

Airborne Transmission of SARS-CoV-2 Virus

WHAT HEALTHCARE WORKERS NEED TO KNOW

Evidence supporting the possibility of airborne transmission of COVID-19 is mounting.

NYSNA's position is **all healthcare facilities must put in place airborne precautions for treating COVID-19 patients and PUIs.**

LATEST SCIENTIFIC FINDINGS

According to a recent National Academies of Sciences, Engineering and Medicine letter to President Trump's Office of Science and Technology Policy, multiple studies have supported airborne (aerosolized) transmission of the COVID-19 virus, even from breathing alone.¹

This evidence contradicts the CDC's contention that workers only need to wear an N95 or higher protection respirator during aerosol-generating procedures such as intubation.

The modes of transmission of an infectious disease determine the control measures that can prevent its spread. Understanding how the SARS-CoV-2 virus is transmitted is key to preventing COVID-19 disease in healthcare workers and in the general population.

There are 3 modes of transmission in which inhalation is a concern:

Droplet Transmission: Large respiratory droplets are generated when a person coughs, sneezes, or talks. Large droplets descend rapidly and travel only short distances. *Inhalation of large droplets may also be possible.*²

Droplet transmission is understood to be a primary mode of transmission of the SARS-CoV-2

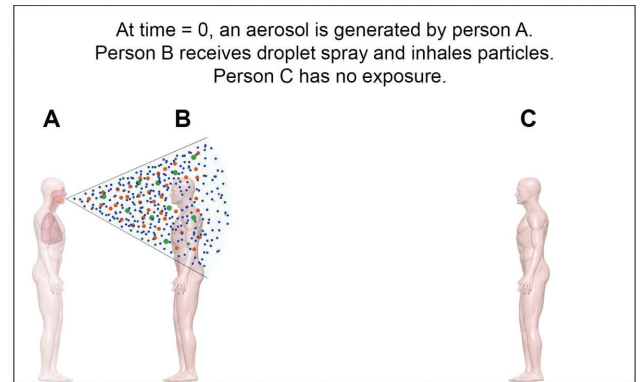


Figure 1. When an aerosol is initially emitted (time=0), the particles are clustered near the source at location A. Someone near the source (location B) may receive large-particle spray and inhale particles of all sizes.

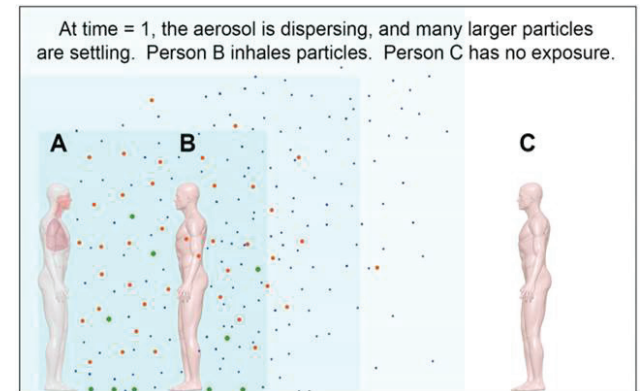


Figure 2. After some time (time=1), the particles begin to disperse and larger particles begin to settle from the air. Person B will continue to inhale particles of all sizes.

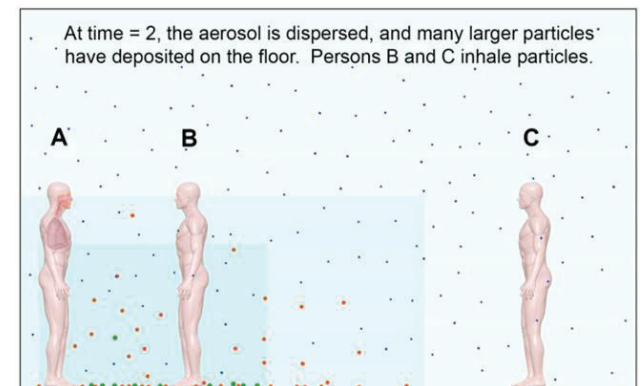


Figure 3. After more time (time = 2), the small particles are uniformly dispersed and more of the larger particles have settled from the air. Persons B and C will inhale particles that are generally smaller, have a smaller size range, and are at a lower concentration than at time = 0.

Carlynn Iverson/CIDRAP

virus. However, “using arbitrary droplet size cutoffs may not accurately reflect what actually occurs with respiratory emissions.”³

Long-Range Airborne Transmission: Droplet nuclei are forcefully expelled small particles of pathogen-containing respiratory secretions which are reduced by evaporation to small, dry particles in the respirable size range. They are capable of remaining airborne for long periods of time and of traveling considerable distances.⁴

Close-Range Aerosol Transmission: A bio-aerosol is an airborne suspension of particles containing whole or parts of biological entities, such as viruses, carried by other materials, such as respiratory secretions. Infectious bioaerosols can be generated from human respiration or by medical procedures such as intubation.

Although the CDC is silent on close-range aerosol transmission, **research supports the possibility that SARS-CoV-2 can be spread via bioaerosols generated directly by patients’ exhalation.** Such bioaerosols are comprised of a range of component materials, from large respiratory droplets to small droplet nuclei that can remain airborne and available for inhalation for up to 3 hours.^{5,6,7,8,9,10} *“The results of available studies are consistent with aerosolization of virus from normal breathing.”*¹¹

IMPACT ON HEALTHCARE WORKERS

Evidence of aerosolized transmission has significant ramifications for inhalational exposure and respiratory protection for nurses and other healthcare workers.

Particles smaller than 5 μm can enter the deep lung and are considered the “respirable” fraction.¹³ The physical size of the SARS-CoV-2 virus is approximately 0.125 μm .¹⁴

A surgical mask is an infection control device designed to help prevent the spread of infection from the wearer’s exhaled breath to potentially susceptible persons.¹⁵ *Most surgical masks are not designed to seal tightly to the face and*

AIRBORNE HAZARDS MEAN WE NEED BETTER PROTECTION!

Evidence supporting the possibility of airborne transmission of COVID-19 is mounting. We need all healthcare employers to implement the following measures immediately:

- Deploy **negative pressure filtration units** to areas designated for care of COVID-19 patients. Use them to remove hazards at the source and before they reach other parts of the facility.
- Mandate and install **PPE donning and doffing zones.** Ad-hoc decontamination spaces will reduce spread of the virus and exposure.
- Deploy **higher level respiratory protection**, like elastomeric half-face masks and powered air purifying respirators (PAPRs). This equipment can be decontaminated safely and reused, easing the pressure on the single-use N95 equipment. Move toward having this equipment available permanently down the road.
- **Organize patient care to minimize staff exposure** and limit back and forth from hot zones to clean zones.
- **Reduce transmission from facility to community**, by providing laundry services or replacement scrubs and hotel options for staff.

To facilities who have implemented some or all of these measures, keep it up. To those who have not: **time to get moving!**



Hospitals must deploy higher level respiratory protection, including powered air purifying respirators (PAPRs).

do not protect against inhalation of droplet nuclei or particles.^{16,17} In contrast a respirator, such as an N95 or PAPR, is designed to protect the wearer against inhalation of specific hazardous agents, such as bioaerosols.

WHAT WE NEED

NYSNA's position is that every healthcare worker must be provided, at a minimum, with an N95 disposable respirator, or higher-level protection, when caring for suspected or confirmed COVID-19 patients, when engaged in aerosol-generating procedures, at triage stations, and in any location where direct contact with COVID-19 confirmed or suspected patients is possible.

Per OSHA, when N95 disposable respirators are required but not available, employers should consider use of respirators that provide equal or greater protection, such as NIOSH-approved reusable elastomeric respirators or powered, air-purifying respirators (PAPRs). Other disposable respirators, such as N99, N100, R95, R99, R100, P95, P99, and P100, are also permissible when N95s are not available.¹⁸ OSHA also requires that respirators be fit tested and that healthcare workers must be medically cleared to wear respiratory protection.

Per the CDC, "In times of shortages, alternatives to N95s should be considered, including other, more protective disposable respirators, elastomeric half-mask and full facepiece air purifying respirators, and powered air purifying respirators (PAPRs) where feasible."¹⁹

REFERENCES

1. National Research Council. Rapid Expert Consultation on the Possibility of Bioaerosol Spread of SARS-CoV-2 for the COVID-19 Pandemic (April 1, 2020). Washington, DC: The National Academies Press. <https://doi.org/10.17226/25769>.
2. CDC. Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Health-care Settings. April 1, 2020. <https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html#adhere>.
3. Bourouiba L. Turbulent Gas Clouds and Respiratory Pathogen Emissions: Potential Implications for Reducing Transmission of COVID-19. *JAMA*, Published Online: March 26, 2020.
4. Ibid.[doi:10.1001/jama.2020.4756](https://doi.org/10.1001/jama.2020.4756)
5. Siegel J. et. al. 2007 *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*. CDC Healthcare Infection Control Practices Advisory Committee. Updated July 2019. <https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf>
6. Galton J. et. al. The role of particle size in aerosolised pathogen transmission: A review. *Journal of Infection* (2011) 62, 1-13.
7. van Doremalen N. et. al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. *NEJM*. Letter. March 17, 2020. DOI: 10.1056/NEJMc2004973.
8. Nazaroff N. Toward understanding the risk of secondary airborne infection: emission of respirable pathogens. *J Occup Environ Hyg*. 2005;2:143-154.
9. Santarpia J. et al. (2020) Transmission potential of SARS-CoV-2 in viral shedding observed at the University of Nebraska Medical Center. Retrieved from <https://www.medrxiv.org/content/10.1101/2020.03.23.20039446v2>.
10. Yuan L, et al. (2020) Aerodynamic characteristics and RNA concentration of SARS-CoV-2 aerosol in Wuhan hospitals during COVID-19 outbreak. Retrieved from <https://www.biorxiv.org/content/10.1101/2020.03.08.982637v1>.
11. National Research Council. Rapid Expert Consultation on the Possibility of Bioaerosol Spread of SARS-CoV-2 for the COVID-19 Pandemic (April 1, 2020). Washington, DC: The National Academies Press. <https://doi.org/10.17226/25769>.
12. Tellier R. et. al. Recognition of aerosol transmission of infectious agents: a commentary. *BMC Infectious Diseases*. 2019. 19:101. <https://doi.org/10.1186/s12879-019-3707>
13. American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH. 2009.
14. 3M. Technical Bulletin #174: Respiratory Protection for Airborne Exposures to Biohazards – Table B. Size of Various Microorganisms. <https://multimedia.3m.com/mws/media/4099030/respiratory-protection-against-biohazards.pdf>.
15. Heinsohn P. et.al.(eds.) *AIHA Biosafety Reference Manual, 2nd ed.* American Industrial Hygiene Association. Fairfax VA. 1996.
16. MacIntyre C.et. al. Efficacy of face masks and respirators in preventing upper respiratory tract bacterial colonization and co-infection in hospital healthcare workers. *Preventive Medicine*. 62:1-7; 2014.
17. Oberg T., Brosseau L. Surgical mask filter and fit performance. *American Journal of Infection Control*. 36(4):276-282; 2008.
18. OSHA. Enforcement Guidance for Respiratory Protection and the N95 Shortage Due to the Coronavirus Disease 2019 (COVID-19) Pandemic. April 3, 2020. <https://bit.ly/oshaguidance>.
19. CDC. Coronavirus Disease 2019 (COVID-19) Infection Control Guidance. April 1, 2020. <https://bit.ly/cdcinfection>.