successful than previous variants at infecting lung cells and miniature lung models called organoids[4]. These experiments also identified a plausible player in the difference: a protein called TMPRSS2, which protrudes from the surfaces of many cells in the lungs and other organs, but is notably absent from the surfaces of most nose and throat cells. Previous variants have exploited this protein to infect cells, but the researchers noticed that Omicron doesn't bind to TMPRSS2 so well. Instead, it tends to enter cells when it is ingested by them[5,6].

Upper airway preferred

Difficulty entering lung cells could help to explain why Omicron does better in the upper airways than in the lungs, says Ravindra Gupta, a virologist at the University of Cambridge, UK, who co-authored one of the TMPRSS2 studies[4]. This theory could also explain why, by some estimates, Omicron is nearly as transmissible as measles, which is the benchmark for high transmissibility, says Diamond. If the variant lingers in the upper airways, viral particles might find it easy to hitch a ride on material expelled from the nose and mouth, allowing the virus to find new hosts, says Gupta.

The latest results could mean that "the virus establishes a very local infection in the upper airways and has less chance to go and wreak havoc in the lungs", Ott says. That would be welcome news – but a host's immune response plays an important part in disease severity, and scientists need more clinical data if they are to understand how Omicron's basic biology influences its disease progression in humans.

Omicron's course of infection could also have implications for children, says Audrey John, a specialist in paediatric infectious disease at the Children's Hospital of Philadelphia in Pennsylvania. Young children have relatively small nasal passages, and babies breathe only through their noses. Such factors can make upper respiratory conditions more serious for children than for adults, John says. But she adds that she has not seen data suggesting an uptick in the numbers of young children hospitalized for conditions that could indicate a severe infection of the upper respiratory tract.

Although there is still much to learn about the new variant, Gupta says that fears raised in late November by the multitude of mutations in Omicron's genome have not been completely borne out. He says the initial alarm offers a cautionary tale: it's difficult to predict how a virus will infect organisms from its genetic sequence alone.

1. Diamond, M. *et al*. Preprint at Research Square https://doi.org/10.21203/rs.3.rs-1211792/v1 (2021).
2. McMahan, K. *et al*. Preprint at bioRxiv https://doi.org/10.1101/2022.01.02.474743 (2022).
3. Bentley, E. G. *et al*. Preprint at bioRxiv https://doi.org/10.1101/2021.12.26.474085 (2021).
4. Meng, B. *et al*. Preprint at bioRxiv https://doi.org/10.1101/2021.12.17.473248 (2021).
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6. Willett, B. J. *et al*. Preprint at medRxiv https://doi.org/10.1101/2022.01.03.21268111 (2022).