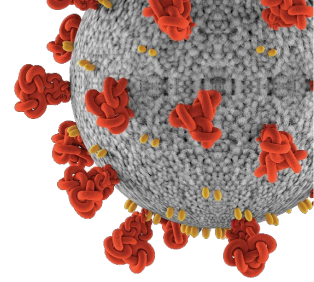

Air Management for the OMS during the COVID-19 Pandemic

June 16, 2020

SARS-CoV-2, the virus that causes COVID-19, is believed to be spread primarily through respiratory droplets. The virus can persist in aerosols for several hours and, depending on the surface, for several days. Because oral and maxillofacial surgery procedures are performed in an area that may contain the virus and because the procedures may produce aerosols, the risk of SARS-CoV-2 transmission is a concern during the delivery of oral and maxillofacial surgery services.

Air management in the office is one step in a layered approach to help minimize the risk of SARS-CoV-2 transmission. There are multiple factors and technologies to consider when implementing an office air management plan. An indoor airspace should be considered contaminated after a person speaks, breathes, coughs or sneezes without a face covering.

At this point in the COVID-19 pandemic, the oral and maxillofacial surgeon (OMS) should prevent entry of contaminated air spaces by anyone without appropriate respiratory protection. Without any air decontamination strategies, it is reasonable to assume the air will be naturally safe to breathe after three hours. Given that most OMSs will find it excessively disruptive to decommission a treatment room for three hours, advanced technology and air management strategies may be used to shorten that time. As more is discovered about this virus, this time recommendation may change.

Heating, Ventilation and Air Conditioning (HVAC) Systems

HVAC systems are designed to regulate temperature and sometimes humidity throughout the spaces of an office or building. Depending on the architecture and structure of the facility, multiple zones may be managed by separate fans, heating and cooling units, air vents and ducts. The OMS should evaluate the flow of air that starts in the areas of the office likely to contain contaminated dental aerosols or respiratory droplets. The concepts that should direct the air management plan should include: 1) isolating the contaminated air spaces from non-contaminated/clean air spaces, 2) maintaining air flow from clean areas to contaminated areas while avoiding air flow from contaminated areas to clean areas, 3) increasing outdoor air into the building, 4) ventilating interior air outdoors and 5) decontaminating air that cannot be ventilated to the outdoors before it is recirculated back into the workspaces.

Modifications to an HVAC system should be carefully considered with consultation with a mechanical engineer and/or qualified HVAC contractor. Modifications to consider include temperature, humidity, duct and ventilation design, pressure, filtration and regional variance in climates. The HVAC system should be maintained with filters changed as recommended by the manufacturer. Most HVAC systems are designed to perform within certain parameters and a designed airflow. Increasing the filtration capacity (13 minimum efficiency reporting value [MERV] or greater)[1] on the HVAC system by installing a filter with a higher MERV may provide benefit.

However, increasing the filtration value may interfere with performance of a specific HVAC system due to the simultaneous increase in resistance to air flow. MERV ratings designate the percentage of particles of a particular size that will effectively be filtered out of the air by a specific air filter. They range from 1-20, with 17-20 for the most extremely sensitive conditions, such as cleanrooms, pharmaceutical manufacturing and

[1] Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. ASHRAE Standard 52.2-2017 – Minimum Efficiency Reporting Value (MERV). 2017.

computer microchip manufacturing. Hospital operating rooms are generally designed to accommodate MERV 16 filtration. Consultation with a mechanical engineer and/or HVAC contractor is recommended to determine the highest filtration level that can be achieved.

Controlling the relative humidity may help limit the survival and spread of SARS-CoV-2. The target humidity should be between 40-60 percent. Lower humidity[2] may favor SARS-CoV-2 viability.

Increasing the percentage of outdoor air supplied via the HVAC should be considered in conjunction with a mechanical engineer and/or HVAC contractor.

Thermostats/fans should be reprogrammed to avoid the system shutting off during occupied hours. Demand-controlled ventilation based on temperature set points or occupancy should be minimized when feasible. The usual functional goal of temperature control is no longer the only reason the system should be activated. With concern for COVID-19, the HVAC systems should run continuously during patient care hours and up to three hours post-occupancy when feasible, or as long as is necessary to complete the number of air exchanges required to filter 99 percent of the particles in the air.[3]

Exhaust fans in the facility should be left on when feasible, especially in bathrooms, as SARS-CoV-2 has been found in fecal matter, and droplets are known to spread from toilet flushing.

Portable HEPA (High Efficiency Particulate Air) Filtration Units

No direct research exists to verify if a HEPA air purifier reduces the transmission of COVID-19. HEPA filters can capture microbes, dust and particulates down to 0.3 microns. HEPA filters are 99.97 percent effective at capturing particles down to 0.3 microns. Keep in mind, an N95 or KN95 is only 95 percent effective at capturing particles down to 0.3 microns. Although SARS-CoV-2 is approximately 0.06 to 0.14 microns, a HEPA filtration device may still help reduce the potential for airborne SARS-Cov-2. HEPA filters consist of a complicated mix of fibers and filaments that carry an electrostatic charge that captures, similar to a magnet, particles even smaller than 0.3 microns. SARS-CoV-2 is generally carried in respiratory droplets,[4] which are much larger, further increasing the chance it will be captured by a HEPA filter.

Consider the use of a portable HEPA air filtration unit, especially during and immediately following an aerosol-generating procedure. Portable HEPA filters can be considered as an adjunct to the HVAC system to expedite room air exchanges and hasten the ability to reuse the room for another patient. HEPA units should be placed so surgical personnel are not between the patient and the HEPA filtration unit, which would direct patient spatter and aerosols toward them.

Ultraviolet (UV) Light

As part of a layered, overlapping process to prevent the airborne transmission of SARS-CoV-2, inactivation of the virus may be achieved with UV light. Ultraviolet germicidal irradiation (UVGI) is electromagnetic light with a wavelength in the range of 100 to 280 nm, with peak germicidal activity around 254 to 265 nm. The biocidal effect of UV is related to energy and duration. UVGI has the potential to cause human health diseases, including skin cancer and eye disease. UVGI cannot be used openly in an occupied space, except when installed in an upper-room fashion. In this design, UVGI lamps are suspended from ceilings or the upper portion of walls. The base of the lamp is shielded to direct the radiation upward and outward to create an intense zone of UVGI in the upper room air while minimizing the UVGI in the occupied lower portion of the room.

Many factors need to be considered when designing and installing an upper-room UVGI. Some of these factors include ceiling height, room temperature, relative humidity and location, and sizing of HVAC supplies and returns that play a role in airflow. UV

[2] Mechanical Contractors Association of America (MCAA). MSCA HVACR and Plumbing Best Practices During COVID-19. 2020. Page 5.
[3] Centers for Disease Control and Prevention. Airborne Contaminant Removal. Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency. 2020.

[4] World Health Organization. Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care. 2014.

technology also is available for installation within HVAC ducts and can additionally aid in inactivating viruses that are filtered through the HVAC filter.

Far UVC,[5] or UV light with a wavelength in the range of 207 to 222 nm, should be considered as an alternative to broad spectrum UVGI. Inactivation of the virus may be without the human health risks. Far UVC can be used in occupied spaces. Further research is needed to support large-scale utilization of far UVC germicidal irradiation.

In summary, the OMS should create and implement an air management plan utilizing a layered application of technology and behavior to minimize the risk of SARS-CoV-2 transmission. Each OMS and facility may have a different combination and method to reach this goal. One prescriptive method does not exist, so no single strategy can be recommended.

Airscrubbing/Decontamination

Air scrubbing is a process utilizing technology to aid in removal of particles and contaminants from the air. Air scrubbing is generally categorized into wet or dry scrubbing. Wet scrubbing uses a damp or wet medium to filter particles and contaminants out of the air. Dry scrubbing utilizes the properties of positive and/or negatively charged ions to destroy certain molecules; disrupt the vitality of airborne organisms and viruses; and cause airborne particles to aggregate, fall and/or be caught in filters. Commercial- and residential-grade portable air scrubbing units are available. Additionally, there are air scrubbers that can be installed in HVAC ductwork similar to UVGI lamps. The air management concept is similar – with the added benefit of removing odors, volatile organic compounds and other air contaminants directly – and indirectly by increasing the efficacy of the air filter. The ions created also are dispersed throughout all of the air in the work space, so the effect is created ubiquitously – where UVGI or even some fogged disinfectants may not reach. Though the absolute benefit of air scrubbing for decreasing SARS-CoV-2 transmission in an OMS office is unclear, it may still be beneficial to improve the general air quality and reduce the recirculation of contaminants.

Resources:

CDC.gov/infectioncontrol/guidelines/environmental/background/air.html

ASME.org/delivered-to-your-home/articles

MCAA.org/wp-content/uploads/2020/04/HVACR-PLUMBING-BEST-PRACTICES.pdf

ASHRAE.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

ASHRAE.org/file%20library/about/position%20documents/filtration-and-air-cleaning-pd.pdf

ASHRAE.org/technical-resources/filtration-disinfection#airborne

NTRS.NASA.gov/archive/nasa/casi.ntrs.nasa.gov/20170005166.pdf

CDC.gov/niosh/docs/2009-105/pdfs/2009-105.pdf?id=10.26616/NIOSHPUB2009105

[5] AAOMS Paper on UV Light and its Applications. 2020. Accessed June 12, 2020.

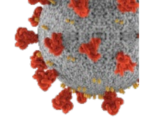

Table E-1 Application Guidelines

Std. 52.2 Minimum Efficiency Reporting Value (MERV)	Application Guidelines		
	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
16 15 14 13	**0.30 to 1.0 µm Particle Size** All bacteria Most tobacco smoke Droplet nuclei (sneeze) Cooking oil Most smoke Insecticide dust Copier toner Most face powder Most paint pigments	Hospital inpatient care General surgery Smoking lounges Superior commercial buildings	**Bag Filters** Nonsupported (flexible) microfine fiberglass or synthetic media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets. **Box Filters** Rigid style cartridge filters 150 to 300 mm (6 to 12 in.) deep may use lofted (air laid) or paper (wet laid) media.
12 11 10 9	**1.0 to 3.0 µm Particle Size** Legionella Humidifier dust Lead dust Milled flour Coal dust Auto emissions Nebulizer drops Welding fumes	Superior residential Better commercial buildings Hospital laboratories	**Bag Filters** Nonsupported (flexible) microfine fiberglass or synthetic media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets. **Box Filters** Rigid style cartridge filters 150 to 300 mm (6 to 12 in.) deep may use lofted (air laid) or paper (wet laid) media.
8 7 6 5	**3.0 to 10.0 µm Particle Size** Mold Spores Hair spray Fabric protector Dusting aids Cement dust Pudding mix Snuff Powdered milk	Commercial buildings Better residential Industrial workplaces Paint booth inlet air	**Pleated Filters** Disposable, extended surface, 25 to 125 mm (1 to 5 in.) thick with cotton-polyester blend media, cardboard frame. **Cartridge Filters** Graded density viscous coated cube or pocket filters, synthetic media. **Throwaway** Disposable synthetic media panel filters.
4 3 2 1	**>10.0 µm Particle Size** Pollen Spanish moss Dust mites Sanding dust Spray paint dust Textile fibers Carpet fibers	Minimum filtration Residential Window air conditioners	**Throwaway** Disposable fiberglass or synthetic panel filters **Washable** Aluminum mesh, latex coated animal hair, or foam rubber panel filters **Electrostatic** Self charging (passive) woven polycarbonate panel filter

Note: A MERV for other than HEPA/ULPA filters also includes a test airflow rate, but it is not shown here because it has no significance for the purposes of this table.