Is SARS-CoV-2 Airborne?

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WHILE we are now past the first six months of the COVID-19 pandemic, some new ideas of the transmission of SARS-CoV-2 have begun to emerge. Some are still being debated. Among the recent important debates are concerns whether the transmission is airborne or not? I have attempted to answer this based on the current understanding.

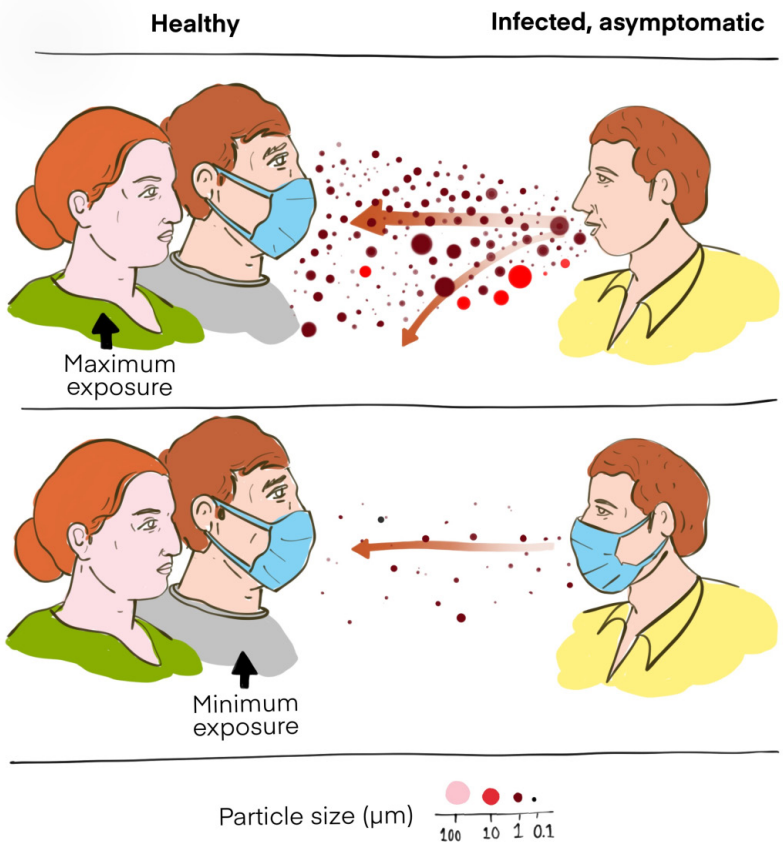
It is now accepted that the route of infection is through the respiratory tract. It is believed that the infection can be acquired through inhalation, or even by touch through the mouth or nose, or possibly eyes. The World Health Organization (WHO) has maintained that the primary spread of infection is through person-to-person contact. This position of the WHO is based on the presumption that when the infected person sneezes or coughs, large droplets are released, which can be inhaled by people in close proximity. Alternately, when these droplets settle on surfaces, people who touch these surfaces are at risk through touching their mouth, nose or eyes, unless hands are washed frequently. Thus, the guidelines issued across the world from time-to-time have been to maintain physical distance, and to wash hands frequently with soap. The large droplets do not travel distances in air very far and quickly settle down, and hence maintaining at least 1 m distance from the infected individual would appear to avoid the risk of contact. The WHO typically refers this as people-to-people contact.

The Centers for Disease Control and Prevention (CDC) in the USA issued a clarification on the 22 May 2020 that "*The primary and most important mode of transmission for COVID-19 is through close contact from person-to-person. Based on data from lab studies on COVID-19 and what we know about similar respiratory diseases, it may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes, but this isn't thought to be the main way the virus spreads*." This clearly indicated that spread through touching surfaces was thought to be a secondary, and possibly minor, source of acquiring infection. Thus, even while the debate on whether infected surfaces are a source of infection rages on, the primary route of infection can be understood to be through inhalation.

It is well known that when people sneeze or cough, they release droplets in the air. These droplets are typically 0.5-12 μm (1μm is 1000th of an mm) in size[1]. The WHO categorises the droplets as "respiratory droplets" if their size is 5-10 μm. Smaller than 5 μm droplets are categorized as "droplet nuclei" by the WHO. The reason for such categorization is important to understand in the perspective of how respiratory diseases are spread.

A sneeze can generate approximately 40,000 respiratory droplets, while cough or talking for 5 minutes can generate approximately 3000 droplet nuclei or smaller droplets[1]. When an infected individual exhales these droplets, they potentially have encapsulated within themselves respiratory pathogens such as *Mycobacterium tuberculosis* (the TB-causing bacterium), influenza virus, SARS-CoV-1, etc.

The larger droplets readily settle on surfaces, whereas smaller droplets or the droplet nuclei remain suspended in the atmosphere for a longer duration[1]. The larger droplets formed by an infected individual during coughing, sneezing, talking or singing, therefore, do not travel far. They settle down quickly. However, the smaller droplets can remain suspended in air for a considerable duration.



The earlier social distancing measures and other precautions suggested by WHO and others are based on the understanding that the SARS-CoV-2 transmission is mainly through larger droplets, which settle on surfaces. However, the evidence that normal speech can generate droplets nuclei, which could remain airborne for a long period of time, raises concerns of viral transmission in confined spaces.

The good news is that considering that oral fluid has about a million copies of viruses per millimetre, the probability that a droplet of 10 μm size contains at least one virus particle is approximately 0.37%. This probability drops down to less than 0.01% for droplets of size less than 1 μm^2. This means that in the estimated 3000 droplet nuclei exhaled by a person while talking for 5 minutes, approximately 10 will contain the encapsulated virus. The number of virion-encapsulated droplets generated during sneezing from an infected person is much larger, say, approximately 100. The droplets dehydrate very quickly in air, especially in the drier climates, making their size even smaller and thereby enhancing their probability to remain suspended in air longer.

With typical nasal breathing, the inhalation of droplets generated by an infected individual leads to their deposition in the respiratory tract, thereby putting the hitherto uninfected person at risk[3]. In open spaces, the small-sized droplets get dissipated in air very quickly, and therefore the concentration of virion-encapsulated droplets in the open is extremely low. Moreover, emerging evidence also suggests that the encapsulated virus in such droplets also gets inactivated by sunlight[4]. However, the concentration of virion-encapsulated droplets is likely to be higher in places that are not well ventilated.

All these emerging evidences and arguments suggest that indeed airborne transmission of SARS-CoV-2 is a distinct possibility. So, how does one protect oneself from airborne infections? The answers are intuitively very straightforward – avoid large crowded gatherings, keep enclosed places like workplaces well ventilated, and most importantly, continue wearing masks even in enclosed spaces.

Zhang *et al*.[3] therefore conclude their analysis by stating that "*wearing of face masks in public corresponds to the most effective means to prevent inter-human transmission, and this inexpensive practice, in conjunction with extensive testing, quarantine, and contact tracking, poses the most probable fighting opportunity to stop the COVID-19 pandemic, prior to the development of a vaccine*". Indeed, wearing masks appears to be the most effective strategy, and possibly mandatory for all to follow.

References:

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4. Simulated Sunlight rapidly inactivated SARS-CoV-2 on surfaces. Ratnesar-Shumate *et al*. *The J. Infect, Dis*. (2020) **222**, 214-222.

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