Airborne Spread of Coronavirus Disease-2019 and Its Implications for Nuclear Medicine Practice

Sir,

Coronavirus disease-2019 (COVID-19) pandemic is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), which is known to spread through droplets, direct contact, and fomites. Till late, the WHO only recognized risk of COVID-19 spread from aerosol-generating medical procedures on confirmed COVID-19 cases. However, the evidence that airborne transmission of SARS-CoV-2 is significant has been reported recently, with implications for infection prevention and control practices. Airborne transmission refers to the presence of viruses within aerosol droplets <5 μm in size and is different from respiratory droplet transmission by that fact that aerosols can remain in the air for long periods of time and be transmitted to others over distances greater than 1 m.[1]

Even the act of speaking produced aerosols of varying sizes, which are usually smaller than those produced during coughing and sneezing.[2] Normal speaking, produces thousands of droplets whose size ranges from 1 to 500 μ and harbors various pathogens.[3] The average load of SARS-CoV-2 in the saliva of infected individuals has been estimated to be 70 lakh per ml.[4] With this average load, it is estimated that at least 1000 virion containing nuclei can remain airborne for >8 min, after 1 min of loud conversation.[3] Studies have also shown that the virus can remain infectious for hours in aerosol and for days on the surfaces.[5] Air sampling from airborne infection isolation rooms in Singapore lodged with SARS-CoV-2-positive patients showed evidence of the virus in two out of the three rooms. This happened despite 12 air changes per hour (ACH) in those rooms.[6] In Wuhan, samples collected from indoor air near the patients were positive for virus in 44% of the samples, while 70% samples collected from the floor were positive.[7] These data are similar to several studies which reported evidence of airborne spread of SARS-CoV-1, which belongs to the same family of viruses as SARS-CoV-2.[8,9] Although more evidence of airborne transmission is needed, additional precautions may be deployed in healthcare facilities, particularly in indoor areas with poor ventilation.

Most diagnostic nuclear medicine procedures require patients stay a few hours in the department and 15–30 min of imaging time in the scanner room. With emerging evidence of air borne spread, protective steps are necessary to reduce the chance of infection to healthcare workers. For individual protection, face mask respirators (N95, FFP2, etc.) should offer adequate protection based on their ability to filter aerosols (already being followed at most centers). However, widely used N95 face respirators need fit test every time they are worn. Inadequate seal potentially reduces the efficiency of face respirators. Powered air-purifying respirators are comfortable and do not require fit test. However, they are expensive, not widely available, and more cumbersome than N95 respirators.

Efforts should also be directed to address the issue of aerosols generated in the imaging rooms. Despite screening of patients before imaging, incidental detection of COVID-19 has been reported based on suspicious imaging findings. Many radiology centers have reported practice of allowing passive air exchange of 1 h along with surface decontamination after imaging a suspected or confirmed COVID-19 patient.[10] However, this may be inadequate as aerosols remain suspended in air for long time and spread over larger areas compared to droplets. The rate of ventilation of a room is an important parameter and is measured in terms of room ACH, which is the ratio of volume of air entering the room per hour to the total room air volume. One ACH removes 20%–60% of the pathogens.[11] Four ACHs require approximately 70 min for removal of 99% of the pathogens and nearly 2 h to remove 99.9% of all pathogens from the air.[12]

Heating, ventilation, and air conditioning (HVAC) systems prevent spread of pathogens by dilution ventilation and exhaust ventilation. Use of negative air pressure imaging rooms is preferred, wherever feasible. However, in places where modification to existing air conditioning system is not feasible, additional measures such as using in-room air purifiers can be useful in reducing and preventing airborne transmission of COVID-19. In-room air-purifying systems are an effective technology for increasing the room ventilation when the same cannot be achieved with HVAC system. In-room air purifiers clean the contaminated air by passing them through a series of filters, which remove the pathogens. Method of air re-circulation determines if there is increased room ventilation rate or if there is negative pressure circulation. If the cleaned air is re-circulated into the room, the equipment increases the room's ventilation. Exhaust of room air out creates negative pressure circulation so that contaminated air does not flow back into the room's circulation. Effectiveness of in-room air purifiers are expressed as effective ACH (eACH). Efficacy of the air purifier depends on the air flow rate through the unit's filter and the air flow patterns in the room. Wrong placement could potentially alter the rooms' air flow pattern and result in reduced effectiveness. Use of negative air pressure imaging rooms is preferred, wherever feasible. To create negative pressure, pressure differential of at least 2.5 Pa is recommended.[12]

High-efficiency particulate air (HEPA) filter traps 99.97% of all particulate matter that is 0.3 μ in diameter. HEPA filters can be fitted into HVAC or in room air conditioner. In-room air purifier with HEPA filter can clear 90% of 0.3 μ particles in <8 min when operated at 400 cubic feet per minute. When an indoor air purifier is utilized, for a 60 m^2 room (typical of a positron emission tomography computed tomography or a gamma camera acquisition room), an air flow of 1080 cubic feet per minute is suggested. This provides equivalent of 12 eACH and a safety factor of 1.5 to account for air mixing and units efficiency. With such flow rates, the most airborne pathogens are expected to be removed in 35 min.[11]

In addition, ultraviolet germicidal irradiation (UVGI) may be useful method to decontaminate airborne pathogens, but it is not a substitute to HEPA filtration. UVGI damages the DNA of microorganisms. The UV lamps can be placed inside the air ducts, ceiling or upper room wall, or inside the air purifier. Effectiveness of UVGI reduces with increasing humidity. Human over-exposure to UVGI is associated with adverse effects involving both skin and the eyes. Air ion generation and emission is another method of air purification by emitting charged ions in the circulation. Usually, employed negative ion generators produce negative ions, which impart electrical charge on aerosols and particles, which drift toward surfaces due to the charge. This cleans the air of particulate matter and aerosols.[13]

These airborne infection prevention and control practices can be used alone or in combination, for the prevention of airborne transmission of COVID-19, especially while imaging suspect or proven COVID-19 patients. Hospital infection control committees.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Morawska L, Cao J. Airborne transmission of SARS-CoV-2: The world should face the reality. Environ Int 2020;139:105730.
2. Anfinrud P, Stadnytskyi V, Bax CE, Bax A. Visualizing speech-generated oral fluid droplets with laser light scattering. N Engl J Med 2020;382:2061-3.
3. Stadnytskyi V, Bax CE, Bax A, Anfinrud P. The airborne lifetime of small speech droplets and their potential importance in SARS-CoV-2 transmission. Proc Natl Acad Sci U S A 2020;117:11875-7.
4. Wölfel R, Corman VM, Guggemos W, Seilmaier M, Zange S, Müller MA, *et al*. Virological assessment of hospitalized patients with COVID-2019. Nature 2020;581:465-9.
5. van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, *et al*. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020;382:1564-7.
6. Chia PY, Coleman KK, Tan YK, Ong SW, Gum M, Lau SK, *et al*. Detection of air and surface contamination by SARS-CoV-2 in hospital rooms of infected patients. Nat Commun 2020;11:2800.
7. Guo ZD, Wang ZY, Zhang SF, Li X, Li L, Li C, *et al*. Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in hospital wards, Wuhan, China, 2020. Emerg Infect Dis 2020;26:1583-91.
8. Li Y, Huang X, Yu IT, Wong TW, Qian H. Role of air distribution in SARS transmission during the largest nosocomial outbreak in Hong Kong. Indoor Air 2005;15:83-95.
9. Xiao S, Li Y, Wong TW, Hui DS. Role of fomites in SARS transmission during the largest hospital outbreak in Hong Kong. PLoS One 2017;12:e0181558.
10. Mossa-Basha M, Meltzer CC, Kim DC, Tuite MJ, Kolli KP, Tan BS. Radiology department preparedness for COVID-19: Radiology Scientific Expert Review Panel. Radiology 2020;296:E106-12.
11. Sehulster L, Chinn RY; CDC, HICPAC. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). MMWR Recomm Rep 2003;52:1-42.
12. Medical Advisory Secretariat. Air cleaning technologies: An evidence-based analysis. Ont Health Technol Assess Ser 2005;5:1-52.
13. Khandare P, Joshi M, Nakhwa A, Khan A, Mariam M, Sapra BK. Unexplored aspects of unipolar ionizer characteristics in context of indoor air cleaning. Environ Sci Pollut Res Int 2019;26:18191-9.

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