Update on SARS-CoV-2 / COVID-19: Thoughts on re-entry

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COVID-19: Thoughts on re-entry

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Introduction

States are beginning to reopen despite unclear nationwide directives and a persistence of new cases in the U.S. As this happens, our recommendations for protecting yourself and your family against infection remain generally the same as during the lock-down. It is impossible to know if reopening in the current climate will result in a second wave of infection--we have to watch the situation develop before offering more concrete recommendations for a return to normal life. In some ways, observing the different outcomes to various re-entry strategies will serve as so-called natural experiments for what are likely to be and not be effective deterrents until broad vaccination and/or herd-immunity has taken place (more on that next week).

Nevertheless, there are reasons to be optimistic. NYC may have represented the worst-case-scenario due to its unique susceptibilities (i.e., population density, high population relying on mass transit, no self-isolation of the infected). The spread outside of metro areas may be much slower and more manageable in the rest of the country. The infectiousness of the virus may be further reduced by less drastic measures, such as avoiding large gatherings and enclosed indoor spaces. This combination of interventions alone may even eliminate exponential spread. Furthermore, improvements in hospital survival rates may bear fruit toward the end of summer, and even a 50% improvement in survival would bring the virus more in line with influenza. While a rapid return to normalcy is unlikely, especially without extensive testing and contact tracing, a more bearable “new normal” may be on the horizon.

With that in mind, below is our updated thinking regarding disease transmission and recommendations for necessary exposures in the near-term.

What we know about transmission

Recent contact tracing studies help us identify factors that are associated with higher rates of infection. In general, viral transmission occurs primarily in close indoor gatherings or due to an infected individual exposing close family members to the virus [source 1, 2, 3]. Outdoor environments seem to present a greatly diminished risk of infection, with a recent study reporting viral transmission to be nearly 19-fold more likely indoors than in open outdoor spaces [source]. Moreover, infection is far more likely to result from inhaling aerosols and droplets than by touching a contaminated surface, which only accounts for roughly 6% of overall cases in one modeling study [source].

To put this in context, most "successful" contagions have at least one Super Power. For example, *C.Difficile* colitis, the scourge of most hospitals, only transmits via fecal-oral route as durable spores. Nearly every surface in a patient's room will get contaminated, and a nurse or doctor can spread it from a single room to 10 or more new patients just by touching surfaces in the room of an infected patient. In the case of SARS-CoV-2, it appears the Super Power is its ability to hyper-efficiently infect via aerosols and droplets. Secondarily, its long incubation period (median of 5 days versus 2 days in influenza) adds to the potential for a-/pre-symptomatic transmission, giving it an added ability to spread rapidly.

As we obtain more information on the COVID-19 virus' particular strengths and weaknesses, it may turn out that not all precautions are of equal value, and that some deserve more attention and diligence than others. The following framework can help us interpret the various data coming in to help each of us create a more personalized, manageable protection plan that is somewhere between total home quarantine and a return to a semblance of normal life. It can hopefully help us answer the question, "What are my chances of being infected?" in various scenarios so we may act accordingly.

Framework

To contract the SARS-CoV-2 illness, a person needs to be exposed to a certain number of viral particles (which can differ from person to person based on many factors, including their own immune system). The number of viral particles necessary to cause infection is referred to as the "infectious dose." These particles, or virions, need to bypass our body's natural passive defenses, namely the skin and mucous membranes that protect us from the outside world; the higher the number of virions you are exposed to, the greater the chance that a few of them will catch a foothold to infect the cells lining your nose, mouth, and lungs. Once this happens, the viruses multiply exponentially until slowed or stopped by the immune system.

It follows that while it may be impossible to completely avoid 100% of viral exposures, we should still aim to minimize our total exposure. Viral transmission from a contaminated surface requires a longer chain of events than inhalation of viral particles, with

infection relying on whether or not you have directly introduced an infectious dose to your body from your hands. While very few SARS-CoV-2 infections have been linked to surface exposures (e.g., groceries, door handles), it is still important to wash hands frequently and avoid touching your face.

Conceptually, airborne transmission is more complicated and we consider four primary drivers of infection risk: the environment where an interaction occurs, the proximity of the interaction, the total inoculum dispersed from an infected person, and the duration of exposure, as illustrated in the Figure, below:

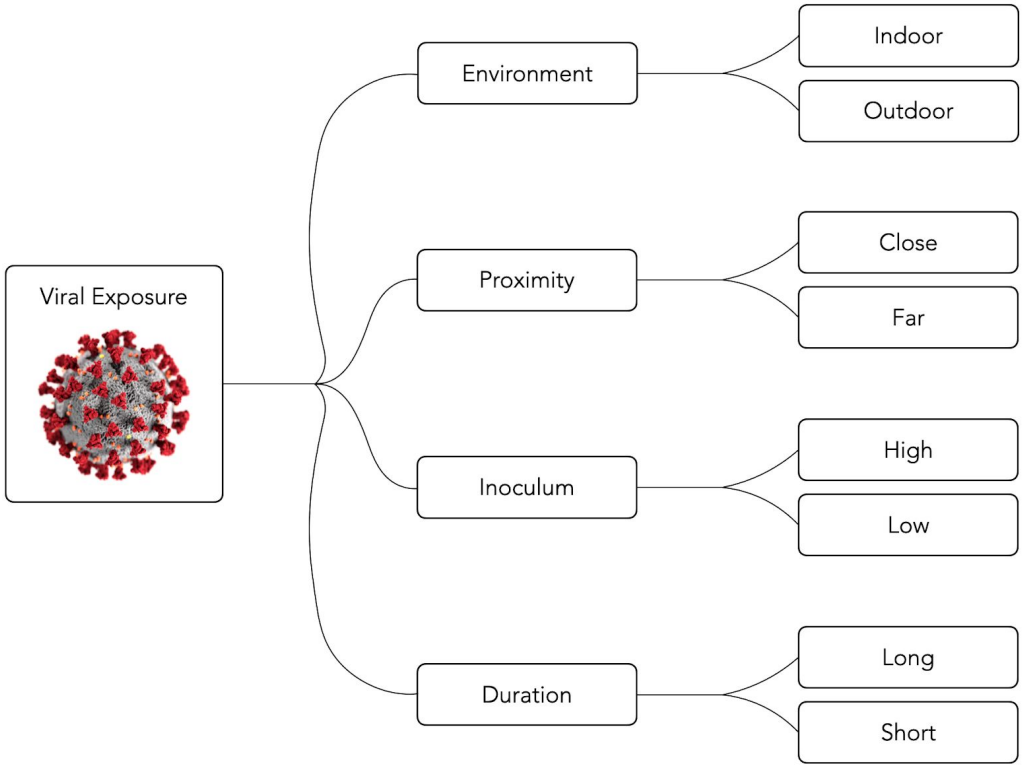

Figure: Proposed risk evaluation model for airborne viral transmission. Total viral exposure can be evaluated on a spectrum as a function of the environment (indoor/outdoor), proximity to other individuals, the total inoculum dispersed by an infected person, and the duration of exposure.

- Environment: Research on SARS-CoV-2 transmission suggests that the virus is much more likely to spread indoors than outdoors [source]. This is due to a number of factors associated with closed spaces—recirculated air, closer proximity to viral carriers, and increased viral load per unit volume [source]. Outdoors, any exhaled viral particles are more quickly diluted, dispersed by the wind, or evaporated, resulting in a lower risk. UV radiation from the sun may also inactivate the virions outdoors. As successful viral transmission may be at least an order of magnitude more likely indoors than in an open-air space (19x in the study mentioned above), the environment where interaction with an infected person takes place is likely the most important factor driving risk of exposure [source].

- Proximity: Although 6 feet (~2 meters) is commonly advocated as a safe distance away from other individuals, this is an arbitrary distinction not based on sound scientific evidence. In some circumstances, the virus can be carried up to 20 feet (~6 meters) in respiratory droplets from breaths, sneezes, and coughs [source]. Proximity risk will vary in different environmental conditions.

- Inoculum: The quantity of virions released by infected individuals into their surrounding environment depends on whether they are nose breathing, heavily mouth-breathing (e.g. shouting or singing), or sneezing/coughing, as well as their personal viral load at the time (how sick they are and at what stage of the illness) [source 1, 2]. While it is thought that peak infectiousness, or "viral shedding," is at the onset of symptoms, the contribution of asymptomatic transmission is not insignificant [source]. Once again, the overall impact of viral shedding is more significant when indoors and in close proximity to the infected person. Because we can't measure this or even estimate it when in contact with strangers, we must still assume that any infected person is at the peak of viral shedding.

- Duration: The amount of time spent in close contact with infected individuals directly increases infection rates. We are unsure of how long is "too long," or frankly even "long enough," but a report detailing exposure to an infected individual within a 6 feet radius for 10 minutes resulted in a 4% infection rate [source]. Additionally, the CDC now considers "prolonged exposure" to be close proximity to an infected individual for 15 minutes [source]. For perspective, well-studied models of tuberculosis (TB) estimate that one needs to be in close contact with an infected individual for more than 4 hours to have a measurably increased risk of contracting TB.

Practical considerations

While it's difficult to quantify the relative contribution of each factor for every possible daily activity, we can at least begin to prioritize our efforts, attention, and diligence with respect to precautions. Don't take a given official recommendation at face value- for example, we can't assume 6 ft is an adequate distance from others in all scenarios. If both parties are wearing N95/surgical masks outdoors and neither are symptomatic, a strict 6 feet apart may not be necessary, and if you are indoors with recycled airflow and an infected person is sneezing, 20 feet might not be enough to prevent transmission. A few other sample considerations:

- Outdoors, a surgical mask probably suffices for a non-crowded thoroughfare. In a very sparsely populated area, you may be able to get away with no mask, donning it only when encountering others;
- Use an N95 for any indoor congregation if possible (groceries, pharmacy, etc) and under no circumstances go to indoor public places with no mask at all. When wearing a mask, remember to avoid frequent adjustments and ensure proper removal to avoid contaminating hands with viral particles (touching the straps only, avoiding the fabric portion of the mask [source]);
- While exposure from contaminated surfaces appears to be far less risky, it is still prudent to wash hands regularly and to disinfect objects/containers that have been recently handled by another person, i.e. food delivery packages, etc. and to avoid contact with frequently touched objects such as doorknobs and subway handles;
- For non-essential public businesses - sporting venues, restaurants, bars, salons, etc, we strongly recommend a conservative wait-and-see approach even in states that have loosened restrictions on these venues until more data regarding new infections emerges.

Frequently asked questions

Q: Should I wear a mask? Which one? When should I wear it?

There is no solid evidence that wearing *cloth* masks reduces the rate of infection. However, even imperfect protection (assuming no other social distancing behaviors are relaxed) is preferred over not wearing a mask, especially in confined spaces, as cloth masks can curb the emission of larger respiratory droplets [source 1,2]. Surgical and N95 masks (without valves; valves protect the wearer but release unfiltered, exhaled breath that exposes others to the wearer) confer greater protection against aerosolized particles when used properly; we recommend their use if available [source]. In general, surgical masks may be most practical for use when walking around in open-air public spaces while N95 respirators can be reserved for shorter encounters of increased risk, such as entering a grocery store, due to the discomfort of prolonged wear.

Q: If I have to go out, are there particular locations I should avoid?

A: Avoid locations that have a high risk for viral particle aerosolization, such as public bathrooms or dentists' offices, unless absolutely necessary. Regarding the former, we still do not know whether a person releases infectious material in feces (alternative is simply dead viral fragments) but toilet flushing creates a high quantity of aerosols. For the latter, although the greatest risk is posed to the dentist/technician, there remains a high risk of general particle transmission due to significant aerosols generated from dental procedures.

Q: Is it okay to go for a run outside?

A: The risk of virus transmissibility outdoors has not been definitively determined but it is likely that solitary outdoor exercise is low-risk. A simulation study was widely circulated which recommended 65ft of distancing for walking, running, and biking, but failed to consider questions of infectious dose and viral survival and thus should be interpreted carefully. [source 1, 2]

Q: Can I go to the gym?

A: It is recommended to stay away from gyms. As mentioned previously, transmission seems to primarily occur through respiratory droplets and smaller aerosolized particles, which are increased with higher effort exertions. Moreover, closed ventilation systems with recycled air increases risk for infection [source]. Even if gyms frequently disinfect surfaces and ventilation integrates fresh outside air with recycled air, a high density of people allows for pathogens to spread more easily.

Q: Can I get COVID-19 from a swimming pool?

A: There is no evidence that the COVID-19 virus can spread in swimming pools. Studies have shown that chlorine and bromine inactivate the virus [source]. However, if you do choose to go to the pool, swimming in larger pools with fewer people is preferred. This will allow for increased proximity from others in and out of the pool in addition to accounting for other factors that may decrease pool disinfectant properties.

Q: If I have to get on an airplane, is there a recommended place to sit and what are the best practices around hygiene?

A: We note that aircrafts are constructed with air circulatory systems that continuously introduce fresh air in the cabin, are fitted with particulate air filters, and the entire air volume is exchanged every three minutes [source]. However, due to the close proximity of passengers and extended time of exposure, we do not recommend flying unless absolutely necessary. A plane flight transmission model study indicated that respiratory disease is unlikely to be directly transmitted beyond 1m of the infectious passenger (i.e., transmission is limited to one row in front/behind a sick passenger) [source]. This model, however, fails to account for the unpredictability of in-flight passenger movement and assumes ideal conditions. If you do board an aircraft, try to sit away from toilets, where the virus is aerosolized by flushing, wear a mask, and disinfect your armrest and tray table surfaces [source].

Q: Can I reuse my surgical/N95 mask and if so, how? Is there a best practice protocol for decontamination at home?

A: At-home decontamination methods are currently not approved by any regulatory agency and both the short and long term effects of reuse after cleaning are unknown. To generally decrease pathogen burden on the mask, it is recommended to store for 2-3 days at room temperature in between uses. N95 masks can be heated at 158 degrees Fahrenheit for 60 minutes [source].

Q: How can I reduce mask discomfort?

A: If you experience facial irritation from wearing a surgical mask, over-the-counter sunscreen with zinc-oxide or a light moisturizer is recommended prior to wear in order to reduce friction without impacting the effectiveness of the existing protection [source]

Q: Are there any updates around grocery shopping and food decontamination?

A: There have not been changes to recommendations made in a previous update document located here

Q: Is there likely to be seasonal variation with COVID-19?

A: Most of our current knowledge is based on modeling with varying degrees of assumption, however initial reports suggest a negative association between viral transmission and temperature but with a relationship that is too weak to rely on for epidemic control [source]