

Confluences and Measures in COVID-19 Infectious Transmission

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While much of the affluent world seems to be beating back the Coronavirus outbreak (for now at least), the United States seems to have plunged into a second surge of infection. The difference seems to be related not only to availability of testing and accurate tracking, but also inconsistent messages from our leaders about what the risks are and how to mitigate them. On the one hand, there are numerous people browsing through public indoor spaces, not following social distancing guidelines, and not wearing masks. On the other hand, one sees people driving around in their car, all by themselves and wearing a mask, or people wearing masks outdoors, in the middle of nowhere, with no one else within 50 feet. Clearly people do not have a shared common understanding of the disease, nor do many of them seem to be thinking critically about what the actual risks are. This is somewhat understandable, as the disease is new, and it seems to vary in its effects significantly from person to person, suggesting that variations in the human population seems to play a large role in how the virus interacts with us.

We are learning more about this disease, but it seems our actions need to be better aligned and coordinated. The following is an attempt to provide some clarity and perhaps guidance to that end. A caveat: I am not a physician or virologist. Below is simply what I have gleaned from my readings and conversations with healthcare and public health professionals. Appended below is the summary findings of a WHO Scientific Brief from 09 July 2020.

Three Confluences: Proximity, Viral Output, and Circulation

To discuss these three factors, one needs to understand some basics about viral transmission. First, a virus cannot reproduce itself without a host cell, so it must have a chance to get into a host and begin reproducing before it can spread. Next, the virus must exist in large enough numbers in the host to produce a viral volume large enough to create a likely chance of transmission. As a rule, the more the virus has invaded and replicated in the host, the more contagious the individual can be. This is usually evident when the host is exhibiting symptoms, but as we know, COVID-19 can be contagious in the pre-symptomatic stages, or even in some asymptomatic individuals. It should also be noted that this particular virus is transmitted primarily through coughing, sneezing, or talking, though also via infected contact surfaces; and that it invades the body of future hosts through the mucus membranes of the eyes, nose and mouth.

The most recent studies of the disease seem to indicate that transmission happens most commonly by breathing air infected by a host, air that is in a stagnant place where there is minimal circulation. This means that smaller indoor spaces with multiple people create the greatest amount of risk, absent any accurate information about who might be infected; and because of the pre-symptomatic and asymptomatic transmissions apparent in this disease, that uncertainty creates an imperative for additional safety.

There is a recent discussion of “super-spreader” events, such as the case of the chorus in Washington, where a single person infected 60 out of 80 persons in the group. That person might be termed a ‘super-spreader’, one who has a high level of viral output; but it should also be noted that these persons were a *choral* group, which means air was being ejected from the lungs and drawn back in again at an elevated rate. This is why indoor activities that involve singing, laughing, shouting, and the like, are particularly risky activities. Because most people regularly participate in such activities as a general rule, the desire for normalcy provides impulse for the riskiest sort of social activity.

Important Protective Measures: Social Distancing, Wearing of Masks and other Face-Protective Devices, and Cleaning Hands and Contact Surfaces

Health experts have found that social distancing provides a most important form of defense against COVID-19 infection. A recent major study of the disease has found that a one-meter distance creates significant protection, two meters provides even more, and after that the extra protection benefit becomes insignificant. Of course one must keep in mind the environment in which one finds oneself to fully gauge the risk, factors such as whether one is indoors or outdoors, the size of the indoor space, how many persons are in it, and whether there is strong or weak air circulation. Humidity is also a factor, as the larger water droplets in humid environments fall faster to the ground and pose less of a risk. As a rule, it would seem that the more people are around and the smaller the less ventilated (and dryer) the space, the more important it is to keep one's distance.

The second measure, wearing of masks, aims at stemming infection by reducing or eliminating viral output from an infected host and minimizing the viral input from an infected environment. Face shields and eye protection mitigate infection through the mucus membranes of the eyes. Again, context determines how important it is to be wearing face protection for yourself and for those around you, and which one is needed in the given circumstance. Some masks, for instance, are better at preventing inhalation of the virus, such as the N-95 variety; and some are better than others at preventing the virus from exiting the host. But one should not conclude from this uncertainty about relative effectiveness that masks aren't important, since most¹ of them reduce the risk of infection to some degree, and all the little details are likely to add up. Ideally, in an uncertain environment which is smaller and less ventilated, all persons should be wearing protection. If both uninfected and infected who are pre-symptomatic (and asymptomatic) are wearing some form of mask or face protection, the risk of contagion is significantly reduced.

A third measure-- hand washing and sanitation of potentially infected surfaces-- is always good practice, and of particular importance for stores, clinics and other public spaces. As with face protection, attention to detail is important, as all the smaller risks over time can add up to much larger ones. Hopefully this precaution will remain in use long after the crisis is over, and become part of our new normal.

Finally, a word on screening. In places where the social distancing guidelines cannot be followed, such as in a massage clinic, measures beyond the recommended personal face protection, handwashing, and surface disinfection become important. Screening persons prior to entry into the building can be undertaken, with not only a body temperature reading, but also blood oxygen saturation reading. The former uses a thermometer (preferably a forehead thermometer, which does not require contact) and checks against persons entering who have a fever. This is always a good idea, but particularly paramount now. The latter measure uses an oximeter to screen out persons who have developed a respiratory infection, but whose symptoms may not have fully manifest. If one's blood oxygen saturation is below a certain level,² one could be infected, suffering from hypoxia,³ and not know it; or, in the cases where they are otherwise compromised in their respiratory system, they likely shouldn't be taking a risk of exposure. Overall, the screening process creates an extra measure of protection for the persons interacting in close proximity in an indoor facility.

¹ Bandanas and similar face coverings do not seem to offer much protection. See *Phys. Fluids* 32, 061708 (2020); <https://doi.org/10.1063/5.0016018>, 30 June 2020.

² We are following a rule of disallowing entry at 95% or lower saturation level.

³ See <https://amp.cnn.com/cnn/2020/05/06/health/happy-hypoxia-pulse-oximeter-trnd-wellness/index.html>

Summary from WHO Scientific Brief⁴

Key points of the brief

Main findings

- Understanding how, when and in what types of settings SARS-CoV-2 spreads between people is critical to develop effective public health and infection prevention measures to break chains of transmission.
- Current evidence suggests that transmission of SARS-CoV-2 occurs primarily between people through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions, or through their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings.
- Airborne transmission of the virus can occur in health care settings where specific medical procedures, called aerosol generating procedures, generate very small droplets called aerosols. 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.
- Respiratory droplets from infected individuals can also land on objects, creating fomites (contaminated surfaces). As environmental contamination has been documented by many reports, it is likely that people can also be infected by touching these surfaces and touching their eyes, nose or mouth before cleaning their hands.
- Based on what we currently know, transmission of COVID-19 is primarily occurring from people when they have symptoms, and can also occur just before they develop symptoms, when they are in close proximity to others for prolonged periods of time. While someone who never develops symptoms can also pass the virus to others, it is still not clear to what extent this occurs and more research is needed in this area.
- Urgent high-quality research is needed to elucidate the relative importance of different transmission routes; the role of airborne transmission in the absence of aerosol generating procedures; the dose of virus required for transmission to occur; the settings and risk factors for superspreading events; and the extent of asymptomatic and pre-symptomatic transmission.

⁴ "Transmission of SARS-CoV-2: implications for infection prevention precautions," World Health Organization (Scientific brief 09 July 2020)

How to prevent transmission

The overarching aim of the Strategic Preparedness and Response Plan for COVID-19(1) is to control COVID-19 by suppressing transmission of the virus and preventing associated illness and death. To the best of our understanding, the virus is primarily spread through contact and respiratory droplets. Under some circumstances airborne transmission may occur (such as when aerosol generating procedures are conducted in health care settings or potentially, in indoor crowded poorly ventilated settings elsewhere). More studies are urgently needed to investigate such instances and assess their actual significance for transmission of COVID-19.

To prevent transmission, WHO recommends a comprehensive set of measures including:

- Identify suspect cases as quickly as possible, test, and isolate all cases (infected people) in appropriate facilities;
- Identify and quarantine all close contacts of infected people and test those who develop symptoms so that they can be isolated if they are infected and require care;
- Use fabric masks in specific situations, for example, in public places where there is community transmission and where other prevention measures, such as physical distancing, are not possible;
- Use of contact and droplet precautions by health workers caring for suspected and confirmed COVID-19 patients, and use of airborne precautions when aerosol generating procedures are performed;
- Continuous use of a medical mask by health workers and caregivers working in all clinical areas, during all routine activities throughout the entire shift;
- At all times, practice frequent hand hygiene, physical distancing from others when possible, and respiratory etiquette; avoid crowded places, close-contact settings and confined and enclosed spaces with poor ventilation; wear fabric masks when in closed, overcrowded spaces to protect others; and ensure good environmental ventilation in all closed settings and appropriate environmental cleaning and disinfection.