INFECTION CONTROL EDUCATION FOR MAJOR SPORTS

NFL Infectious Disease News – August 2020

Infection Control Education for Major Sports (ICS)
Volume 1, Number 2

Modes of Transmission of SARS-CoV-2 and the Role of Increased Ventilation

This newsletter will focus on current evidence surrounding the modes of transmission of SARS-CoV-2 and practical advice for optimization of ventilation. The content of this newsletter represents a summary of current information as of August 3, 2020 and is subject to change due to the novel and evolving nature of SARS-CoV-2.

When discussing modes of transmission for respiratory viral illnesses, most physicians speak of "droplet" transmission pathogens and "airborne" transmission pathogens. Droplet transmission pathogens are typically spread through exposure to particles ≥5 microns (μm) in size (e.g., "droplet particles").[1] Due to their size, these particles typically fall to the ground within 3-6 feet of the person exhaling the droplets, so those who spend a significant amount of time in close proximity to that individual are at greatest risk of contracting illness from an infected individual.

Airborne transmission pathogens are classically transmitted via droplet nuclei, defined as particles <5μm in size. Droplet nuclei may remain suspended in the air for a longer period of time and travel further distances before settling, giving rise to concern for widespread transmission among populations. Measles, for instance, is a classic airborne transmission virus that can spread throughout public transportation or crowds very quickly.[2]

What is the primary mode of transmission of SARS-CoV-2?

The consensus among the infectious disease and epidemiologic community is that *this virus is primarily transmitted through prolonged close contact with an infected individual's respiratory droplets.*[1,3,4] This consensus is based on laboratory data, micro-epidemiologic studies, and population-level epidemiologic studies. Laboratory data consists of air sampling and surface sampling data. Many studies have not found SARS-CoV-2 RNA in air sampling at all, and those that have found detectable viral genetic material found it in concentrations at least 10,000-fold lower than on analysis of contaminated surfaces.[5–7]

Micro-epidemiologic data consists of contact tracing and ring testing of known positive cases. Some of the early studies of household contacts during this pandemic found a positivity rate among exposed household contacts of approximately 10%.[8,9] A recent

Chris Hostler, MD, MPH
christopher.hostler@icforsports.com

Dev Anderson, MD, MPH
deverick.anderson@icforsports.com

systematic review found that although the secondary attack rate varied from 4.6% to 49.56% in published studies, the vast majority were <20%.[10] This attack rate is consistent with primarily droplet transmission, as airborne pathogens like measles and varicella (chicken pox) have secondary attack rates >80%.[2,11]

Finally, the macro-epidemiologic value of R_0 (R-naught) - which represents the number of people that an infected person is likely to subsequently infect – can shed some light on the mode of transmission for respiratory viral illnesses. While difficult to estimate and dependent on many assumptions, the majority of estimates for the R_0 of SARS-CoV-2 are between 2 and 5.[12,13] Classically airborne pathogens such as measles and varicella have an R_0 of 12-18.[2,11] The R_0 of SARS-CoV-2 in NFL players and staff is unlikely to be as high as the general population due to the rigorous testing, disinfection, PPE, and other risk mitigation protocols in place, but we should have greater clarity on this over time.

Does this mean that COVID-19 can't be transmitted through the air?

No! Despite the fact that the preponderance of available evidence suggests that this pathogen is **primarily** transmitted through larger respiratory droplets, it's important to recognize that droplet size and the distance at which people are most contagious is not a discrete value, but rather represents a spectrum. When people breathe or cough or sneeze or speak, they release droplets of all different sizes that may follow air currents for a variable distance before settling. Certain activities, such as singing or loud talking may produce a greater volume of infectious small particles. In some instances, this can lead to "super spreader" events as described in the case where a single infected individual likely caused 32-52 subsequent infections through the course of a 2.5-hour choir practice.[14] Super spreader events will be expounded upon in a future ICS Newsletter. *There is an increasing recognition of the role of "short-duration aerosols" in transmission of SARS-CoV-2, especially among unmasked individuals, which further increases the need to emphasize appropriate adherence to masking.*[15]

Will adjusting HVAC systems and increasing ventilation reduce transmission?

It's unclear at this time how much increasing ventilation will reduce transmission of SARS-CoV-2, but it's reasonable to assume that greater ventilation will reduce exposure to infectious droplets of all sizes. Larger droplets will likely be forced to the ground more quickly with increased airflow (especially if air vents are blowing air downwards) and smaller droplets will dissipate more quickly if ventilation is increased, thus reducing the viral burden in the air. The Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA) both recommend increasing ventilation to mitigate the risk of transmission.[16,17]

Chris Hostler, MD, MPH
christopher.hostler@icforsports.com

Dev Anderson, MD, MPH
deverick.anderson@icforsports.com

That said, it is reasonable and appropriate to improve ventilation in athletic facilities in accordance with CDC guidance out of an abundance of caution. These measures will improve the likelihood that respiratory droplets fall to the ground more quickly and may further mitigate the risk of transmission.

The following are suggested ways to improve air circulation in athletic facilities (adapted from CDC guidance):

- Increase the percentage of outdoor air taken in by HVAC systems
- Increase total airflow supply to occupied spaces, if possible
- Disable demand-control ventilation controls that reduce air supply based on temperature or occupancy
- Consider using natural ventilation (open windows or garage doors) to increase outdoor air dilution of indoor air when environmental conditions and building requirements allow
- Improved central air filtration
    - Increase air filtration to as high as possible without significantly diminishing design airflow (MERV-13 and higher rated filters are viral-rated filters, though MERV-9 and higher filters are utilized in healthcare laboratories, so it would be reasonable to use at least MERV-9 filter; see ASHRAE standards)
    - Inspect filter housing and racks to ensure appropriate filter fit and check for ways to minimize filter bypass
- Consider running the HVAC system at maximum outside airflow for 2 hours before and after occupied times
- Consider using portable HEPA fan/filtration systems to enhance air cleaning, especially in higher-risk areas (weight room, athletic training room)
- Ensure exhaust fans in restroom facilities are functional and operating at full capacity when the building is occupied
- Consider using ultraviolet germicidal irradiation (UVGI) as a supplemental technique to inactivate potential airborne virus in the upper-room air of common occupies spaces. This guidance is a consideration by CDC based off their 2009 guidelines for UVGI in healthcare settings to add additional protection against transmission of tuberculosis
- Additionally, because the premise of our infection prevention program is to apply healthcare facility standards to athletic facilities, facilities may consider demonstrating effective ventilation by testing the number of air changes per hour (ACH) in areas where staff and athletes will be spending a considerable amount of time. The industry standard for outpatient medical facilities is 4 ACHs, so this standard could be considered by athletic facilities

Chris Hostler, MD, MPH
christopher.hostler@icforsports.com

Dev Anderson, MD, MPH
deverick.anderson@icforsports.com

Summary

The primary mode of transmission of SARS-CoV-2 is prolonged, close contact with an infected individual's respiratory droplets. Airborne transmission does not seem to be a primary driver of this pandemic, but it is important to recognize that transmission occurs along a spectrum. Certain activities or certain individuals may pose a greater risk of short-duration aerosol transmission. Accordingly, it is appropriate to follow the CDC guidance listed above to improve ventilation and filtration of air in facility HVAC systems.

References

1. Transmission of SARS-CoV-2: implications for infection prevention precautions. Accessed August 3, 2020. https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions
2. Guerra FM, Bolotin S, Lim G, et al. The basic reproduction number (R0) of measles: a systematic review. *Lancet Infect Dis*. 2017;17(12):e420-e428. doi:10.1016/S1473-3099(17)30307-9
3. Klompas M, Baker MA, Rhee C. Airborne Transmission of SARS-CoV-2: Theoretical Considerations and Available Evidence. *JAMA*. Published online July 13, 2020. doi:10.1001/jama.2020.12458
4. CDC. Coronavirus Disease 2019 (COVID-19). Centers for Disease Control and Prevention. Published February 11, 2020. Accessed August 4, 2020. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
5. Santarpia JL, Rivera DN, Herrera VL, et al. Aerosol and surface contamination of SARS-CoV-2 observed in quarantine and isolation care. *Scientific Reports*. 2020;10(1):12732. doi:10.1038/s41598-020-69286-3
6. Cheng VCC, Wong S-C, Chen JHK, et al. Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARS-CoV-2 in Hong Kong. *Infect Control Hosp Epidemiol*.:1-6. doi:10.1017/ice.2020.58
7. Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient | Infectious Diseases | JAMA | JAMA Network. Accessed August 4, 2020. https://jamanetwork.com/journals/jama/fullarticle/2762692
8. Burke RM. Active Monitoring of Persons Exposed to Patients with Confirmed COVID-19 — United States, January–February 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69. doi:10.15585/mmwr.mm6909e1
9. Household secondary attack rate of COVID-19 and associated determinants in Guangzhou, China: a retrospective cohort study - The Lancet Infectious Diseases.

Chris Hostler, MD, MPH
christopher.hostler@icforsports.com

Dev Anderson, MD, MPH
deverick.anderson@icforsports.com

Accessed August 4, 2020. https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30471-0/fulltext
10. Shah K, Saxena D, Mavalankar D. Secondary Attack Rate of COVID-19 in household contacts: Systematic review. *QJM*. doi:10.1093/qjmed/hcaa232
11. 2020 Yellow Book Home | Travelers' Health | CDC. Accessed August 4, 2020. https://wwwnc.cdc.gov/travel/page/yellowbook-home-2014
12. L L, D L, X L, et al. Modes of contact and risk of transmission in COVID-19 among close contacts. Published online March 26, 2020. doi:10.1101/2020.03.24.20042606
13. Zhang S, Diao M, Yu W, Pei L, Lin Z, Chen D. Estimation of the reproductive number of novel coronavirus (COVID-19) and the probable outbreak size on the Diamond Princess cruise ship: A data-driven analysis. *Int J Infect Dis*. 2020;93:201-204. doi:10.1016/j.ijid.2020.02.033
14. Hamner L. High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice — Skagit County, Washington, March 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69. doi:10.15585/mmwr.mm6919e6
15. Fears AC, Klimstra WB, Duprex P, et al. Early Release - Persistence of Severe Acute Respiratory Syndrome Coronavirus 2 in Aerosol Suspensions - Volume 26, Number 9—September 2020 - Emerging Infectious Diseases journal - CDC. doi:10.3201/eid2609.201806
16. CDC. Communities, Schools, Workplaces, & Events. Centers for Disease Control and Prevention. Published April 30, 2020. Accessed August 4, 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html
17. Guidance on Preparing Workplaces for COVID-19. :35.

Chris Hostler, MD, MPH
christopher.hostler@icforsports.com

Dev Anderson, MD, MPH
deverick.anderson@icforsports.com