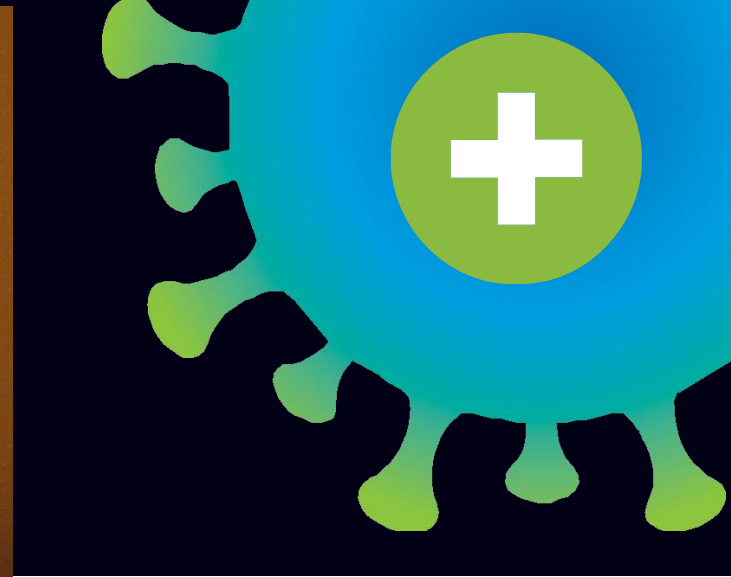




ASHRAE Epidemic Task Force

Dental Facilities | 1-19-2022



Introduction/Background

- Dental professionals have been impacted by COVID-19 and face unique challenges in a wide variety of clinical environments. [See this exposure graphic for Dentists](#)
- Given the prominent role of airborne infective aerosols in transmitting COVID-19, the dental community needs to work with professionals in the heating ventilation and air conditioning (HVAC) industry for guidance on achieving safer and healthier indoor air quality (IAQ) spaces.
- [Modes of Transmission](#)
- [ASHRAE Statements on Airborne Transmission and Core Recommendations](#)

Aims & Objectives

- To provide the Dental Profession with Evidence Based scientific and technological information related to HVAC, indoor air quality (IAG), Water Quality, and other environmental concerns to promote a safe and healthy dental setting.
- To encourage the establishment, acceptance, and understanding of appropriate engineering principles by the Dental Profession to promote safer dental working environment in clinical and laboratory settings.
- To promote proper dental office design with the objective of helping to minimize the effect of infectious challenges such as airborne COVID-19 and waterborne Legionella.
- Do No Harm
- Protect Dental Workers and Patients
- Empower people to make and carry out the best decision they can.
- Consider the type of HVAC system, the configuration, clinical needs, facility infrastructure capacity, and limited resources available.

General Recommendations

- [Patient Placement Strategies](#)

General Best Practice HVAC Recommendations for Dental Practitioners

- [Primary Source Management to Limit Contamination at the Source – The Mouth of the Patient](#)
- [Source Control Considerations](#)
- [Are your Main Dental Office HVAC Filters Adequate? Choosing Appropriate Dental Office HVAC Filtration Levels](#)
- [In Room or Portable Air Cleaners.](#)
- [Achieving proper hourly room air changes as best possible.](#)
- [Establishing Proper Room Airflow Directions](#)
- [Consider Maintaining 40-60%RH.](#)
- [Employing Disinfection and UV technologies](#)
- [Split System Air Conditioners and Natural Ventilation](#)
- [Surgery on Active COVID-19 Patients](#)
- [Working from a Mobile Dental Van](#)

Maintaining and Servicing of Air and Water Systems in the Dental Environment

- [HVAC System Maintenance and Filter Removal & Replacement](#)
- See [ASHRAE COVID-19 Filtration and Disinfection section for greater detail.](#)
- [Waterborne Pathogen Prevention](#)
- [Transmission through air in toilet rooms](#)
- [Building Readiness](#)

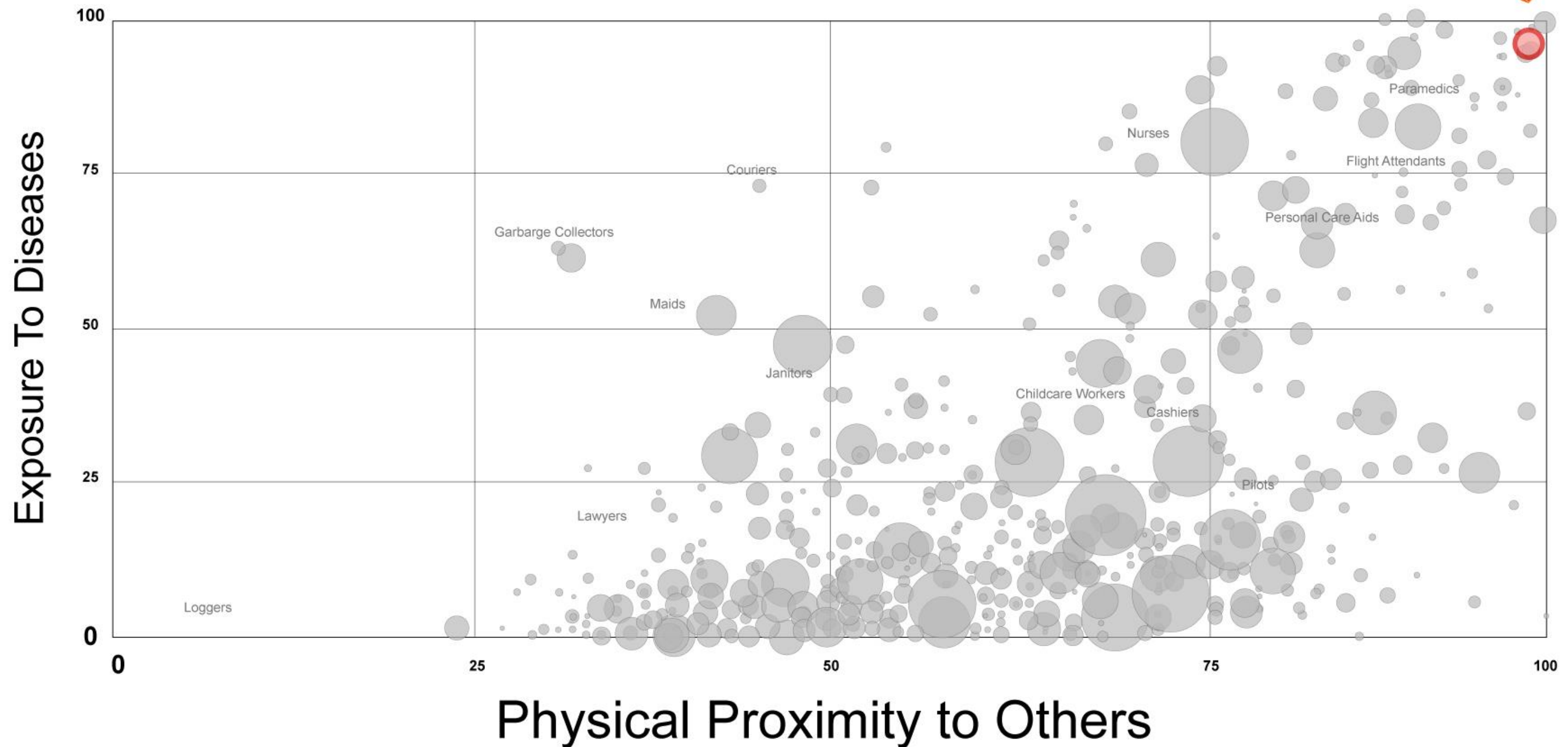
OTHER

- [Healthcare Team Members](#)
- [Disclaimer](#)

Dentist have a high level of exposure



Dentists



Source: National Elf Service.com



Modes of Transmission

SARS-CoV-2, the virus that causes COVID-19, is transmitted by various pathways as described below:

•According to the World Health Organization as of 12-23-21:

<https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-covid-19-how-is-it-transmitted>

- Current evidence suggests that the virus spreads mainly between people who are in close contact with each other, for example at a conversational distance. The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe. Another person can then contract the virus when infectious particles that pass through the air are inhaled at short range (this is often called short-range aerosol or short-range airborne transmission) or if infectious particles come into direct contact with the eyes, nose, or mouth (droplet transmission).
- The virus can also spread in poorly ventilated and/or crowded indoor settings, where people tend to spend longer periods of time. This is because aerosols can remain suspended in the air or travel farther than conversational distance (this is often called long-range aerosol or long-range airborne transmission).
- People may also become infected when touching their eyes, nose or mouth after touching surfaces or objects that have been contaminated by the virus.

•According to the CDC as of 7-14-21: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html>

COVID-19 spreads when an infected person breathes out droplets and very small particles that contain the virus. These droplets and particles can be breathed in by other people or land on their eyes, noses, or mouth. In some circumstances, they may contaminate surfaces they touch. People who are closer than 6 feet from the infected person are most likely to get infected.

COVID-19 is spread in three main ways:

- Breathing in air when close to an infected person who is exhaling small droplets and particles that contain the virus.
- Having these small droplets and particles that contain virus land on the eyes, nose, or mouth, especially through splashes and sprays like a cough or sneeze.
- Touching eyes, nose, or mouth with hands that have the virus on them.

See also the ASHRAE Environmental Health Emerging Issue Brief, "[Pandemic COVID-19 and Airborne Transmission](#)" (insert link).

The Virus May Be Aerosolized During [Toilet Flushing](#), even in subsequent flushes following initial use by an infectious person.

Consider keeping plumbing traps full of water or mineral oil to avoid transmission of air through dry traps. SARS-CoV-1 and SARS-CoV-2 have both been shown to be transmitted this way, and two SARS-CoV-2 published studies posited transmission in a similar manner.



Airborne Transmission Statement & Core Recommendations



ASHRAE Statement on airborne transmission of SARS-CoV-2

- Airborne transmission of SARS-CoV-2 is significant and should be controlled. Changes to building operations, including the operation of HVAC systems can reduce airborne exposures.

ASHRAE Statement on operation of heating, ventilating, and air-conditioning systems to reduce SARS-CoV-2 transmission

- Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

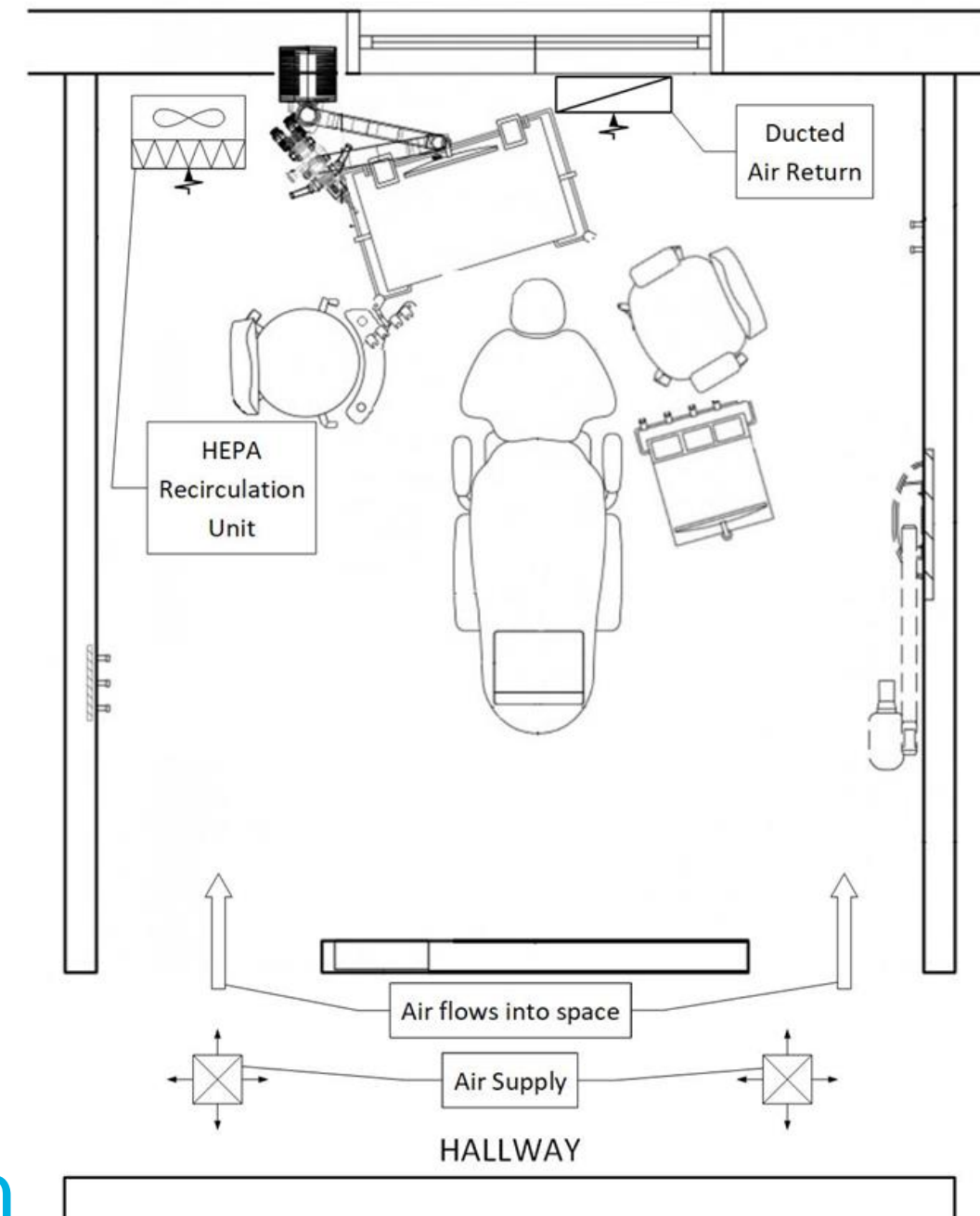
ASHRAE Core Recommendations for Reducing Airborne Infectious Aerosol Exposure are available [HERE](#).



Patient Placement Strategies



- Well-ventilated individual operatories are preferred
- If floor plan is open:
 - Confirm at least 6 feet of space between patient chairs
 - Place physical barriers between patient chairs (floor to ceiling preferred if fire code compliant)
 - Orient operatories parallel to the direction of airflow if possible
- Patient orientation:
 - Patients should be oriented with their head away from pedestrian corridors, towards the rear wall when using vestibule-type office layouts, and near the return air vents



Graphic by CDC/NIOSH



Primary Source Management to Limit Contamination at the Source

– The Mouth of the Patient

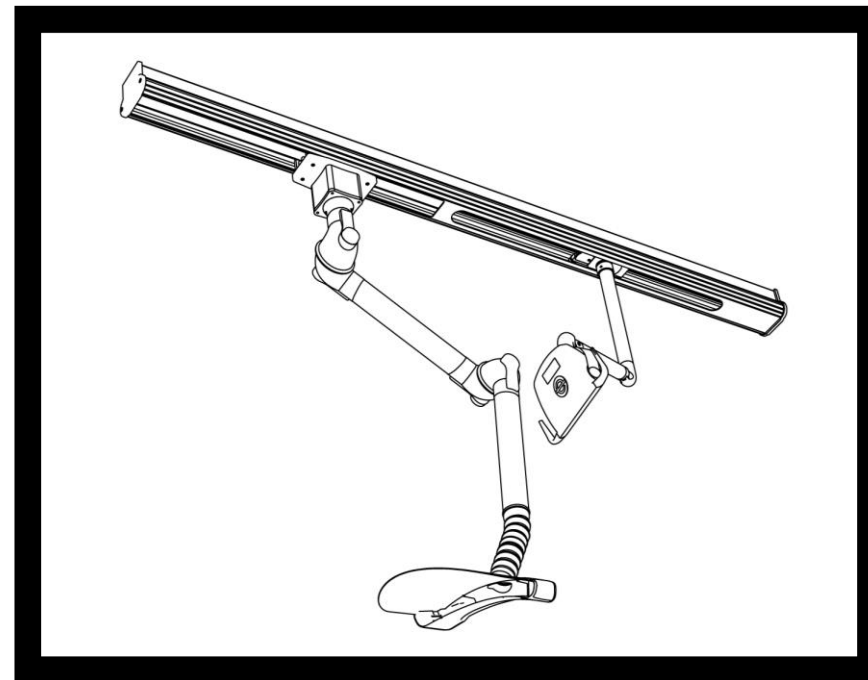


- Source Control
 - The principal of Source Control in Dentistry seeks to remove the airborne particles before they can travel beyond the patient. The mechanical suction evacuation of aerosols and exhaled air from the patient helps to minimize its wider distribution and mixing within the rest of the air in the room. Consider filtering the exhaust.
- Portable Air Evacuation Carts
 - New portable air evacuation carts are now available that will draw air directly from the area of the patient’s mouth and run it through several HEPA filters before either exhausting it externally out of the room, or reintroducing it, albeit in “cleaner” form back into the clinical area. Whether such units can exhaust into the high-speed dental evacuation system is not documented yet.
- Other Measures
 - Modifying or eliminating certain dental procedures, wider use of rubber dams, manual or slow speed instrumentation techniques can also help to minimize widespread aerosol contamination.
- Practical Recommendation:
 - Consider a side dental cart with source evacuation capabilities.



Source Control Considerations

- Capture is very dependent on the proximity of the capture device to the source
- Consider ability to maintain adequate lighting
- Consider sound levels of capture devices when operational



Are Your Main Dental Office HVAC Filters Adequate?



- MERV Rating
 - ASHRAE pioneered a filter rating system named a MERV rating. The fraction of particles removed from air passing through a filter is termed “filter efficiency” and is provided by the Minimum Efficiency Reporting Value (MERV) under standard conditions. Buildings commonly have MERV 6 or MERV 8 filters. Most dental offices do not employ HEPA rated filters. See [ASHRAE Filtration/Disinfection Guidance](#) for more information.
- Dental Office Air Filters
 - Consider the need to sustain proper air flow, maintain room air change rates, and permit proper heating, cooling, and humidity control when evaluating filter upgrades. Filters with MERV ≥ 13 (or ISO equivalent) are efficient at capturing airborne viruses.
 - A minimum MERV 13 or better is desirable, but increased filter efficiency may result in increased pressure drop through the filter. Depending on the system, this may result in lower airflows.
 - To help decide whether a given HVAC systems can handle filter upgrades without negative impacts to pressure differentials and/or air flow rates prior to changing filters, consult with HVAC specialists including ASHRAE professionals. Improved filter technology has resulted in some MERV 13 filters having similar pressure drops to older technology MERV 8 filters. This fact, coupled with adjustments to the HVAC system fan speed, can enable higher filtration rates than were previously used.



Are Your Main Dental Office HVAC Filters Adequate? (Cont.)



- HEPA Filters

- HEPA filters are very dense and while HEPA filters can be located in HVAC systems, most HVAC systems are not designed to overcome the pressure drop of a HEPA filter. To function properly, such filters must be sealed within filter racks. HEPA filter efficiency is better than a MERV 13 rating, but due to high pressure drops, HEPA filters may not be able to be retrofitted into existing HVAC systems and they may not be necessary for all dental offices.
- The CDC notes other HEPA filter considerations [HERE](#).
- Maintenance costs associated with HEPA filters are high compared with other types of filters.
- Portable HEPA units are available to augment systems that cannot provide adequate airflow or to provide increased effectiveness in airflow.

- Practical Recommendation

- Confirm that there is no bypass around the filters.
- Operate the system fan continuously during occupancy during an epidemic, even if heating and cooling are not required, to obtain the benefit of air filtration.
- Ask an HVAC Professional to evaluate current HVAC system filters and if upgrades are feasible.
- Conduct a risk assessment to determine whether HEPA filters are warranted for specific areas. An HVAC Professional can calculate the contaminant concentration reduction for your system with various levels of filtration for comparison purposes.



In-Room or Portable Air Cleaners



- In-Room or Portable HEPA filter units can be utilized for auxiliary HVAC in dental operatories to reduce bioaerosols or in waiting rooms. These units can have a greater benefit in spaces below 6ACH.
- Device is located inside the room where air cleaning is desired. Place air cleaner as close to the patient as feasible where air intake and discharge are not impeded (e.g., not near furniture or behind curtains).
- Air is pulled into the device, and cleaned air is returned to the room or adjacent space. Flexible ductwork can be attached to some devices to allow strategic positioning of intake and/or discharge locations, including discharge outside the room to create pressure differences and/or create clean to less-clean directional airflow.
- See also the 1-page [ASHRAE In-Room Air Cleaner Guidance for Reducing Covid-19 In Air in Your Space/Room](#)



Achieving proper hourly room air changes as best possible



- Air Changes an Hour (ACH)

- June 3, 2020, the CDC offered a Clinician Outreach and Communication Activity Webinar titled: Guidance for Dental Settings During the COVID-19 Response, [HERE](#).
- The webinar refers to 2003 CDC Guidelines noting 6 ACH, but these are being reviewed. Older models assume ideal air mixing of aerosols, no obstacles to air flow (ex. dental chair), and no “re-contamination of the room by the exhaust air” even though it may only be vented through a HEPA filter and then reintroduced to the room. Different rooms may be “zoned” for different air flows and these settings are often guided by the comfort of the room occupants.
- Some countries such as the United Kingdom have started to look at a recommended level of 10ACH for dental operatories (new construction).
- Continued on next page



Achieving proper hourly room air changes as best possible (cont.)



CDC has published air change clearance rates (assuming perfect mixing) based on room ACH. These times are viewed as impractical for most dental offices. Therefore, ancillary methods of aerosol control, such as source management, are being scrutinized to achieve safer conditions in less time.

ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6 ⁺	46	69
8	35	52
10 ⁺	28	41
12 ⁺	23	35
15 ⁺	18	28
20	14	21
50	6	8

Consider The ASHRAE Equivalent Outdoor Air Calculation, which incorporates the combination of the actual outdoor air, impact of filtration or air cleaning technologies on recirculated air, and the impact of air cleaning technologies in the space.

– See [ASHRAE Building Readiness Guidance for Equivalent Outdoor Air Calculation Examples](#) and a link to the [Calculator Spreadsheet](#).

Practical Recommendation

- Ask your building owner to have an HVAC Professional analyze and explain the ACH rate and/or Equivalent Outdoor Air Calculation for each room in your office.
- Balancing of airflows by adjusting the zoning settings for the HVAC system may be needed.



Establishing Proper Room Airflow Directions and Patterns from Clean to Less Clean Areas



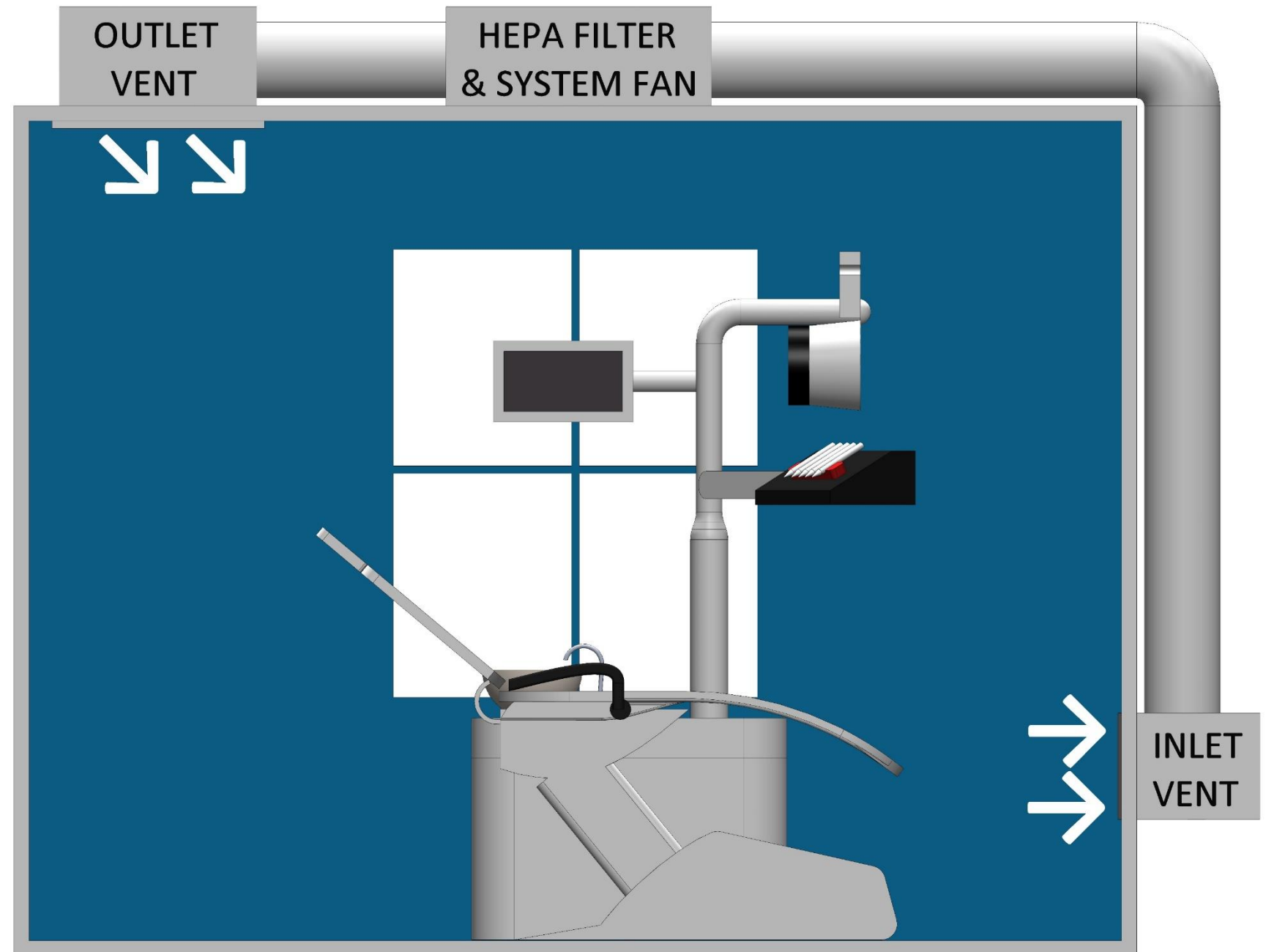
- Air flow direction
 - When directional airflow is not specifically required, or not recommended as the result of a risk assessment, promote mixing of space air without causing strong air currents that increase direct transmission from person-to-person.
 - Rooms with source generation (typically the Operatory where the patient is treated) and toilet rooms are considered “less clean”. Other spaces such as waiting rooms or equipment cleaning rooms may also be considered “less clean” compared to areas such as office spaces or clean storage.
 - In most dental offices, the diffusers in the ceiling provide supply air flow out into various rooms and there tends to be a centrally located return grille for drawing airflow back into the HVAC system.
 - Once an office has been built out, major modifications after the fact may prove more costly or impractical.
- Any shared areas?
 - Some buildings have common shared duct work that may supply multiple dental office suites. Potentially air and possible contaminants from a general dentist in Suite 201 may travel to an endodontist’s office in Suite 202. Building HVAC systems can have many configurations. The risk of recirculation by the HVAC system is a function of total system size, the amount of outside air, and the level of filtration.



Clean-to-Less-Clean Air Movement Concept



- Room set-ups are unique in terms of where supply and return are located relative to the patient. This shows one room layout that can be achieved using central HVAC system or Portable HEPA units.
- For central HVAC systems: As necessary, reposition the supply air louvers, exhaust air grilles, and adjust damper settings.
- For portable HEPA units: Make use of flexible ductwork to connections. Consider temporary partitions to create desired flow pattern.



Graphic: CDC/NIOSH



Consider Maintaining 40-60% RH



Optimal relative humidity continues to be an area of active research.

- Dry air below 40% RH has been shown to:
 - Reduce healthy immune system function (respiratory epithelium, skin, etc.)
 - Increase transmission of some airborne viruses and droplets (COVID-19 still being studied)
 - Increase survival rate of pathogens
 - Decrease effectiveness of hand hygiene and surface cleaning because of surface recontamination or too-quick drying of disinfectants
 - For references to the above research, [see those listed in this document.](#)
- Take care if restarting older humidifiers to confirm cleanliness of internal components and water sources and proper moisture absorption in the airstream.
- Watch interior spaces to confirm no condensation is occurring, which would permit mold and moisture issues.
- [Climate-Informed HVAC Increases in Relative Humidity May Fight Pandemic Viruses](#)
- [ASHRAE Tech Hour: Optimize occupant health, building energy performance, and revenue through indoor air hydration](#)



Employing Disinfection and UV Technologies



- UV Air Cleaning (Note difference between biofouling control vs. virus inactivation)

- UV systems are often installed in air handlers to control biofouling of cooling coils. These systems provide low UV output and are not likely to eradicate virus in the moving airstream. In-duct UV systems *can be* designed to deliver the necessary dose during the available exposure time to inactivate virus suspended in the air. Such systems require a *much higher* UV output and are typically designed for 500 fpm moving airstream, minimum irradiance zone of 2 feet, minimum UV exposure time of 0.25s, and minimum target UV dose of 1,500 $\mu\text{W}\cdot\text{s}/\text{cm}^2$. UV light systems should always be coupled with filtration.

- UV-C Disinfecting Lighting

- Upper air UV light fixtures mounted in occupied spaces at heights of 7 ft and above can eradicate airborne SARS-CoV-2 virus. Most direct UV lights are harmful to occupants and furnishings so there are precautions that should be taken during design and installation. Ventilation should maximize air mixing or use supplemental fans for upper room UVC to be more effective. Consider this as an option when there is little or no mechanical ventilation or in congregate settings.

- Bi-Polar Ionization/Corona Discharge/Needlepoint Ionization and other Ion or Reactive Oxygen Air Cleaners

- High voltage electrodes create reactive ions in air that react with airborne contaminants, including viruses. A convincing body of scientifically-rigorous, peer-reviewed studies does not currently exist on this emerging technology; manufacturer data should be *carefully* considered and correspond with same application and occupancy scenario of your intended use. Must comply with UL 2996 and AHSRAE 62.1 as ozone build up can be harmful to humans.
- See [ASHRAE Filtration/Disinfection](#) for information on other technologies such as VHP, Pulsed Xenon, and Chemical Disinfectants.



Split System Air Conditioners and Natural Ventilation



- Split System Air Conditioners
 - Split air conditioners can be utilized, however split system air conditioners are not capable of very high levels of filtration and some are not configured to bring in outside air for ventilation (ductless splits). Avoid strong air currents that would increase transmission from person-to-person.
- Natural Ventilation
 - Utilizing a window for ventilation is helpful if the HVAC is not working or is not available or is not able to provide sufficient outdoor air. Fans can be added at the windows to direct airflow out of a space while facilitating lower-velocity inward airflow from other openings.
 - A low-cost method to approximate the effectiveness of natural ventilation can be evaluated using portable infra-red CO₂ meter and a source of CO₂ (Ex. Dry Ice). Contaminate the room with the CO₂ source, remove the source, temporarily mix the room air, and then measure CO₂ degradation with windows/doors closed and fans off. Repeat with windows/doors open and fans operating.



Surgery on Active COVID-19 Patients



- Operating on active COVID-19 patients
 - Avoid surgery or delay the procedure unless a dental emergency.
 - Only staff essential to treatment should be present in the room, particularly if aerosol generating procedures are being undertaken.
 - Our ASHRAE Healthcare Guidance includes information for operating on a COVID-19 patient, however, this guidance is tailored to an inpatient setting and specific guidelines for dental facilities have not been developed. See [ASHRAE Healthcare Guidance](#) under the section “Specific How-To and Unique Areas: Operating on COVID-19 positive patient”.
 - The CDC also has prepared [Guidelines for Preventing the Transmission of TB in Healthcare Settings](#), which has additional guidance that has been utilized in an inpatient setting for COVID-19 patients but has not been specifically adapted for dental facilities.
 - The CDC has COVID guidance for Dental Care. See [Guidance for Dental Settings](#).



Working From a Mobile Dental Van



- Mobile dental vans
 - In the US and elsewhere such mobile units serve a vital role in helping to bring much needed dental care to underserved populations. Such mobile clinics also play an important role in providing preventive care, such as dental sealants, to pediatric populations so that dental caries (dental decay) can be avoided in the first place.
- Standard Recommendations
 - There are some standard recommendations, such as wearing PPE such as masks, limiting the number of patients in the space at any given time, and spacing out patients to allow for some clearing of the air in between patient visits. At close distances that are required for dental work, the HVAC system is limited in its ability to protect staff from an asymptomatic patient, so consistent wearing of PPE, hand hygiene, and surface disinfection are essential. Staff should also be encouraged to take breaks and eat meals outside, rather than to remove their masks or linger inside the van.
- Continued on next page



Working From a Mobile Dental Van (cont.)



- Maximize Outside Air
 - When weather allows, take steps to introduce plenty of outside air into the van by opening doors and windows and positioning fans to move fresh air through the space.
- Airflow Patterns
 - Consider what the airflow patterns are like in the van when different combinations of open/closed windows or doors, on/off fans, and the AC unit are running. It is not desirable to have air blown across multiple people. Experiment with different configurations of windows/doors open, fans on, and the AC unit (perhaps there are options to adjust or redirect some of the supply grilles) to see how it impacts the way the air flows in the space. There may also be options to reconfigure the internal furniture so that air does not pass by multiple people on the way back to the return of the AC unit or to the exhaust openings. It may also help to open a door if it does not heavily impact the temperature of the van, or to add another fan blowing in or out of the open door to increase the overall amount of ventilation in the space.
- In Room or Portable HEPA Filter
 - Consider adding one or more [portable HEPA filter units](#) to the van to further reduce the concentration of contaminants in the space. These units increase ACH and improve average room filter efficiency at the same time. Be mindful of the air currents generated by the portable HEPA unit, depending on how its inlet and discharge are positioned.



HVAC System Maintenance and Filter Replacement during the Pandemic



- For HVAC systems suspected to be contaminated with SARS-CoV-2, it is not necessary to suspend HVAC system maintenance, including filter changes, but **additional safety precautions are warranted**.
- The risks associated with handling filters contaminated with coronaviruses in ventilation systems under field-use conditions have not been evaluated.
- Workers performing maintenance and/or replacing filters on any ventilation system with the potential for viral contamination should wear appropriate personal protective equipment (PPE):
 - A properly-fitted respirator (N95 or higher)
 - Eye protection (safety glasses, goggles, or face shield)
 - Disposable gloves
- Consider letting the filter load up further than usual to reduce frequency of filter changes.
 - Don't let pressure drop increase enough to disrupt room pressure differentials.
 - Confirm filters remain snug in their frames.
- When feasible, filters can be disinfected by lightly spraying with a 10% bleach solution or another appropriate disinfectant, approved for use against SARS-CoV-2. Use something like hairspray (spray paint works almost as well) to fixate before removal. Filters (optionally disinfected or not) can be bagged and disposed of in regular trash.
- When maintenance tasks are completed, maintenance personnel should immediately wash their hands with soap and water or use an alcohol-based hand sanitizer.



Waterborne Pathogen Prevention



- When an area of a dental facility is reopened for use, water systems in these spaces should be evaluated in their entirety following the facility's water management plan. This may include flushing and testing for waterborne pathogens, drainage system borne pathogens, etc. prior to occupancy, and subsequent control measures discussed, if needed, to prevent HAI's.
 - [ASHRAE Standard 188-20018 and ASHRAE Guideline 12-2020](#)
- Due to changing municipal water usage declining (i.e. older water with less disinfectants in it), dental facilities should consider testing the incoming water for disinfectant and bacteria to determine if their incoming water quality is worsening.
- Water usage inside the facility may change and thus new waterborne pathogen hot spots may develop. Dental facilities should consider additional flushing where low use may occur.
- Carefully consider changes to the system. For example, changing to hands free (sensor) faucets to minimize contact potential may result in increased water age, requiring piping modifications.
- Maintaining the cleanliness of fixtures, especially those that can produce aerosols, like faucet aerators, will mitigate exposure to waterborne pathogens. Having cleaning procedures in place for water-aerosolizing fixtures can help reduce exposure.
- Additional resources:
 - <https://www.aspe.org/coronavirus-covid-19-preparedness-resources/>
 - [ASHE Monograph: Water Management in Health Care Facilities: Complying with ASHRAE Standard 188](#)
 - <https://www.cdc.gov/coronavirus/2019-ncov/faq.html#COVID-19-and-Water>
 - <https://www.cdc.gov/coronavirus/2019-ncov/php/building-water-system.html>
 - https://www.hse.gov.uk/news/legionella-risks-during-coronavirus-outbreak.htm?utm_source=govdelivery&utm_medium=email&utm_campaign=coronavirus&utm_term=legionella&utm_content=construction-9-jun-20

Transmission through air in toilet rooms and into patient rooms

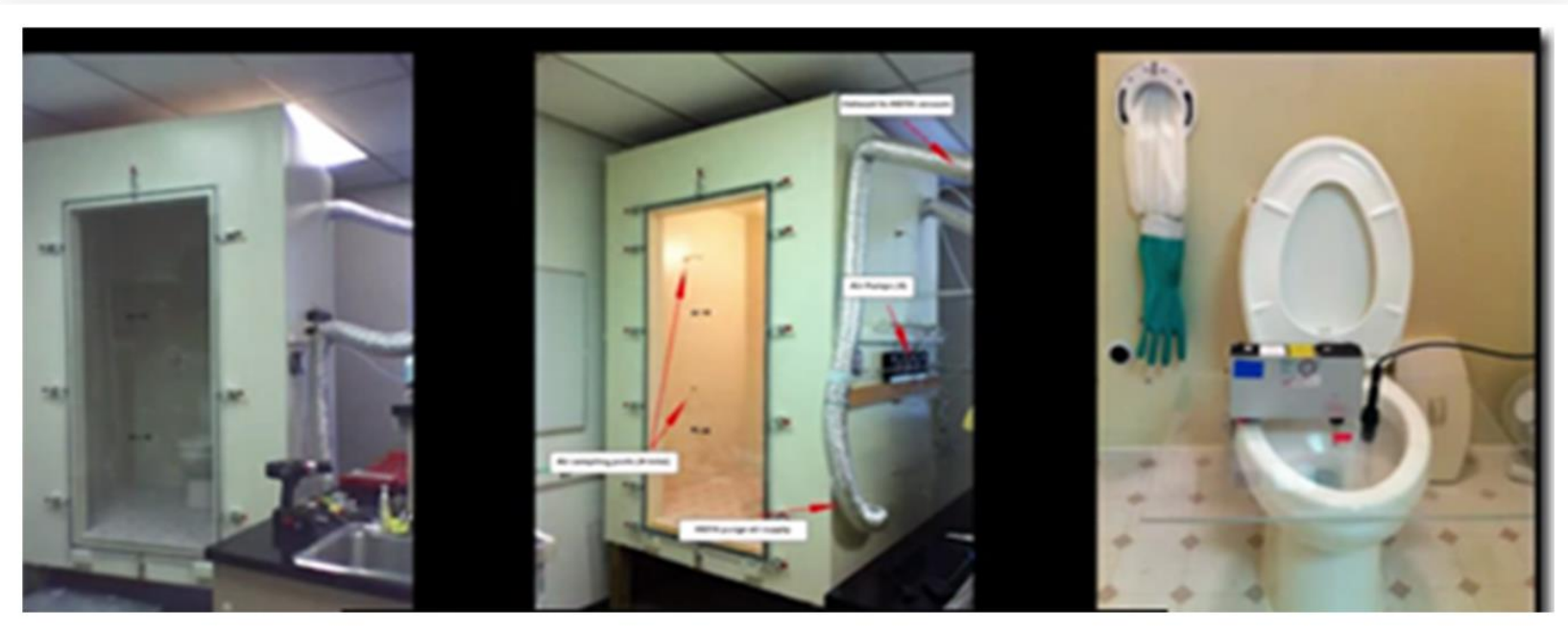


Studies have shown that toilets can be a risk of generating droplets and droplet nuclei “plumes” into the air that could contribute to pathogen transmission.

- Keep toilet room doors closed, even when not in use
- Put the toilet seat lid down, if there is one, before flushing¹
- Confirm that fan is operating

Hospital airborne C-Difficile Study²

- C-Diff seeded in a toilet
- Water samples, settle plates, and air samples
- Spores present after 24 flushes
- Droplet nuclei spore bioaerosol produced over at least 12 flushes



1. Best, EL et.al Potential for aerosolization of *Clostridium difficile* after flushing toilets: the role of toilet lids in reducing environmental contamination risk 2012 J Hosp Infect
2. Johnson, David Mead, Kenneth et.al Toilet Plume Aerosol Generation Rate and Environmental Contamination Following Bowl Water Inoculation with *Clostridium difficile* Spores 2019 American Journal of Infection Control

Johnson, David Mead, Kenneth et.al. Lifting the Lid on Toilet Plume Aerosol: A Literature Review with Suggestions for Future Research 2013 American Journal of Infection Control



Building Readiness



- The [ASHRAE Building Readiness Guidance](#) is meant to provide practical information and checklists for how your building should be operating and how to practically check its operation. Guidance is available for operation during the following conditions:
 - Epidemic Conditions in Place
 - Post-Epidemic Conditions in Place



Healthcare Team Members



Below are the members of the Healthcare Team of the Epidemic Task Force

Traci Hanegan (Chair)	Coffman Engineers, Inc.
Robert Block	Dr. Robert M. Block, DDS
Mike Cummiskey	Virginia Dept. of Health/Dental Division
Tim Earhart	McDonough Bolyard Peck
David Eldridge	Grumman/Butkus Associates
Jeremy Fauber	Heapy
Jonathan Flannery	ASHE
Melvin Glass	EMC Engineers
Eric Granzow	Specialized Engineering Solutions
Rick Hermans	Retired
Jerry Ivey	Willis-Knighton Health System
Roger Lautz	Affiliated Engineers Inc.
Mike Meteyer	Erdman
Frank Mills	Frank Mills Consulting
Zaccary Poots	Toro-Aire Inc
Michael Sheerin	TLC Engineering Solutions
Wayne Stoppelmoor	Schneider Electric
Paul Supan	American Dental Association Volunteer
Steven Welty	Green Clean Air
Laurence Wilson	WSP

Thank you also to Dr. David Ahearn and to Alberto Garcia for sharing information used in this Dental Guidance.



Disclaimer



This ASHRAE/ASHE guidance document is based on best available evidence and knowledge as of the date of this document. In the context of the rapidly evolving state of knowledge regarding transmission of COVID-19, design professionals may consider interventions that adopt a precautionary principle, taking reasonable actions that reduce risk while awaiting greater scientific certainty. Therefore, this guidance should be read in conjunction with the relevant government guidance and available research. This material is not a substitute for the advice of a qualified professional. By adopting these recommendations for use, each adopter agrees to accept full responsibility for any personal injury, death, loss, damage or delay arising out of or in connection with their use by or on behalf of such adopter irrespective of the cause or reason therefore and agrees to defend, indemnify and hold harmless ASHRAE and ASHE, the authors and others involved in their publication from any and all liability arising out of or in connection with such use as aforesaid and irrespective of any negligence on the part of those indemnified.

