

Ten reasons why the coronavirus is airborne

April 15 2021



This transmission electron microscope image shows SARS-CoV-2 -- also known as 2019-nCoV, the virus that causes COVID-19 -- isolated from a patient in the US. Virus particles are shown emerging from the surface of cells cultured in the

lab. The spikes on the outer edge of the virus particles give coronaviruses their name, crown-like. Credit: NIAID-RML

There is consistent, strong evidence that the SARS-CoV-2 virus, which causes COVID-19, is predominantly transmitted through the air, according to a new assessment published today in the medical journal *Lancet*. Therefore, public health measures that fail to treat the virus as predominantly airborne leave people unprotected and allow the virus to spread, according to six experts from the UK, U.S. and Canada, including Jose-Luis Jimenez, chemist at the Cooperative Institute for Research in Environmental Sciences (CIRES) and University of Colorado Boulder.

"The evidence supporting airborne [transmission](#) is overwhelming, and evidence supporting large droplet transmission is almost non-existent," Jimenez said. "It is urgent that the World Health Organization and other public health agencies adapt their description of transmission to the scientific evidence so that the focus of mitigation is put on reducing airborne transmission."

The team of experts, led by the University of Oxford's Trish Greenhalgh, reviewed published research and identified 10 lines of evidence to support the predominance of the airborne route.

At the top of their list: Super-spreader events such as the Skagit Choir outbreak, in which 53 people became infected from a single infected case. Studies have confirmed these events cannot be adequately explained by close contact or touching shared surfaces or objects.

Moreover, transmission rates of SARS-CoV-2 are much higher indoors than outdoors, and transmission is greatly reduced by indoor ventilation.

The team highlighted research estimating that silent (asymptomatic or presymptomatic) transmission of SARS-CoV-2 from people who are not coughing or sneezing accounts for at least 40 percent of all transmission. This silent transmission is a key way COVID-19 has spread around the world, "supporting a predominantly airborne mode of transmission," according to the assessment. The researchers also cited work demonstrating long-range transmission of the virus between people in adjacent rooms in hotels; people who were never in each other's presence.

By contrast, the team found little to no evidence that the virus spreads easily via large droplets, which fall quickly through the air and contaminate surfaces.

"We were able to identify and interpret highly complex and specialist papers on the dynamics of fluid flows and the isolation of live virus," lead author Greenhalgh said. "While some individual papers were assessed as weak, overall the evidence base for airborne transmission is extensive and robust. There should be no further delay in implementing measures around the world to protect against such transmission."

The new work has serious implications for [public health measures](#) designed to mitigate the pandemic. First, "droplet measures" such as handwashing and surface cleaning, while not unimportant, should be given less emphasis than airborne measures, which deal with inhalation of infectious particles suspended in the air.

If an infectious virus is primarily airborne, someone can potentially be infected when they inhale aerosols produced when an infected person exhales, speaks, shouts, sings, or sneezes. So airborne control measures include ventilation, air filtration, reducing crowding and the amount of time people spend indoors, wearing masks whenever indoors (even if not within 6 feet or 2 meters of others), attention to mask quality and fit, and

higher-grade PPE for healthcare and other staff when working in contact with potentially infectious people.

"It is quite surprising that anyone is still questioning whether [airborne transmission](#) is the predominant transmission pathway for this virus or not," said co-author Professor Kimberly Prather, an aerosol scientist from the University of California San Diego. "Only by including inhalation of aerosols at both close and long range can we explain the many indoor outbreaks that have occurred around the globe. Once we acknowledge this virus is airborne, we know how to fix it. There are many examples of places that have fared much better by acknowledging this virus is airborne from the start. The world needs to follow their lead as soon as possible."

More from the authors

Professor David Fisman, a physician-epidemiologist at the University of Toronto: "It's critically important for public health experts to work collaboratively with aerosol scientists and engineers. Establishment of aerosol transmission as the dominant mode of transmission of SARS-2 is actually good news, because we have abundant expertise for reducing the risk from aerosols. But these tools won't be put into use as long as there is a lack of clarity from public health agencies on how this disease spreads."

Infectious diseases physician Professor Robert Schooley from the University of California San Diego: "When one starts with the understanding that the [virus](#) replicates in the lungs and is exhaled with each breath in a range of particle sizes, some of which can travel well beyond the magical 6-foot curtain posited as the limit for droplets—and can persist in poorly ventilated locations—it is inevitable to conclude that public health strategies must center on those that reduce airborne spread of respiratory pathogens."

Professor Zeynep Tufekci, a sociologist from University of North Carolina, Chapel Hill said: "it's essential that the guidelines to the public explain accurately explain transmission mechanisms and their relative importance rather than focusing on binary rules like "six feet" that do not apply the same way across different contexts. Even after a whole year, we still see the widespread practice of unnecessary levels of cleaning to the detriment of public health, use of plexiglass indoors that is far from sufficiently protective and, depending on air flows, may even be contraindicated, instead of attention to ventilation and aerosol risks. We cannot fix this situation without accurately informing the public so that people feel empowered to make decisions to better protect themselves across different contexts, and adjusting guidelines globally to fit the best available evidence."

More information: *Lancet* (2021). [DOI: 10.1016/S0140-6736\(21\)00869-2](https://doi.org/10.1016/S0140-6736(21)00869-2)

Provided by University of Colorado at Boulder

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