COVID-19 Fact Sheet #2
Virus Transmission: How It Occurs
April 2, 2020

A lot of questions surround the topic of virus transmission, centering around – What can we do to keep our employees safe while they continue to work? (The focus of this Fact Sheet is on non-healthcare facilities and employees.) There is no perfect plan – we still have too much to learn about COVID-19. It is easy to get pulled in different directions by all the information that is being generated. But we can look at what we do know about the virus, about virus transmission in general and, if we stick with the science, we can come up with a plan that provides protection that is practical and leads to a reduction of risk. We need to approach this in the same way we evaluate other health and safety risks. This starts with an understanding of the "hazard" and the "risk" and then moves to identifying and implementing "controls" to eliminate or reduce the risk. Let's first take a look at the hazard.

THE HAZARD

We can't literally "Take a look" because this virus is SMALL – 0.12 microns. To give you an idea of how small that is: A human hair has an average diameter of about 50 microns so you could line up over 400 of those viruses across the tip of a piece of hair!! You cannot see anything that is smaller than about 50 microns without a microscope.

But are you ever going to have just a little naked virus floating around? Nope – the virus is always going to be enclosed in – well, all the stuff I don't really have to go into detail about. But those glops of stuff are still going to be very small.

There are 3 ways that infectious particles get transmitted:

- Contact Transmission
- Droplet Transmission
- Aerosol Transmission

We expect that the virus can get transmitted by contact with contaminated items. It gets more complicated when we look at Droplet and Aerosol Transmission.

Where Did that 6 Feet of Separation Come From?

You have probably already seen somewhere a photo like the one above of the big sneeze. Droplet transmission occurs when glops of stuff containing virus are spewed into the air by a cough or sneeze. A few people even release some saliva at times when they talk or shout. Some of these droplets are pretty big, about 100 microns, and can be seen. It is estimated that there are a couple thousand of these in a cough and about *half a million* in a sneeze! These "big" droplets, those greater than 100 microns, tend to drop within a few feet of the coughing person – the source of the virus. When disease transmission is thought to be from "Droplets", six feet of social distance is recommended to minimize exposure to the virus.

But there are also some smaller glops or droplets, that remain airborne for a period of time. Disease transmission is considered to be by "Aerosol" transmission when the particles are smaller, less than 5 microns, and these are called "droplet nuclei". These smaller particles can move beyond the six foot "cough zone" and remain airborne for extended periods of time. We know that measles, for example, are transmitted by these smaller particles.

What makes this even more complicated is that we know that big droplets can rapidly become smaller when they are in an environment where the relative humidity is very low (like February in Wisconsin). Bottom line: there is **not** a clear distinction between droplet and aerosol transmission so it makes sense to assume that aerosol transmission is possible.

According to the World Health Organization (WHO) on March 29, 2020, "COVID-19 virus is primarily transmitted between people through respiratory droplets and contact routes. In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported." This report does emphasize that aerosols are produced under certain circumstances, particularly during health care procedures. Research is being conducted to detect viral particles in the air. This is complicated because detection does not necessarily translate to hazard. Some viral particles can be detected that are no longer viable or capable of causing infection. Expect to see more data on aerosol transmission.

There is one, slightly more icky, possibility that is being explored. Is the virus aerosolized when a toilet is flushed? We don't know. There is valid reason for concern. We know that flushing produces an aerosol – chemotherapeutic drugs have been detected on the walls of bathrooms used by patients receiving the drugs. Some individuals with COVID-19 infection have reported gastrointestinal symptoms. However, at this point, there has been only one study that found the virus in a stool sample. (Not sure how many samples have been studied though.) Cases of fecal-oral transmission have not been identified. This is another area where we don't have enough information. It is not yet known if the virus is present, and capable of causing infection, in other body fluids such as urine or breast milk.

The Virus Stays Alive on Surfaces for 8 Hours, no 3 Days, no 9 Days, no 30 Days!

I have seen all of these numbers. Here's what we know right now based on a study from the National Institutes of Health (home of Dr. Fauci), CDC, UCLA and Princeton University scientists published in *The New England Journal of Medicine* in March 2020:

Viable COVID-19 was detected in aerosols for up to three hours, up to four hours on copper, up to 24 hours on cardboard and up to three days on plastic and stainless steel. It should be noted that the amount of viable virus decreases over time. The amount of **viable** virus was cut in half after 5.6 hours on stainless steel and after 6.8 hours on plastic. Dr. Jay Butler, M.D. of CDC noted in a webinar on March 30, 2020 that evidence from China suggests that mail was not a factor in disease transmission. The data that indicated 9 day stability came from a review of research on the other coronaviruses that cause SARS and MERS. There are other studies that show survival of SARS coronavirus for two weeks. It was surmised that COVID-19 would have a similar survival time. Viral particles were also detected on one of the cruise ships 17 days after an outbreak but it is not known if the virus was still viable. The viability of the virus is dependent upon temperature and humidity. Research on this will continue. If you look at the data it is very important to note whether the viral particles that were detected were considered viable, that is, still capable of causing infection at the time period in question.

In summary, here is what we know about the "Hazard" and "Risk" of exposure to COVID-19:

HAZARD
Aerosol transmission is possible. Particle size matters. Particles larger than about 100 microns (this includes the virus and surrounding material) land somewhere pretty quickly. Particles smaller than that remain airborne for longer periods of time depending on the particle size. Particles larger than 10 microns that are inhaled are deposited in the nose or the back of the throat (nasopharynx). Particles with a diameter of 5 microns or less are considered "respirable" and can reach the lungs. For some particles, silica, for example, we are most concerned about those that can reach the lungs. But for aerosols containing virus we need to be concerned about those that get caught in the nose as well. It appears that there are receptors for COVID-19 in the upper respiratory tract as well as in the lungs. The primary difference then between infectious particles of various sizes is not whether they are "respirable" but how long they stay airborne, continuing to present an exposure risk. Six feet may not be far enough. But we have to look at all of the variables including time in an area, hygiene practices of the source person, how many times you touch your face, and even air changes in the room.

Transmission is possible from contact with surfaces contaminated with the virus. The exact length of time that the virus remains viable has not been determined. There is good evidence that the virus likely remains viable on smooth metal surfaces like doorknobs or handrails and plastic surfaces for up to three days.

RISK - It's all about space and time.
What we know for sure is that the highest risk is within 6 feet of someone who is coughing and sneezing. Risk is lower but may not be zero when the distance increases. Risk is lower if this "source person" covers their mouth when they cough or sneeze. We don't know at what point a person, infected with COVID-19, begins to release the virus in their secretions. So far, it looks like it may be a couple days before symptoms appear but that has not been established. We do know that the source person is spewing the most viruses as they cough or sneeze when symptoms **first appear.** This is presumed to be the time when the virus has begun to reproduce and the source person's immune system is just starting to fight back.

We also know that the duration of contact with the infected source person is a factor in the likelihood of virus transmission. A short passing in the Break room or a quick hello in the hallway are low risk. Working outside in a nice breeze is safer than being inside. Sharing a pen is risky. Sharing a pen and then scratching an itch on your nose increases the risk. Climbing a ladder, using the hand rails ten minutes after a coughing "source person" is risky. Touching the hand rail four hours later is less risky, especially if the hand rail is exposed to sunlight (UV light) for those four hours. Spending an hour in a conference room, even when six feet away, increases the risk. Sitting next to someone within two feet increases the risk again.

Individuals who are at high risk – over 60 years, those with chronic health problems, those who are immunosuppressed, and, I will add, smokers (including those using E-cigs) due to effects of smoking on the lungs and the immune system – need to socially isolate.

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