

Interview with Dr. Jose-Luis Jimenez, aerosol scientist, on the airborne nature of the SARS-CoV-2 virus

Benjamin Mateus
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Dr. Jose-Luis Jimenez is a professor of chemistry at the University of Colorado-Boulder. His area of expertise includes aerosols, atmospheric chemistry, aircraft studies, instrument development, mathematical modeling, and disease transmission. The Spanish-born scientist is one of the most cited worldwide in the fields of geosciences and aerosols.

He was one of the 239 signatories last year of an open letter to the World Health Organization (WHO) and Center for Disease Control and Prevention (CDC) urging them to acknowledge that airborne aerosols are critical in the transmission of the SARS-CoV-2 virus.

CDC and WHO official guidance continued to emphasize respiratory droplets as the main route of transmission. Respiratory droplets are small bits of saliva or respiratory fluids that infected individuals expel when they cough, sneeze, or speak. Though they are propelled through the air, they quickly fall to the ground because of their weight, traveling three to six feet at most. Though droplets are important when coughing and sneezing, it is actually talking in close proximity that plays a significant role in COVID-19 infections. Speech and simply breathing produce small respiratory particles that can stay afloat for considerable time, leading to aerosol transmission.

The July 2020 open letter was in response to a rebuff by the WHO scientists during an early April 2020 Zoom meeting with a group of 39 scientists from various fields of aerosol physics, geophysical sciences, and chemistry, urging recognition of the aerosol transmission of the COVID-19 infection.

With 20 years of experience in studying aerosols, Dr. Jimenez used social media channels to warn the public, providing them with a scientifically based recognition of aerosol transmission of respiratory pathogens and how to protect themselves and their communities. As a report in MIT Technology Review in October 2020 noted, “He convened a group of nine other experts in the field to create this open-access Google Doc offering comprehensive advice on what you need to know about aerosol transmission, from best practices for masks to whether it’s safe to travel by airplane.”

Dr. Jimenez was kind enough to accept the invitation by the World Socialist Web Site to sit for an interview.

Benjamin Mateus: Dr. Jimenez, thank you for your time. We are very appreciative that you have accepted our invitation. I am sure you are every busy.

Jose-Luis Jimenez: Not at all. Happy to do this.

BM: As a discipline, where did aerosol science begin? I think it would be important to make the connection between the physics and the biology of aerosol.

JLJ: Aerosol science is important for many applications. For example, meteorology, there is the formation and evaporation of clouds, fog, drizzle, rain. For pollination of plant species, that often goes with the wind

(anemophilous plants, I think they call them). Also, for air pollution, from smoke indoors or outdoors, or photochemical smog, or soot from oil fires. There are also radioactive elements from nuclear explosions or power plant accidents that end up in aerosols. We deliver medicines through aerosols such as the treatment of asthma with albuterol [inhalers]. Even car tires are rubber mixed with a carbon black aerosol. There are many applications where aerosols are used to make materials. And there is, of course, airborne transmission of diseases.

[Dr. Jimenez explained in his article published in Time magazine, “aerosol transmission is similar to droplet transmission, except that the bits of fluid are so small that they can linger in the air for minutes to hours. To understand the scale of aerosols, the diameter of a human hair is about 80 microns, and aerosols smaller than about 50 microns can float in the air long enough to be inhaled. SARS-CoV-2 is only 0.1 micron in diameter, so there is room for plenty of viruses in aerosols.”]

BM: The airborne nature of the coronavirus has become quite a political topic. It appears that we have understood that these diseases have been aerosolized for some time. Apparently, there were studies conducted even as late as back in 2018, by the CDC itself, where they determined that even the influenza virus was aerosolized. Maybe you can speak to the reluctance on the part of these public health institutions and why they were resistant to your suggestions that SARS-CoV-2 was transmitted in aerosol forms? And briefly, if you can, speak to the circumstances surrounding the letter that was eventually sent to the World Health Organization.

JLJ: In response to your first question, there are studies dating back to at least 1979, showing that aerosolization was possible for influenza. In that case, there was the famous *Moser et al.*, study in which an airplane was parked on the tarmac for three hours without ventilation. There was a person with influenza who was coughing and then most of the airplane got sick with influenza.

We have had indications for a long time, and there are more recent studies that have found live virus in exhaled breaths. Researchers like Linsey Marr, who have been studying these for decades—she recently said that her guess is that influenza is mostly spread by aerosols, through the airborne mechanism by inhalation.

There is a historical reason, and I will send you a few links later, and I’ve written a long thread in Twitter where I explain the history of the resistance.

But briefly, the problem is that basically during most of human history, since Hippocrates, who said, “if a lot of people get infected with the same disease, we have to suspect the air because it’s what we have the most in common,” then throughout human history it was thought that this is expressed through the air was the theory of miasma. But, they thought, it wasn’t coming from another person through the air, but from putrid

matter and things like that. It was then pretty phantasmagoric.

This persists basically in some form until the end of the 1800s with the advancement of the germ theory led by Louis Pasteur and [later] Robert Koch that showed there was no disease being transmitted [through noxious air.]

[Miasmatic theory is an obsolete medical theory advanced by Hippocrates in the fourth century B.C. that the spread of disease was a byproduct of noxious air emanating from rotten organic matter. The theory was accepted for more than two millennia across Europe and China until the advancement of the germ theory of disease in the late 1800s.]

[The germ theory of disease states that microorganisms, also called pathogens or germs, that are too small to be seen with the naked eye, are the source of disease in humans and other animals. It is understood that environmental and hereditary factors can influence the severity of a disease. Though physicians in the Middle Ages, such as Ibn Sina in 1025 who advanced the possibility of people transmitting a contagion, had proposed basic forms of the germ theory, it was the important work conducted by Louis Pasteur in the late 1850s and then Robert Koch (founder of the modern field of infectious disease) in the 1880s that led to the “golden era” of bacteriology and the identification of the actual organisms that cause diseases.]

But then the whole paradigm is shifted by Charles Chapin, an American public health researcher. He writes an extremely influential book in 1910. And in that book, he says that the most important infection is not airborne infection; it is contact infection, when we are close to other people, when we touch them, or when we have these spray droplets, which Chapin called “spray-borne infection” that fly from one person to the other, and they hit the person in the eyes, in the nose, in your mouth. And this [Chapin claims] is the main mode of infection.

And that’s why social distance works, which is something we already knew then. And he says that [long-distance] airborne infection is unproven and unlikely in his opinion. He doesn’t think it’s important for any disease. And he’s too successful. He was expressing his opinion about these things, about the spray droplets, and about the lack of airborne infection. But this becomes a dogma in infectious diseases.

For example, the first chief epidemiologist of the CDC, Alexander Langmuir, who was in that role for 20 years, 1949 to 1969, said that Chapin was the greatest American epidemiologist, and this view of contact infection was basically foundational at the CDC, and they were misinterpreting the studies.

It’s obvious when you read that they were misinterpreting the studies, because they were so convinced about the droplets, that infection in close proximity meant droplets, that they didn’t understand that social distancing also works for airborne infection. But like smoke in the air, the pathogen is more concentrated in front of the person.

So, that extends to 2020, when WHO sees that this disease transmits in close-proximity, and they say this is a droplet disease and it is not airborne. And they say that on the 28th of March, [2020]; they say that extremely strongly in that Tweet and Facebook and whatever, that it is a fact it is not airborne and to say that it is airborne is misinformation.

So, you were asking about our meeting with WHO. I wasn’t working on the disease transmission before the pandemic, but I knew colleagues that were, like Linsey Marr and Lidia Morawska [internationally recognized air quality and health expert from the Queensland University of Technology]. We were already discussing the topic and doing some research about COVID when the WHO puts out the Tweet.

So, Lidia Morawska contacts me. She is trying to put together an international team of scientists from many fields to contact the WHO and tell them that we think they are really wrong in saying that this is not the airborne disease. And so, we form what we call the group of 39 scientists.

[On April 3, 2020, the 39 experts in the field of air quality and aerosols

led by Lidia Morawska, who also works as a consultant for the WHO, meet with the international agency to discuss these concerns. However, the meeting is dominated by staunch proponents of contact and droplet modes of transmission.]

As Linsey Marr said, we felt they were just entertaining us. They were absolutely closed to the idea that there was transmission through the air. They told us we had no evidence, even though we had evidence. Actually, there was more evidence of transmission through the air than there was of transmission from surfaces or large droplets.

[On May 1, 2021, The Lancet published a commentary by Drs. Jimenez and Greenhalgh titled “Ten scientific reasons in support of airborne transmission of SARS-CoV-2,” which reviews the arguments and the literature that bolsters their conclusions.]

Even a year later, there are zero cases demonstrating transmission of disease through surfaces. And the WHO is still saying that the disease can transmit through surfaces. But the CDC has said that [route of transmission] is very difficult. And *Nature* magazine has said the same thing, and it has basically yelled at the WHO to stop saying it goes through surfaces because the science shows its highly unlikely.

For these spray-borne droplets, the large droplets, the WHO still says they are the main mode of transmission. It isn’t that [the primacy of] this route hasn’t been demonstrated for COVID; it is that it has never been demonstrated directly for any disease in the history of medicine.

All that is going on is that Chapin said that infection in close proximity was due to droplets. He didn’t have evidence; *he just said it... that it was more likely than airborne.* [Emphasis added] And that became a dogma. And now that the dogma is being questioned, they are questioning the people that are questioning it. They have tried to ignore them, like it has been the case.

So, that’s why it has taken so long to do this and why, once we realized that they were not going to listen to us, we wrote that letter of the 239 scientists, which was written by the group of 39. And then we asked 200 colleagues to sign it. And that was why we reported, that was in the *New York Times* or whatever... That’s really when, since then, there has been an ongoing debate in the press.

And I think, we have partially won. The WHO, on the 30th of April [2021], and the US CDC, on the 7th of May [2021], have accepted that airborne transmission is an important mode of transmission, which before they had not done. They still say things in confusing ways as much as possible, but it is now accepted by the mainstream public health agencies that these viruses are airborne.

By now, what I believe is that the scientific evidence supports that airborne transmission is the only important mode of transmission. There may be other modes of transmission, but they are very minor.

BM: I’m also interested in your work and the amalgam between physics, biology and infectious disease, and even the politics. Perhaps you can speak to these issues?

JLJ: Well, let me tell you what comes to mind and then we can follow up if it isn’t clear. Basically, researchers in infectious disease study what happens to the virus inside of the body. But then the virus, no matter how infectious it is, must reach another person to infect them and that happens through travel in the physical world.

This virus can clearly travel through the air, either through large aerosols or through small aerosols. And that is the domain of aerosol science, which is basically physics with some chemistry added. But because there has been a denial for a hundred years, since [Dr. Charles] Chapin, that viruses are transmitted through the air, people in infectious disease, almost unanimously, don’t study aerosols. Why would you study aerosols which are confusing and complicated?

If they are not important, they don’t transmit the diseases. They have plenty of important things to study, right?

So, that has been a huge problem. And then, the attitude has been that

people in other societies [and disciplines] didn't have anything to contribute to this. During this pandemic we have been called by some ... jokingly ... as owners of ventilation companies, implying that when we wrote the letter that we were doing it with the expectation of some financial gain or something. Some even said that we didn't have anything to contribute or didn't even understand the subject. Even the WHO personnel said similar things.

I will send you an article by Trisha Greenhalgh and co-authors. What they do is called a Bourdieusian analysis ... and they explained basically the social constructing, that the infectious disease doctors that were denying aerosol transmission were in control of all the institutions, at least systematically excluded aerosol scientists.

[The authors of the above study wrote, "Aerosol scientists—typically, chemists, and engineers—representing the heterodoxy were systematically excluded from key decision-making networks and committees. Dominant discourse defined these scientists' ideas and methodologies as weak, their empirical findings as untrustworthy or insignificant, and their contributions to debate as unhelpful." In other words, scientists that understood and took note that the coronavirus could transmit airborne were excluded from discussing their findings.]

BM: Now that CDC has basically said vaccinated individuals no longer need to wear masks, what concerns does this raise for you?

JLJ: In my humble opinion, the CDC lifted the mask mandate too early, with too few people vaccinated and variants like Delta starting to propagate in the US. So, that may slow down the rate at which cases decrease or perhaps cause a bump in cases like in the UK right now. I assume it is unlikely that it would be more than that, although that's not my field.

BM: How should we prepare for future flu seasons especially in schools?

JLJ: The flu is like a yearly mini-pandemic. And there is a strong suspicion that it is also transmitted through the airborne mechanism (aerosol inhalation) as COVID-19. And clearly the measures that we deployed for COVID-19 have been exceptionally successful against the flu (for which we have more immunity, and it is less contagious than COVID). So, we will need to encourage people who have symptoms to stay home (and offer paid sick leave so that people can actually do that). And wear masks when with symptoms, or for people at risk of flu complications when sharing air indoors with lots of people in flu season. And improve ventilation in schools.

BM: Did the Moser study [from 1979] gain any traction in the debate? The article's conclusions leave the question hanging—they term the transmission mechanism "large aerosol droplets." Additionally, the Milton study on influenza, funded by the CDC in 2018, proved that influenza was aerosolized. All this information about airborne respiratory viruses was present before the pandemic. Quite eye-opening.

JLJ: These studies were not considered important in the mainstream, I think.

BM: Were they inconvenient? For instance, when the pandemic hit, they closed schools. Then they promoted the idea that children don't or rarely get the virus. After much work now we understand that children and schools were a critical factor for the community transmission of the coronavirus. Thoughts?

JSJ: Don Milton or Linsey Marr would know more, but I think it was general disbelief. The public health and infection prevention professions thought they knew how transmission worked and were no longer paying attention to the details. Researchers working on airborne [aerosolized] transmission of the flu were viewed as oddballs.

BM: I was reading about TB (or measles) and that the work in the 1930s to 1960s had set a limit of 5 microns for aerosol. If you can speak to this history. Perhaps you could also speak about how humans generate aerosols, how big are these particles, how much viral particle is needed for

a high probability of getting infected, etc. I think a clear description of this would be valuable.

JLJ: There are good journalistic articles on the history of the 5-micron error. I will send them to you.

BM: What are your thoughts on the Delta variant in the UK, the schools there, and the developing situation here in the US?

JLJ: Well, it is clear that the Delta variant is significantly more contagious. And the spread is exponential, so it being more contagious makes transmission much harder to control. However, the vaccines seem to work well against it. So, Delta is likely to lead to substantial outbreaks in geographical areas or population groups that have substantial numbers of unvaccinated people. As well as in countries where the vaccines used have relatively low efficacy, such as Sinovac. In the US there are many states (including some in the Southeast) that have low vaccination rates. And vaccination rates are also low among minorities and other groups. I would expect to see outbreaks there. We know that transmission is higher when people share more air indoors, so we may see some of this in the summer in the Southeast (people spending more time indoors with air conditioning) and then in the fall/winter in the colder parts of the US (too cold outside).

BM: One last question: any new research and/or policy coming from this work in aerosol? I was reading about the rise in Respiratory Syncytial Virus (RSV) infections in children returning to day care.

JLJ: Yes, for example this study highlighted by Linsey Marr on twitter. Transmission in shared hospital rooms, with distance, curtains, no contact, is the same as in households. So, it points to the air, not to close contact and large droplets.

BM: Dr. Jimenez, again, thank you for answering these questions and all your insight on this subject.

JLJ: My pleasure. Take care.

Concluded.

Links provided by Dr. Jimenez on airborne nature of respiratory diseases such as COVID-19:

1. The 60-year-old scientific screwup that helped COVID kill: <https://www.wired.com/story/the-teeny-tiny-scientific-screwup-that-helped-covid-kill/>

2. The scientific paper (preprint) that the Wired article describes: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3829873

3. This is the thread on the larger arc of history (we are working "as we speak" to turn it into a scientific paper): <https://threadreaderapp.com/thread/1391111720526024708.html>

4. Twitter thread: <https://twitter.com/jljcolorado/status/1391111720526024708>

5. This is an excellent article about the misunderstanding of airborne transmission: <https://doi.org/10.1016/j.jhin.2020.12.022>

6. This article summarizes the scientific evidence why we think that airborne transmission is the dominant mode: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(21\)00869-2/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00869-2/fulltext)

7. This one we talk about the paradigm shift that recent discoveries must usher: <https://science.sciencemag.org/cgi/doi/10.1126/science.abg2025>

8. Slides: <http://Bit.ly/COVID-Aerosols3>

9. COVID shared room air transmission estimator: <http://tinyurl.com/covid-estimator>

10. Frequently Asked Questions: <http://tinyurl.com/faqs-aerosol>

11. Divulgacion Numeroteca: <https://numeroteca.org/cat/en-el-aire/>

12. Twitter: <http://twitter.com/jljcolorado>

13. Letters to governments: http://Bit.ly/Letter_Inhalation

14. Canal de YouTube (español e inglés): <https://www.youtube.com/c/JoseLuisJimenez>

15. Talk with Professor Lidia Morawska discussing how humans

generate aerosols, how big they are, etc.:
<https://www.youtube.com/watch?v=fVwgMia1Yyk>



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