

WHY THE WHO TOOK TWO YEARS TO SAY COVID IS AIRBORNE

Early in the pandemic, the World Health Organization stated that SARS-CoV-2 was not transmitted through the air. That mistake and the prolonged process of correcting it sowed confusion and raises questions about what will happen in the next pandemic. **By Dyani Lewis**

As 2021 drew to a close, the highly contagious Omicron variant of the pandemic virus was racing around the globe, forcing governments to take drastic actions once again. The Netherlands ordered most businesses to close on 19 December, Ireland set curfews and many countries imposed travel bans in the hope of taming the tsunami of COVID-19 cases filling hospitals. Amid the wave of desperate news around the year-end holidays, one group of researchers hailed a development that had seemed as though it might never arrive. On 23 December, the World Health Organization (WHO) uttered the one word it had previously seemed incapable of applying to the virus SARS-CoV-2: ‘airborne’.

On its website, a page titled ‘Coronavirus disease (COVID-19): How is it transmitted?’ was quietly edited to state that a person can be infected “when infectious particles that pass through the air are inhaled at short range”, a process otherwise known as “short-range aerosol or short-range airborne transmission”.

The website says that transmission can occur through “long-range airborne transmission” in poorly ventilated or crowded indoor settings “because aerosols can remain suspended in the air or travel farther than conversational distance”.

“It was a relief to see them finally use the word ‘airborne’, and to say clearly that airborne transmission and aerosol transmission are synonyms,” says aerosol chemist Jose-Luis Jimenez at the University of Colorado Boulder.

The seemingly uncontroversial statement marked a clear shift for the Switzerland-based WHO, which had tweeted categorically early in the pandemic, “FACT: #COVID19 is NOT airborne,” casting the negative in capital letters as if to remove any doubt. At that time, the agency maintained that the virus spreads mainly through droplets produced when a person coughs, sneezes or speaks, an assumption based on decades-old infection-control teachings about how respiratory viruses generally pass from one person to another. The guidance recommended distancing of more than one metre – within which these droplets were

thought to fall to the ground – along with hand washing and surface disinfection to stop transfer of droplets to the eyes, nose and mouth.

It took until 20 October 2020 for the agency to acknowledge that aerosols – tiny specks of fluid – can transmit the virus, but the WHO said this was a concern only in specific settings, such as indoor, crowded and inadequately ventilated spaces. Over the next six months, the agency gradually altered its advice to say that aerosols could carry the virus for more than a metre and remain in the air.

But this latest tweak is the WHO’s clearest statement yet about airborne transmission of SARS-CoV-2. And it places the virus among a select group of ‘airborne’ infections, a label long reserved for just a handful of the world’s most virulent pathogens, including measles, chickenpox and tuberculosis.

The change brings the WHO’s messaging in line with what a chorus of aerosol and public-health experts have been trying to get it to say since the earliest days of the outbreak. Many decry the agency’s slowness in stating – unambiguously – that SARS-CoV-2 is airborne. Interviews conducted by *Nature* with dozens of specialists on disease transmission suggest that the WHO’s reluctance to accept and communicate evidence for airborne transmission was based on a series of problematic assumptions about how respiratory viruses spread.

For example, even in the middle of the fast-moving epidemic, the WHO dismissed field epidemiology reports as proof of airborne transmission because the evidence was not definitive, something that is difficult to achieve quickly during an outbreak. Other criticisms are that the WHO relies on a narrow band of experts, many of whom haven’t studied airborne transmission, and that it eschews a precautionary approach that could have protected countless people in the early stages of the pandemic.

Critics say that inaction at the agency led to national and local health agencies around the world being similarly sluggish in addressing the airborne threat. Having shifted its position incrementally over the past two years, the WHO also failed to adequately communicate its changing position, they say. As a result, it didn’t emphasize early enough and clearly enough the importance of ventilation and indoor masking, key measures that can prevent airborne spread of the virus. Lidia Morawska, an aerosol scientist at the Queensland University of Technology in Brisbane, Australia, spearheaded several efforts to convince the WHO and other health agencies of the airborne threat. She says that airborne transmission was “so obvious” as far back as February 2020, and that omitting it from official guidelines was disastrous.

But Dale Fisher, an infectious-diseases physician at the National University Hospital in Singapore and chair of the WHO’s Global



Public-health advice on COVID-19 in early 2020 focused on sanitizing surfaces more than protecting against airborne transmission.

Outbreak Alert and Response Network steering committee, doesn't think that confusion over whether the virus is airborne has had a defining impact on how the pandemic has played out. "It's not the cause of the catastrophe we've seen," he says.

"So many assumptions that we had about this virus were proven false."

Some other researchers defend the agency's response, given the rapidly evolving situation. "I really don't think anybody dropped the ball, including WHO," says Mitchell Schwaber, an infectious-diseases physician at Israel's ministry of health and an external adviser to the WHO. "So many assumptions that we had about this virus were proven false. We always, we always were learning new things."

Resolving this debate about how to assess the transmission of respiratory viruses matters, say researchers, because a more deadly

variant of SARS-CoV-2 could emerge at any time, and new respiratory viruses will almost certainly plague humanity at some point. It's not clear whether the WHO and the world will be ready.

Tension in the air

In the final days of March 2020, Morawska contacted dozens of colleagues – an international mix of aerosol scientists, infectious-disease specialists, and building and ventilation engineers – to get the word out about the airborne threat of SARS-CoV-2. On 1 April 2020, the group sent an e-mail laying out their case to Michael Ryan, head of the WHO's Health Emergencies Programme, and Maria Van Kerkhove, technical lead of the WHO's COVID-19 response.

Within an hour, the agency was on the phone. Two days later, the group attended a video conference with members of the Health Emergencies Programme and the Infection Prevention and Control Guidance Development Group (IPC GDG) – an external group of about 40 clinicians and researchers that

advises the WHO on infection containment, especially in hospitals. At the time of the meeting, more than one million people had been infected with SARS-CoV-2, and 54,000 had died. Community spread was rampant in several countries.

Morawska presented what she says was a compelling case for airborne transmission. Two facts stood out. First, there was solid evidence that people were becoming infected even when they were more than one metre – the safe distance recommended by the WHO – from a contagious individual. Second, years of mechanistic studies had demonstrated how mucus in a person's airway can spray into aerosols during speech and accumulate in stagnant rooms. Morawska felt rebuffed by the WHO and its advisers. "I didn't have a feeling that they were trying to see this from our perspective," she says.

She and other people who study aerosols and airborne disease transmission say that the IPC GDG is ill-equipped to assess this type of transmission because most of its members have focused on controlling infections in

Feature

hospitals and they lack expertise in the physics of how airborne contagions spread. At the time of the 1 April meeting, no one in the IPC GDG had studied this type of disease transmission, say critics.

"If it is a new disease, you better include everyone," says Yuguo Li, a building environment engineer at the University of Hong Kong, whose study of the SARS outbreak in 2002–03 had concluded that the virus responsible, SARS-CoV, probably spread through the airborne route¹. He suspected that SARS-CoV-2 was also airborne, although he initially thought that only short-range airborne transmission was likely.

Marcel Loomans, an indoor-air-quality physicist at Eindhoven University of Technology in the Netherlands, says that it is often hard to find common ground between the two disciplines. "On the medical side, they were not aware of how aerosols behave in the air and what ventilation can do," he says. People end up "talking past each other".

The disconnect was there even in the use of scientific terms. Infection-control experts have long drawn a hard line between droplet viruses and airborne ones, seeing only the latter as capable of travelling far and lingering in the air. "Dogmatic bias is certainly a big part of it," says Don Milton, an occupational-health physician who studies aerosol transmission of infectious diseases at the University of Maryland in College Park. He says that he was disappointed but not surprised by the WHO's lack of action in addressing the airborne threat

after the 1 April meeting. "I'm just familiar with how the medical profession thinks," he says.

But Schwaber, who chairs the IPC GDG, recalls the meeting differently. "We took very seriously the issues that they raised at the meeting, and responded to them," he says. "Nothing was being blown off, nothing was being ignored."

At the time, he says, the available evidence suggested that airborne precautions throughout hospitals – including N95 masks for staff, visitors and patients – were unnecessary. Still, faced with soaring deaths among front-line doctors and nurses, most hospitals and

"You've got to explain all the data, not just the data that you've picked to support your view."

health agencies adopted these precautions on their COVID-19 wards, as well as less-stringent protections such as wearing surgical masks in other areas of the hospital.

Mark Sobsey, an environmental microbiologist at the University of North Carolina in Chapel Hill who is a member of the IPC GDG, says that especially in the early days, the concerns brought to the WHO about airborne transmission were "largely unfounded" and lacked credible evidence, such as the isolation of infectious virus particles from air samples. Epidemiological data from outbreak

investigations were "especially weak", he says.

According to Trish Greenhalgh, a primary-care health researcher at the University of Oxford, UK, the IPC GDG members were guided by their medical training and the dominant thinking in the medical field about how infectious respiratory diseases spread; this turned out to be flawed in the case of SARS-CoV-2 and could be inaccurate for other viruses as well. These biases led the group to discount relevant information – from laboratory-based aerosol studies and outbreak reports, for instance. So the IPC GDG concluded that airborne transmission was rare or unlikely outside a small set of aerosol-generating medical procedures, such as inserting a breathing tube into a patient.

That viewpoint is clear in a commentary by members of the IPC GDG, including Schwaber, Sobsey and Fisher, published in August 2020 (ref. 2). The authors dismissed research using air-flow modelling, case reports describing possible airborne transmission and summaries of evidence for airborne transmission, labelling such reports "opinion pieces". Instead, they concluded that "SARS-CoV-2 is not spread by the airborne route to any significant extent".

In effect, the group failed to look at the whole picture that was emerging, says Greenhalgh. "You've got to explain all the data, not just the data that you've picked to support your view," and the airborne hypothesis is the best fit for all the data available, she says. One example she cites is the propensity for the virus to transmit in 'superspreader events', in which

CHANGING VIEWS OF HOW COVID SPREADS

Throughout much of 2020, the World Health Organization (WHO) held tight to the idea that SARS-CoV-2, the virus that causes COVID-19, spreads through relatively large 'respiratory' droplets that are expelled by infected people while coughing, sneezing or speaking. These droplets contaminate nearby surfaces or get breathed in, so the WHO stressed the importance of washing hands and disinfecting surfaces.

It took many months for the agency to acknowledge that the virus could travel on tiny particles called aerosols that can spread widely and linger in the air. And nearly two years passed before the WHO clearly stated that the virus is airborne.

2020

23 February

"The disease can spread from person to person through small droplets from the nose or mouth which are spread when a person with COVID-19 coughs or exhales. These droplets land on objects and surfaces around the person. Other people then catch COVID-19 by touching these objects or surfaces, then touching their eyes, nose or mouth. People can also catch COVID-19 if they breathe in droplets from a person with COVID-19 who coughs out or exhales droplets. This is why it is important to stay more than 1 metre (3 feet) away from a person who is sick."

The WHO does not mention transmission by means of aerosols, or that the virus can spread across distances of more than one metre or remain in the air.

28 March

"FACT: #COVID19 is NOT airborne ..."

"The virus that causes COVID-19 is mainly transmitted through droplets generated when

an infected person coughs, sneezes or speaks."

"These droplets are too heavy to hang in the air. They quickly fall to the ground."

The agency explicitly states that the virus is not airborne, despite reports at the time suggesting that it could be.

9 July

"Outside of medical facilities, some outbreak reports related to indoor crowded spaces have suggested the possibility of aerosol transmission, combined with droplet transmission, for example, during choir practice, in restaurants or in fitness classes. In these events, short-range aerosol transmission, particularly in specific indoor locations, such as crowded and inadequately ventilated spaces over a prolonged period of time with infected persons cannot be ruled out."

In a detailed 'Scientific Brief', the WHO continues to stress that transmission is through droplets that fall onto surfaces



Early WHO advice on masks recommended them only for infected people and their carers.

numerous individuals are infected at a single gathering, often by a single person. “Nothing explains some of these superspreader events except aerosol spread,” says Greenhalgh.

Throughout 2020, there was also mounting evidence that indoor spaces posed a much greater risk of infection than outdoor environments did. An analysis of reported outbreaks recorded up to the middle of August 2020 revealed that people were more than 18 times as likely to be infected indoors as outdoors³.

If heavy droplets or dirty hands had been the main vehicles for transmitting the virus, such a strong discrepancy would not have been observed.

Although the WHO played down the risk of airborne transmission, it did invite Li to become a member of the IPC GDG after he spoke to the group in mid-2020. Had the organization not at least been open to his view that infections were caused by aerosols, especially at short range, “they would not have invited

me there as they knew my standing”, he says.

Still, Li is disappointed that it took the WHO until October 2020 to acknowledge that aerosols play a part in disease transmission in community settings (see ‘Changing views of how COVID spreads’). And in its updated guidelines on mask use, in December 2020, the agency still emphasized shortfalls and gaps in the evidence for aerosol transmission, and the need for more “high quality research” to understand the specifics of how the virus spreads. It wasn’t until the end of April 2021 that long-range aerosol transmission was added to a question-and-answer section on the agency’s website about how the virus spreads. And the term airborne wasn’t officially added until December 2021.

Conservative approach

Some scientists note that the WHO’s decision to classify SARS-CoV-2 as airborne, belated as it was, is momentous. That’s because it flies in the face of the established view of respiratory virus transmission that held sway when the pandemic began — that nearly all infectious diseases are spread by droplets, not through the air. And researchers say that this change is particularly important because the organization generally takes a conservative approach. “What the WHO says is normally based on a consensus of expert advice and opinion,” says Christopher Dye, an epidemiologist who served as the scientific adviser to the agency’s director-general until 2018.

And although the WHO has drawn strong

and are spread by surface contamination or by close contact. But, for the first time, it acknowledges that transmission by aerosols might be possible, contradicting its previous statements.

20 October

“Current evidence suggests that the main way the virus spreads is by respiratory droplets among people who are in close contact with each other. Aerosol transmission can occur in specific settings, particularly in indoor, crowded and inadequately ventilated spaces, where infected person(s) spend long periods of time with others, such as restaurants, choir practices, fitness classes, nightclubs, offices and/or places of worship. More studies are under way to better understand the conditions in which aerosol transmission is occurring outside of medical facilities where specific medical procedures, called aerosol generating procedures, are conducted.”

The WHO states that aerosol transmission happens outside of medical settings.

2021

30 April

“Current evidence suggests that the virus spreads mainly between people who are in close contact with each other, typically within 1 metre (short-range). A person can be infected when aerosols or droplets containing the virus are inhaled or come directly into contact with the eyes, nose, or mouth.

The virus can also spread in poorly ventilated and/or crowded indoor settings, where people tend to spend longer periods of time. This is because aerosols remain suspended in the air or travel farther than 1 metre (long-range).”

The WHO for the first time mentions that aerosols can stay suspended in the air or travel long distances.

23 December

“Current evidence suggests that the virus spreads mainly between people who are in close contact with each other, for example at a conversational distance ...

The virus can also spread in poorly ventilated and/or crowded indoor settings, where people tend to spend longer periods of time. This is because aerosols can remain suspended in the air or travel farther than conversational distance (this is often called long-range aerosol or long-range airborne transmission).”

Nearly two years into the pandemic, the WHO uses the term ‘airborne’ for the first time.

criticism for the way in which it assessed SARS-CoV-2 transmission, some researchers don't find the agency's response surprising. The international community looks to the WHO for early warnings of disease outbreaks. But when it comes to science, the agency "sees its role as certifying the current expert consensus, not (usually) advancing new, tentative knowledge", says Peter Sandman, an independent risk-communications specialist based in New Jersey who has worked as a consultant to the WHO.

Schwaber says: "Individuals and governments and public-health bodies are looking to a WHO GDG, not to conjecture. They're looking to a WHO GDG to put out guidance. That everything that we say can be backed by evidence."

The WHO frequently gets attacked, "so you can understand how they'd be risk averse", says Tom Frieden, president of the global-health initiative Resolve to Save Lives and former head of the US Centers for Disease Control and Prevention (CDC). Frieden is critical of some aspects of the WHO's pandemic response, including how slow it was to recommend the use of masks. But he says that the agency is in a difficult position during health crises.

In 2009, for instance, it was accused of being alarmist over the H1N1 swine influenza outbreak that petered out with few lives lost. "WHO got hit hard for that," says Dye, even though he thinks the agency was right to be cautious and declare a public-health emergency of international concern.

Hard line to tread

Virologist May Chu, a member of the IPC GDG at the Colorado School of Public Health in Aurora, says that the WHO treads a difficult line, and tends to be quite conservative in its recommendations to avoid putting out information that later proves to be incorrect. "You can't be backtracking" on advice, adds Fisher, because "then you lose complete credibility".

The gravity of the situation might have made the WHO even more cautious in its pronouncements and less likely to stray from consensus views, according to Sandman's partner Jody Lanard, an independent risk-communications specialist who has also worked with the WHO in the past.

In previous situations – such as during the Ebola outbreak in West Africa, and in polio vaccine campaigns – the WHO was more nimble than it has been during the COVID-19 pandemic, Lanard says. "I've seen them be able to change what their approach was, or try different things," she says. But during the pandemic "it's so tempting to be very, very cautious", because millions of lives will be affected by the agency's recommendations. Loomans and others question why, when concerns were growing that SARS-CoV-2 could be airborne, the WHO didn't adopt a precautionary approach by acknowledging the possibility of

different risks, even without definitive proof.

And in May 2021, the Independent Panel for Pandemic Preparedness and Response (IPPPR), a body established by the WHO a year earlier to review the agency's actions at the start of the pandemic, called out the WHO for not applying the precautionary principle to another crucial aspect of COVID-19 transmission – whether it could spread from human to human (see go.nature.com/3iqhfjm). "There is a case for applying the precautionary principle in any outbreak caused by a new pathogen resulting in respiratory infections, and thereby for assuming that human-to-human transmission will occur unless the evidence specifically indicates otherwise," the IPPPR said in its 2021 report.

In practice, applying the precautionary approach to the question of how SARS-CoV-2 – or any newly emerged pathogen – is transmitted would mean initially assuming that all routes of transmission are possible. "That should be your starting point, and then you can strike out routes if you're sure," says Loomans.

But Schwaber says that this approach carries risks. "To say, well, the best interests of the patient and the best interests of the health-care worker involve invoking the precautionary principle would also imply that there's no downside to invoking it," he says. Taking full precautions against airborne transmission would require major changes at hospitals, such as using negative-air-pressure isolation rooms and uncomfortable N95 masks for all staff and visitors. Such changes need to be weighed against the evidence that they are required, he says.

Sobsey says that the WHO did adopt the precautionary principle, in part because of the advice from aerosol scientists. That's why, he says, the agency stated in July 2020 that

"I think there's been a sea change in thinking at WHO as a consequence of the experience with this virus."

airborne transmission couldn't be ruled out – and why it started placing more emphasis on ventilation as a protective measure, even though the evidence for airborne transmission was weak at the time.

"They are not totally wrong," says Li of those who claimed there were gaps in the evidence for airborne transmission, especially over larger distances. "It's nothing bad to seek solid scientific evidence," he says, but "when you see the spread so significantly, do you still wait for a nice *Nature* or *Science* article?" he says.

Still, other health organizations moved faster than the WHO despite the uncertainty. In February 2020, Li was contacted by the Chinese Center for Disease Control and Prevention for advice on air conditioning in

public buildings and on public transport. At Li's suggestion, he says, the centre recommended maximizing airflow in buildings from the outside, to help flush out any airborne contagion. At the time, Li didn't think that ventilation would substantially reduce infection from a virus that he suspected was airborne only over short distances – an assumption that he later disproved. But he recommended improved ventilation because "I always support a precautionary approach," he says.

Communication problems

One thing that's still missing, says Jimenez, is a clear communication campaign from the WHO. Its director-general, Tedros Adhanom Ghebreyesus, acknowledged the challenges in his opening remarks at the agency's global conference on communicating science during health emergencies, on 7 June 2021. "Scientific processes, decision-making in an emergency context and mass communication do not fit together easily," Tedros said, adding that "high-quality research takes time, but time is something we don't have in an emergency".

During the early months of the pandemic, the WHO was fighting battles on other fronts. While it grappled with shortages of protective equipment and ventilators, it was also contending with misinformation about unproven treatments for COVID-19 and US threats to pull its funding from the organization.

But critics say that even two years into the pandemic, the WHO hasn't clearly communicated the risks from airborne transmission. And, perhaps as a result, governments around the world spent much of the pandemic focusing on hand washing and surface cleaning, instead of ventilation and indoor masking.

"The cacophony of changing messages has undoubtedly contributed greatly to resistance to masks and other measures," says Jimenez.

On 15 December 2021, less than two weeks before the latest change in wording on the WHO's website, Jimenez put out a call on Twitter for evidence of how governments and organizations either "don't know how to protect their citizens, or use @WHO's ambiguity to avoid doing so". He enumerated more than 100 examples in which health advice at the time was at odds with airborne precautions, indicating that the message was not filtering out from the agency.

Jimenez has continued to receive such examples. Now that the agency has changed the wording on its main website, Jimenez can call out these 'COVID Hall of Shame' offenders, as he labels them, for providing advice that is no longer in line with the international health agency.

"That is the arrogance, a bit, of what WHO is," says Chu. "Once you post [new guidance], it's pretty passive. They expect you to come to their website. They don't necessarily broadcast it."



Schoolchildren in Taipei eat lunch behind partitions to stop the spread of COVID-19 in April 2020, after the WHO stressed the dangers of respiratory droplets that travel short distances.

But that's exactly what's needed, says Jimenez, especially given early communications that still haunt the agency, such as its tweet about COVID-19 not being airborne. "No doubt we owe the persistence of misinformation to that WHO announcement and firm position, at the time in which we were all scared and eager to learn how to protect ourselves, very early in the pandemic," says Jimenez.

The agency defends its actions throughout the pandemic. In a statement to *Nature* last month, a spokesperson said: "WHO has sought the expertise of engineers, architects and aerobiologists along with expertise in infectious diseases, infection prevention and control, virology, pneumology and other fields since the early days of the COVID-19 pandemic. In August 2020, we established the Environment and Engineering Control Expert Advisory Panel (ECAP) for COVID-19 to provide expert contributions for the development of guidance through evaluation and critical interpretation of available evidence (benefits and harm of interventions) related to relevant technical questions including indoor air quality management and ventilation as an engineering control measure in the context of COVID-19."

The organization says that initial guidance covered airborne precautions in health-care settings, but notes that: "As the evidence on the transmission of COVID-19 has expanded, we have learnt that smaller-sized infectious particles known as aerosols also play a role in transmission in community settings, and WHO has adapted its guidance and messages to reflect this in the December 2020 update to our mask guidance."

In response to critics who say that it hasn't adequately highlighted the changes it has made regarding the risks of airborne

transmission, the WHO says that it has held about 250 press briefings and hundreds of live social-media events during the pandemic. It adds that it also pushes out information through social-media channels, meetings with doctors and mailing lists to scientists.

That's not enough, according to some researchers. Stephanie Dancer, a microbiologist at the Edinburgh Napier University, UK, says that the WHO needs to be clear about its position so that others follow its lead. "They have to show true strength of character and stand up and say, 'We got it wrong. We're going to get this right. Here are our next set of guidelines. This is where we're going to go. This is what we advise,'" she says.

Off to a bad start

Part of the problem was how emphatic the WHO was at the beginning of the pandemic, says Heidi Tworek, a historian and public-policy specialist at the University of British Columbia in Vancouver. "To say that COVID was definitively not airborne unfortunately meant there was a massive hill to climb to undo that," she says. Right from the beginning, the WHO and other public-health authorities and governments should have emphasized that SARS-CoV-2 was a new coronavirus, and that guidelines would inevitably change, she says. "And when they do, it's a good thing because it means we know more."

"We're really talking here about two failures, not one," says Sandman. "Being reluctant to change your mind, and being reluctant to tell people you changed your mind." Like other public-health and scientific organizations, the WHO "are afraid of losing credibility by acknowledging that they got something wrong", he says.

But when Lanard worked with the WHO in 2005 to draft its risk-communications guidelines, one tenet that she advocated – to admit mistakes and errors when they occur – was removed from the final draft. She says that there were good reasons behind that decision, including that health officials in some countries could have faced imprisonment – or worse – if they had promoted information from the WHO that turned out to be incorrect. Officials and scientific advisers in several countries have received death threats during the pandemic. "Inevitably you'll get it wrong sometimes," says Frieden. And the WHO is in a position that means "whatever they do, they get attacked", he says.

On the science front, questions remain about how much of COVID-19 transmission is airborne. Sobsey says that researchers still need to come up with evidence that the airborne route makes "an important contribution to the overall disease burden". Many on the other side of the aisle, such as Jimenez, are convinced that airborne transmission predominates. The US Office of Science and Technology Policy voiced strong support for this view on 23 March, when its head, Alondra Nelson, issued a statement called 'Let's Clear the Air on COVID', which said "the most common way COVID-19 is transmitted from one person to another is through tiny airborne particles of the virus hanging in indoor air for minutes or hours after an infected person has been there."

Other viruses long suspected of being airborne – including influenza and common cold viruses – will also be scrutinized. In September 2021, the US National Institutes of Health awarded Milton a multimillion-dollar grant to conduct trials that will determine whether airborne or droplet routes lead to influenza infection.

Li says that there's much greater recognition of airborne transmission because of the COVID-19 pandemic, and research over the next few years will probably show that most respiratory viruses can spread in this way. So the whole world will be more alert to the possibility of the airborne threat when old or new infectious diseases start spreading.

In the WHO, too, attitudes have shifted, according to Sobsey. "I think there's been a sea change in thinking at WHO as a consequence of the experience with this virus," he says, "which is – be more precautionary, even if you're not sure."

Dyani Lewis is freelance reporter in Melbourne, Australia.

1. Yu, I. T. S., Wong, T. W., Chiu, Y. L., Lee, N. & Li, Y. *Clin. Infect. Dis.* **40**, 1237–1243 (2005).
2. Conly, J. et al. *Antimicrob. Resist. Infect. Control* **9**, 126 (2020).
3. Bulfone, T. C., Malekinejad, M., Rutherford, G. W. & Razani, N. *J. Infect. Dis.* **223**, 550–561 (2021).