Life without infection (1)

Be most careful about airborne infections

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As the number of SARS-CoV-2 infections continues to surge, people's anxiety and fear are only increasing as they do not find effective measures to control the infection without stopping economic activity. Now more than ever, it is necessary to go back to the starting point and focus on "not getting infected" and rebuild our behavior and life.

How can we live a life that is free from infection?

In order to do so, we need to know why we are infected.

The route of transmission of SARS-CoV-2 is droplet / contact infection, and airborne infection. The most important is "airborne infection" *via* aerosols suspended in the air from the breathing, talking, singing, etc. of infected persons.

This is because, first, droplet and contact infection caused by coughing, sneezing, etc. are visible and noticed, so both the person and those around them can be aware of and be vigilant and avoid them. In addition, contact with droplets from infected patients is not common for most citizens, except for medical personnel.

On the other hand, aerosols floating in the air can be inhaled through the nose or mouth without knowing it, causing infection. So, we don't know when or where we got infected. Airborne infections are transmitted by daily breathing, so they can take advantage of the incorrect response to infect.

It appears that this is not the way to deal with it, but on the contrary, if we recognize the characteristics of airborne infection, we will be able to respond firmly without infection.

The key point is to always place the highest priority on airborne infection, and to effectively and optimally implement infection prevention measures such as "ventilation and wearing masks". "avoiding the three Cs" and "physical distancing." By doing this, you will be able to judge the best decision for yourself according to the situation at the time and understand how to act.

Walking Fun in Seasons

Ten scientific reasons to support airborne transmission of SARS-CoV-2

On 15 April 2021, the online edition of The Lancet published a paper summarizing the scientific basis for aerosol airborne transmission of the new coronavirus SARS-CoV-2.

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Ten scientific reasons in support of airborne transmission of SARS-CoV-2

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A systematic review by WHO-funded Heneghan et al., published as a preprint in March 2021, states that "the lack of a recoverable viral culture of SARS-CoV-2 prevents us from drawing firm conclusions about airborne transmission"[1]. The widespread dissemination of these conclusions and the results of the review has become a cause for concern because of its close relevance to public health.

When the infectious virus spreads mainly through large rapidly falling respiratory droplets, key control measures are reduced direct contact, surface cleaning, physical barriers, physical distancing, wearing masks within droplet distances, respiratory hygiene, and so-called AGP (areosol-generating health-care procedures: Examinations and medical procedures that produce aerosols) are the wearing of specialized high-level protective clothing. In this measure, there is no need to distinguish between indoor and outdoor activities. This is because the infection mechanism, which depends on the gravity of droplet infection, is the same indoors and outdoors.

However, if the infectious virus is mainly airborne, it can be transmitted by inhaling the aerosol produced when an infected person exhales, talks, screams, sings, sneezes, or coughs. Measures to avoid inhalation of infectious aerosols are needed to reduce airborne transmission of the virus, such as ventilation, air filtration, reducing crowding and indoor dwell time, wearing masks indoors at all times, paying attention to the quality and fit of masks, and a high level of protection for healthcare workers[2]。 It is difficult to directly prove airborne transmission of respiratory viruses[3]. Mixed findings from studies that detect viable viruses in the air provide insufficient evidence to conclude that viruses are not airborne, as long as there is overall scientific evidence. Decades of meticulous research, not involving the capture of viable viruses, have shown that infectious diseases that were once thought to be spread by droplets are airborne[4)]. The following 10 streams of evidence collectively support the hypothesis that SARS-CoV-2 is transmitted primarily by airborne routes[5)].

1) **The superspread phenomenon** (the spread of infection by superspreaders) causes substantial SARS-CoV-2 infections: in fact, the superspread phenomenon can be the main driver of the pandemic[6)]. Detailed analysis of human behavior and interactions, room size, ventilation, and other variables in settings such as choir concerts, cruise ships, slaughterhouses, nursing homes, correctional facilities, etc. show some patterns (long-distance infection and the basic reproduction number (R_0) described below) consistent with airborne diffusion of SARS-CoV-2, which cannot be adequately explained by droplets or surface vectors[6)]. The high incidence of such events strongly suggests the predominance of aerosol transmission.
2) Long-distance transmission of SARS-CoV-2 among people in adjacent rooms but not in direct contact has been recorded in quarantine hotels[7)]. Historically, it has been possible to prove long-distance transmission only in the complete absence of community-acquired infection4).
3) Asymptomatic or pre-symptomatic transmission of SARS-CoV-2 from people who do not cough or sneeze is likely to account for at least one-third, possibly up to 59%, of all infections worldwide, and is the primary way SARS-CoV-2 spreads around the world[8)], supporting airborne transmission as the main mode. Direct measurements have shown that conversation produces thousands of aerosol particles and a small number of large droplets[9)] ,and this supports the airborne transmission route.
4) SARS-CoV-2 infection is higher indoors than outdoors[10)], which is significantly reduced by indoor ventilation[5)]. Both observations support that airborne transmission is the main route.
5) Cases of nosocomial infections are documented in medical documentation: they describe strict precautions against droplets and contact and the use of personal protective equipment (PPE) to protect against droplets, but do not mention aerosol exposure at all[11)].
6) Viable SARS-CoV-2 has been detected in the air. In laboratory experiments, SARS-CoV-2 remained infectious in the air for up to 3 hours and had a half-life of 1.1 hours[12)]. Viable SARS-CoV-2 was identified in an air in a room occupied by a COVID-19 patient in the absence of areosol-generating health-care procedures (AGPs)[13)] and was also detected in air samples from an infected person's car[14)]. Other studies have failed to capture viable SARS-CoV-2 in air samples, which is to be

expected. Aerial virus collection is technically difficult for several reasons, including the limited effectiveness of some collection methods for collecting particulates, dehydration of the virus during collection, damage to the virus due to impact (leading to reduced viability), reaerosolation of the virus during collection, and retention of the virus in devices[3)]. Measles and tuberculosis are the two main airborne infections and have not yet been cultivated from indoor air[15)].

7) SARS-CoV-2 has been identified in air filters and building ducts in hospitals with COVID-19 patients. Such places can only be reached by aerosols[16)].

8) Studies in which infected and non-infected animals were placed in separate cages and connected through air ducts showed SARS-CoV-2 infection, which can only be adequately explained by aerosols[17)].

9) To the best of the authors' knowledge, no studies have provided strong or consistent evidence to disprove the hypothesis of SARS-CoV-2 airborne transmission. While some people have avoided SARS-CoV-2 infection by sharing air with infected people, this situation can be explained by a combination of factors, including orders of magnitude of fluctuations in viral shedding between infected people and differences in environmental (especially ventilation) conditions[18)]. Individual and environmental variability means that a small number of primary cases (especially those that release high levels of the virus in crowded indoor spaces with poor ventilation) account for the majority of secondary infections, which is supported by high-quality data from close contact tracing from several countries[19,20)]. The wide variability in the respiratory viral load of SARS-CoV-2 refutes the argument that SARS-CoV-2 cannot be transmitted through the air. This is because the R_0 of SARS-CoV-2 (estimated to be about 2.5)[21)] is lower than that of measles (estimated to be about 15)[22)], especially since R_0 is an average value and does not take into account the fact that only a small number of infected people release a large amount of virus. Overdispersion of R_0 is well establishted in COVID-19 documentation[23).]

10) There is limited evidence to support the other major routes of infection, namely respiratory droplets or fomite[9,24)]. Evidence for respiratory droplet transmission of SARS-CoV-2 has been cited as susceptibility between people in close proximity to each other. However, most proximity infections, along with small numbers of remote infections, are likely to be explained by exhaled aerosols, in which the shared air is diluted with distance from the infected person[9)]. The false assumption that proximity transmission is due to large respiratory droplets or surface contact has historically been used for decades to rule out airborne transmission of tuberculosis and measles[15, 25)]. This became the dogma of medicine, and the direct measurement of aerosols and

droplets was ignored, resulting in the overwhelming number of aerosols produced by respiratory activity and errors such as arbitrary boundaries between aerosols and droplets with a particle size of 5µm (rather than the correct boundary of 100µm) were revealed[15, 25]. Because respiratory droplets are larger than aerosols, it is sometimes argued that they contain more virus. However, in diseases where pathogen concentrations are quantified by particle size, smaller aerosols show higher pathogen concentrations than droplets when both are measured[15].

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