# MEMORANDUM

To: Steve Striffler, FSU President
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From: Brendan Sharkey, Esq.

RE: Health and Safety consultation – ventilation and filtration to reduce the spread of COVID

Date: September 3, 2021

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This memorandum provides an overview of why air flow matters and highlights relevant measures of ventilation and/or filtration that have been shown to reduce the risk of COVID-19 transmission. It was drafted with input from Dan O'Connor, Esq.; Sarah Gibson Esq., MS; Mike Sireci, MS, CMA; Rafael Moure-Eraso, PhD, CIH and myself.

The analysis summarizes and cites guidance from the leading public health organizations, occupational health organizations and ventilation professional organizations. Specifically, these organizations include: the Harvard School of Public Health (HSPH), the American Industrial Hygiene Association (AIHA), the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), the Massachusetts Department of Public Health and other related scientific studies.

## I. Why air flow matters.

Scientific studies suggest that airborne transmission of COVID-19 is a means by which the virus spreads.[1] The virus spreads from person to person mainly through respiratory droplets produced when an infected person coughs, sneezes or talks.[2] The CDC cautions that these droplets can land in the mouths or noses of people nearby or possibly be inhaled into the lungs.[3]

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[1] COVID-19 is the official name of the disease that is caused by the coronavirus SARS-CoV-2. https://www.cdc.gov/coronavirus/2019-ncov/cdcresponse/about-COVID-19.html. In the interest of minimizing confusion, this report will use the common parlance of COVID-19 when referring to the spread of the SARS-CoV-2 coronavirus.

[2] https://www.cdc.gov/coronavirus/2019-ncov/faq.html#Spread; see also ASHRAE Epidemic Task Force document "Reopening Schools and Universities" dated July 17, 2020. https://www.ashrae.org/technical-resources/reopening-of-schools-and-universities

[3] https://www.cdc.gov/coronavirus/2019-ncov/faq.html#Spread.

The majority of large droplets are drawn by gravity to land on surfaces within about 3 – 7 feet.[4] Although a person may get COVID-19 by touching a surface on which large virus droplets have landed, and then touching their own mouth, nose, or eyes, touching surfaces is not thought to be the main way the virus spreads, according to the CDC.[5]

Studies also show that COVID-19 can spread through tiny droplets in the air produced when one merely talks or breathes. Specifically, studies show that COVID-19 can remain suspended in the air as infectious tiny droplets called aerosol for up to 16 hours.[6] The infected droplets can also travel up to tens of meters in indoor environments.[7] The risk of the virus spreading, and therefore the number of people exposed, can be affected both positively and negatively by the airflow patterns and by heating, ventilating and air conditioning (HVAC) systems.[8]

Outdoor environments represent unlimited dilution of COVID-19 and pose a reduced risk of transmission of COVID-19. Similarly, diluting indoor airborne virus concentrations can lower the risk of contracting the disease.[9] Increasing the amount of clean outdoor air (or its equivalent) supplied to indoor spaces reduces the amount of airborne virus particles and lowers occupants' relative risk of contracting the disease.[10] Achieving adequate dilution of airborne virus particles indoors may require supplying increased amounts of outdoor air, or air that has been filtered so that it is equivalent to outdoor air.

## II. Which standards of ventilation and filtration may reduce the spread of the virus?

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4 ASHRAE Position Document on Infectious Aerosols, April 14, 2020, page 4, citing Baron, P. n.d. Generation and Behavior of Airborne Particles (Aerosols).
https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf
Presentation published at CDC/NIOSH Topic Page: Aerosols, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Public Health Service, U.S. Department of Health and Human Services, Cincinnati, OH. www.cdc.gov/niosh/topics/
aerosols/pdfs/Aerosol_101.pdf.

5 https://www.cdc.gov/coronavirus/2019-ncov/faq.html#Spread

6 See Morawska, L. and Cao, J. 2020. "Airborne transmission of SARS-CoV-2: the world should face the reality," Environment International, Apr. 10, 2020. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7151430/

7 See Fears, A.C. et. al. 2020. Comparative dynamic aerosol efficiencies of three emergent coronaviruses and the unusual persistence of SARS-CoV-2 in aerosol suspensions. https://www.medrxiv.org/content/10.1101/2020.04.13.20063784v1.

8 See ASHRAE Position Document on Infectious Aerosols, April 14, 2020, page 1. https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

9 American Industrial Hygiene Association (AIHA), *Reducing the Risk of COVID-19 Using Engineering Controls*, 9/9/20, page 3. https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Guidance-Documents/Reducing-the-Risk-of-COVID-19-using-Engineering-Controls-Guidance-Document.pdf

10 Ibid, page 3.

A. Outdoor air intake (OA). The demand-controlled ventilation systems should be disabled and dampers should be opened 100%.[11]

B. Air Changes per Hour (ACH). 3-10 ACH is correlated with a reduction in relative risk of COVID-19 infection. For example, 3 ACH correlates to a 78% relative risk reduction; 4.5 ACH correlates to a 90% relative risk reduction; 6 ACH correlates to a 95% relative risk reduction; and 10 ACH correlates to a 99% relative risk reduction.[12] 5 ACH is recommended.[13] This means that the volume of air in an indoor space should be replaced with outdoor air once every five times per hour. ACH is calculated as follows: ACH = CFM * 60 / volume of room.

C. CFM outdoor air. Although ACH is the most straightforward and direct measure of outdoor air volume, in some instances, ACH by itself may not be a sufficient gauge of ventilation adequacy. In rooms in which high density occupation is expected, measuring cubic feet per minute (CFM) of outdoor air may provide additional useful information about the adequacy of ventilation. MTA recommends 20 cfm/person outdoor air.[14]

D. MERV 13 filters. ASHRAE recommends the installation of filters with a Minimum Efficiency Reporting Value (MERV) 13 or greater rating to capture infected aerosol droplets.[15] The HSPH recommends assuming an 80% capture efficiency for calculations that include a MERV 13 filter.[16]

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[11] ASHRAE, *Reopening of Schools and Universities*, https://www.ashrae.org/technical-resources/reopening-of-schools-and-universities, 7/22/20.

[12] American Industrial Hygiene Association (AIHA), *Reducing the Risk of COVID-19 Using Engineering Controls*, 9/9/20, Figure 2, page 4 https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Guidance-Documents/Reducing-the-Risk-of-COVID-19-using-Engineering-Controls-Guidance-Document.pdf, .

[13] Harvard School of Public Health, *Portable Air Cleaners: Selection and Application Considerations for COVID-19 Risk Reduction* https://schools.forhealth.org/wp-content/uploads/sites/19/2020/08/Harvard-Healthy-Buildings-Program-Portable-Air-Cleaners.pdf, August 2020; Harvard School of Public Health, *5 Step Guide to Checking Ventilation Rates in Classrooms,* August 2020, p.26.

[14] MTA's guidance is based upon the Massachusetts Department of Public Health's guidance of 800 ppm $CO_2$. DPH = Mass. Dept. of Public Health, *Carbon Dioxide and its Use in Evaluated Adequacy of Ventilation in Buildings*, document available from list at https://www.mass.gov/lists/indoor-air-quality-manual-and-appendices Conversion of $CO_2$ levels to cfm outdoor air is not exact, but information from Washington State University indicates that $CO_2$ levels of 800 ppm correlate to 20 cfm per person. ASHRAE's guidance is 10 cfm per person.

[15] https://www.ashrae.org/technical-resources/filtration-disinfection

[16] Harvard School of Public Health, *5 Step Guide to Checking Ventilation Rates in Classrooms,* August 2020, p.31.

E. Relatively humidity (RH). RH levels should remain between 40% - 60%. Studies suggest that RH below 40% may increase the risk of infection.[17]

F. Portable Air Cleaners (PAC). PACs (i.e. air purifiers) with High Efficiency Particulate Air (HEPA) filters can be highly effective in reducing concentrations of infectious aerosols in a single space if appropriately selected and deployed.[18] The 5 ACH target can be achieved by a combination of outdoor air ventilation and supplementary air cleaning by HEPA filter PACs.[19]

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17 See ASHRAE Position Document on Infectious Aerosols, April 14, 2020, page 8, citing Taylor, S., and M. Tasi. 2018. Low indoor-air humidity in an assisted living facility is correlated with increased patient illness and cognitive decline. *Proceedings, Indoor Air 2018* 744:1–8; Stone, W., O. Kroukamp, D.R. Korber, J. McKelvie, and G.M. Wolfaardt. 2016. Microbes at surface-air interfaces: The metabolic harnessing of relative humidity, surface hygroscopicity, and oligotrophy for resilience. *Frontiers in Microbiology* 7:1563. DOI: 10.3389/fmicb.2016.01563; Goffau, M.C., X. Yang, J.M. van Dijl, and H.J. Harmsen. 2009. Bacterial pleomorphism and competition in a relative humidity gradient. *Environmental Microbiology* 11(4):809–22. DOI: 10.1111/j.1462-2920.2008.01802.x. https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

18 See ASHRAE Position Document on Infectious Aerosols, April 14, 2020, page 7. https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

19 Harvard School of Public Health, *Portable Air Cleaners: Selection and Application Considerations for COVID-19 Risk Reduction* https://schools.forhealth.org/wp-content/uploads/sites/19/2020/08/Harvard-Healthy-Buildings-Program-Portable-Air-Cleaners.pdf, August 2020.