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Executive Office of the President
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Dear Dr. Droegemeier:

This letter responds to your question concerning the possibility that the SARS-CoV-2 virus could be spread by conversation, in addition to sneeze/cough-induced droplets.

Currently available research supports the possibility that SARS-CoV-2 could be spread via bioaerosols generated directly by patients' exhalation. One must be cautious in imputing the findings with one respiratory virus to another respiratory virus, as each virus may have its own effective infectious inoculum and distinct aerosolization characteristics. Studies that rely on PCR to detect the presence of viral RNA may not represent viable virus in sufficient amounts to produce infection. Nevertheless, the presence of viral RNA in air droplets and aerosols indicates the possibility of viral transmission via these routes.

A recent study of SARS-CoV-2 aerosolization at the University of Nebraska Medical Center showed widespread presence of viral RNA in isolation rooms where patients with SARS-CoV-2 were receiving care. Santarpia et al. collected air and surface samples from 11 isolation rooms that were used to care for patients infected with SARS-CoV-2. Included in that study were both high volume air samples and low volume personal air samples. Of note, air collectors positioned more than 6 feet from each of two patients yielded samples positive for viral RNA when evaluated using RT-PCR, as did air samplers placed outside patient rooms in the hallways. Personal collectors worn by samplers also were positive even though patients were not coughing while samplers were present. Anecdotally, the highest airborne RNA concentrations were recorded by personal samplers while a patient was receiving oxygen through a nasal cannula (19.17 and 48.21 copies/L). While this research indicates that viral particles can be spread via bioaerosols, the authors stated that finding infectious virus has proved elusive and experiments are ongoing to determine viral activity in the collected samples.[1]

[1] Santarpia 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.

An airflow modeling study following the SARS-CoV-1 outbreak in Hong Kong in the early 2000s supports the potential for transmission via bioaerosols. In that study, the significantly increased risk of infection to residents on higher floors of a building that was home to an infected individual indicated to the researchers a pattern of infection consistent with a rising plume of contaminated warm air.[2]

In a recent study conducted at the University of Hong Kong, not yet subject to peer review, Leung et al collected respiratory droplets and aerosols from children and adults with acute respiratory illnesses with and without surgical masks. The investigators found human coronaviruses [other than SARS-CoV-2], influenza virus, and rhinovirus from both aerosols and respiratory droplets. Surgical masks reduced detection of coronavirus RNA in both respiratory droplets and aerosols, but only respiratory droplets and not aerosols for influenza virus RNA. These findings suggest that surgical facemasks could reduce transmission of human coronavirus and influenza infections if worn by infected individuals capable of transmitting the infection.[3]

A study of SARS-CoV-2 raises concerns about transmission via aerosols generated from droplet contaminated surfaces. Liu, et. al. collected 35 aerosol samples in two hospitals and public areas in Wuhan. From samples collected in patient care areas the highest concentration of virus was found in toilet facilities (19 copies m-3), and in medical staff areas the highest concentrations were identified in personal protective equipment (PPE) removal rooms (18-42 copies m-3). By comparison, in all but two crowded sites, the concentrations of virus found in public areas was below 3 copies m-3. The authors conclude that a direct source of SARS-CoV-2 may be a virus-laden aerosol resuspended by the doffing of PPE, the cleaning of floors, or the movement of staff.[4] It may be difficult to re-suspend particles of a respirable size. However, fomites could be transmitted to hands, mouth, nose or eyes without requiring direct respiration into the lungs.

Individuals vary in the degree to which they produce bioaerosols through normal breathing.[5] This may have a bearing on efficiency of transmission of SARS-CoV-2 by different infected but asymptomatic individuals.

Additional research specific to the aerosolization of SARS-CoV-2 during breathing and speech, the behavior of SARS-CoV-2 containing aerosols in the environment, both from laboratory studies and clinical experience, and the infectivity of bioaerosols containing SARS-CoV-2, would provide a more complete understanding of the level of risk of transmission of SARS-CoV-2 via bioaerosols spread by exhalation and normal speech.

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[2] Yu, et al. (2004). Evidence of airborne transmission of the severe acute respiratory syndrome virus. NJEM. 350. 1731-9. DOI:10.1056/NEJMoa032867.

[3] Leung, et al. (2020). Respiratory virus shedding in exhaled breath and efficacy of face masks. Under review. DOI:10.21203/rs.3.rs-16836/v1

[4] Liu, 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.

[5] Edwards, D., et al., (2004) Inhaling to mitigate exhaled bioaerosols. PNAS. 101 (50) 17383-17388; DOI:10.1073/pnas.0408159101,

However, for no respiratory virus is the exact proportion of infections due to air droplet, aerosol, or fomite transmission fully established, and many individual factors and situations may contribute to the importance of each route of transmission.

While the current SARS-CoV-2 specific research is limited, the results of available studies are consistent with aerosolization of virus from normal breathing.

This response was prepared by staff of the National Academies of Sciences, Engineering, and Medicine based on a rapid review of the available literature and input from me. Ed Nardell, Harvard University and Georges Benjamin, APHA, contributed to this response. Ellen Wright Clayton, Vanderbilt University Medical University, and Bobbie Berkowitz, Columbia University School of Nursing, reviewed and approved this document on behalf of the National Academies' Report Review Committee and its Health and Medicine Division.

My colleagues and I hope this input is helpful to you as you continue to guide the nation's response in this ongoing public health crisis.

Respectfully,

Harvey V. Fineberg, M.D., Ph.D.
Chair
Standing Committee on Emerging Infectious Diseases and 21st Century Health Threats