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Reducing COVID-19 Transmission in Homes

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Introduction

Owners and renters all over the world are being encouraged to stay home as much as possible to mitigate the spread of the SARS CoV-2 virus and the COVID-19 disease. It is prudent to take reasonable precautions at home to reduce risks during the pandemic because most COVID-19 transmission happens in the home (see “learn more”). This is particularly true for households with infected or sensitive members. Furthermore, because people infected with COVID-19 can be asymptomatic you may have an infected person in your home for several days before you know it.

The evidence to date shows that you get a COVID-19 infection by breathing in the SARS-CoV-2 virus in droplets emitted by an infected person. The closer you are to an infected person the more droplets there are in the air for you to breathe. The advice to keep a physical distance of 6 feet or 2 meters is therefore very helpful to reduce the risk of infection. However, beyond this separation distance there is still considerable risk due to airborne particles if you are sharing an indoor space (see “learn more”).

This article is based on recommendations from the America Society of Heating, Refrigeration and Air-conditioning Engineers: ASHRAE. ASHRAE is responsible for the U.S. Indoor Air Quality (IAQ) standards and its membership includes leading IAQ experts from all over the world. Backed by a growing body of research on airborne transmission of the SARS-CoV-2 virus that leads to COVID-19, ASHRAE has published guidance (ASHRAE.org/covid19) for residential buildings to organize isolation spaces in homes and suggesting options for using the home’s heating, ventilating and air-conditioning (HVAC) equipment and systems to reduce potential risks of virus transmission through the air.

In addition, ASHRAE recently updated the *ASHRAE Position Document on Infectious Aerosols.* The position document now states: “Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.” (See “learn more”.)

What Can Homeowners and Occupants Do to Reduce their Risk of Exposure?

There are three main principles that can be applied to reduce the risk of airborne transmission in homes. They have been used for many years in healthcare/hospital environments and can be adapted to other buildings.

Isolate

Isolate infected or higher-risk people from the rest of the household and exhaust air to outside from contaminated rooms. Control the air flow direction in your home: from uncontaminated rooms to contaminated rooms to outside.

Dilute

More ventilation lowers concentrations – reduces amount of virus entering your body. Increasing ventilation is usually accomplished by increasing mechanical ventilation air flows or increasing air flow due to natural effects by opening windows.

Filter

Removing the particles carrying the virus from the air in the building. This is usually accomplished using mechanical air filtration systems.

General guidance you can take to follow these principles is outlined in Table 1. The first column of Table 1 suggests actions that can be taken immediately in many homes. The second column provides details of how to accomplish those actions, depending on the types of HVAC equipment and systems installed in the home. The third column lists additional actions that could be taken later, to improve the capability of the home to provide additional protections. Table 2 provides guidance on creating an isolation space for an infected person and Table 3 provides guidance for creating a protected space for sensitive individuals. For guidance for multifamily homes, see Table 4.

Table 1. General Guidance		
	Do Now (if you can)	**Plan to Do Later** (when safe, to lower risk during future epidemics)
Increase outdoor air ventilation, but do not sacrifice thermal comfort or increase ventilation when high polluting events occur, such as wildfires	1. Open windows during favorable outdoor conditions. 2. If you know you have a heat recovery ventilator (HRV or ERV) or other ventilation system installed in your house, ensure that it is ON. The most common types are exhaust fans located in a laundry room or bathroom or supply systems that operate on a controller connected to the central heating and cooling system. 3. Run one or more quiet bath or kitchen exhaust fans continuously (so long as they are vented outside). In a home with natural draft combustion appliances, ensure that these appliances draft properly. If your HVAC system has an economizer use it as much as possible while maintaining acceptable indoor temperature and humidity conditions.	If you do not have a ventilation system, hire a qualified contractor to install one*. The ventilation should comply with ASHRAE Standard 62.2 at a minimum.
Use high efficiency air filtration	1. If you have a high efficiency air filter (MERV 13** or better) in your central heating and cooling system, operate the thermostat in "FAN ON" mode (low speed if possible) to increase filtration rate, or use a system cycler if you have one installed. It is not recommended to run central AC continuously in warm-humid weather. 2. If you do not have a high efficiency filter in your central heating and cooling system, you may use room air cleaners with high efficiency filters. Follow EPA guidance for selection and use***.	1. Install a better filter in your central heating and cooling system. If your filter slot is 1-inch or less, do not exceed MERV 13. Or you may hire a qualified HVAC contractor to install a 2-inch or greater filter system. 2. When replacing your filter during epidemic episodes, use a mask and gloves and put the old filter in a plastic disposal bag immediately upon removal.
Avoid overly dry air	If you have very dry indoor air, use a central humidifier or a room humidifier in the bedrooms of at-risk occupants. Follow manufacturers' instructions for proper humidifier maintenance to prevent mold growth.	Hire a qualified home performance contractor to air-seal your house****. This will help reduce drafts, improve comfort, save energy, and prevent overly dry conditions in your home.
Prevent sewer gases from contaminating your home	1. Run water in each sink, tub, drain and shower and flush unused toilets to fill all plumbing traps and prevent sewer gas entry. 2. When using the toilet, turn on exhaust fan for several minutes and close the lid before flushing.	

* HRV/ERV installation guidance: https://basc.pnnl.gov/home-improvement-expert/checklists/balanced-hrverv. Bath Exhaust Fan installation guidance: https://basc.pnnl.gov/home-improvement-expert/checklists/bathroom-exhaust-fan. Kitchen Exhaust Fan installation guidance: https://basc.pnnl.gov/ home-improvement-expert/checklists/kitchen-exhaust-fan

** FPR 10 and MPR 1500 are comparable to MERV 13

*** EPA air cleaner guidance: https://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home-0

**** Home air sealing guidance: https://basc.pnnl.gov/home-improvement-expert/checklists/home-air-sealing

Table 2. Guidance for Creating an Isolation Space	
Setup appropriate area for isolation space	1. When possible, the isolation space should have its own bathroom. 2. Independent heating and cooling is recommended. A portable room heater, portable air conditioner, or window air conditioner may be used if necessary. 3. If there is a central forced-air system that would mix air between the household and the isolation space, seal these grilles in the isolation space (e.g. with tape or magnetic covers).
Operate exhaust fan to depressurize the isolation space	1. Separate exhaust ventilation should be provided in the isolation space. 2. If the room has a bathroom with a fan, turn it on and leave doors open between the bathroom and isolation room. 3. If possible, install a fan in a window and make sure it draws air from the room and blows it outside. 4. Do not continuously operate exhaust fans that are outside the isolation space unless required to provide minimum ventilation rates. 5. Minimize use of openable windows elsewhere in the home.

Table 3. Guidance for Creating a Protected Space	
Setup appropriate area for protected space	1. When possible, the protected space should have its own bathroom. 2. Independent heating and cooling is recommended. A portable room heater, window air conditioner, or portable air conditioner may be necessary. 3. If there is a forced-air system that would mix air between the household and the protected space, seal the supply and return grilles that are in the protected space (e.g. with tape or magnetic covers). 4. Use a high efficiency room air cleaner in the protected space and follow EPA Guidance for selection and use.
Operate supply fan to pressurize the protected space	Separate fresh air ventilation should be provided in the protected space: 1. If the room already has a window air conditioner installed, use it in “outdoor supply” mode. 2. Otherwise install a window fan and ensure it draws outside air into the protected space. Window fans with air filters are preferred. 3. If the protected space includes a bathroom with an exhaust fan, that fan should only run when the bathroom is in use. 4. Continuously operate exhaust fans in common spaces/remainder of house. In a home with natural draft gas appliances, do not run ALL exhaust fans in your home at the same time unless your home has been tested by a home performance contractor to be safe under these operating conditions.

Table 4. Additional Guidance for Multi-Family Building Owners & Operators		
	Do Now (if you can)	**Plan to Do Later** (when safe, to lower risk during future epidemics)
Administrative Controls	1. Encourage residents to wear face masks or face shields, and to keep at least 6 ft. away from others when in common spaces. 2. Provide face masks or face shields for all staff members and contractors who serve the facility, and require that they wear them without exception when in proximity to others. 3. Post COVID-19 guidance in all common areas. Promote communication with and among building residents related to COVID-19 protection and management. 4. For detailed guidance regarding resident and staff safety, common rooms in your building, and preventing the spread of COVID-19, refer to the Centers for Disease Control and Prevention (CDC) "COVID-19 Guidance for Shared or Congregate Housing".	
Ensure proper operation of building venting systems	1. Inspect for and correct common deferred maintenance items. In particular, install clean filters for outdoor air intakes, check and adjust exhaust fan belt condition and tolerances. Refer to "HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic" at www.ashrae.org 2. Check/replace/fix all backflow dampers. 3. Check all plumbing stacks, vents, and drains. Run water in each sink/tub/shower and flush unused toilets to fill all plumbing traps and prevent sewer gas entry. 4. Ensure that common space ventilation systems are operating correctly and comply with ASHRAE 62.1. 5. Upgrade air filtration in both common areas and dwelling units in both ventilation and heating/cooling systems. 6. Open outdoor-air dampers as much as possible, while being mindful of the thermal comfort of residents.	1. Install deeper filter holders that can accommodate better filters without increasing operating costs. 2. Install or upgrade kitchen and bathroom exhaust and makeup air equipment ventilation systems.
Ensure proper operation of dwelling unit ventilation systems	Ensure that existing ventilation systems are maintained and operating properly.	1. Air-seal dwelling units to minimize contamination between adjacent dwelling units (<0.2 cfm per sq. ft. @ 50 Pa) 2. Upgrade ventilation systems to meet or exceed ASHRAE standards using good design practices such as described in the ASHRAE Design Guide for Low- and Mid-Rise Multifamily Residential Buildings[i].

Operate exhaust fan to depressurize units with infected residents	1. Provide exhaust ventilation separated from any central system for any unit with infected residents. 2. If possible, install a fan in a window and make sure it draws air from the room and blows it outside. If using a window air conditioner, open the ventilation damper. 3. Open windows should be minimized to avoid inflowing air that could push contaminated air to other units in the building through interior leakage paths. 4. Assist and guide the covering or sealing central system heating/cooling air vents in rooms to isolate dwelling units that have infected residents.	
Filtration	Install clean filters in ventilation and central heating/cooling systems in public areas and dwelling units. 1. Consider installing replacement filters rated at the highest efficiency compatible with the physical constraints of the filter rack and the air flow and pressure requirements of each system. The minimum filter efficiency should be MERV 13 (or ePM1 according to ISO16890, MPR 1900, or FPR-10). Used filters should be considered contaminated. Personnel should be properly protected and spent filters should be sealed in plastic bags for disposal. 2. Ensure that filters are installed to minimize air bypass around filter. 3. For further details, consult "HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic" at www.ashrae.org.	Consider permanent upgrade of central systems' fine particle filtration efficiency for public areas. The recommended minimum filter efficiency is MERV 13 (or ePM1 according to ISO16890, MPR 1900, or FPR-10). While many systems can accept MERV 13 filters without modification, consider upgrading the filtration system so that even better filters can be used. Some systems may have difficulties maintaining air flow and pressure requirements, even with MERV 13 and these systems should definitely be upgraded. Also consider changing the controls and equipment so that the filtration system can operate continuously, or at least a minimum amount of time per hour without using excessive energy.
Other measures	1. Place portable air cleaners (purifiers) in common spaces such as meeting rooms, laundry rooms, lobbies, exercise rooms, and elevators. Avoid the use of ozone-generating air-cleaning devices. Refer to "ASHRAE Position Document on Filtration and Air Cleaning". 2. Assist with covering or sealing heating/cooling air vents in rooms in dwelling units with higher-risk residents. 3. Open outdoor-air dampers as much as possible, while being mindful of the thermal comfort of residents. 4. Consider closing recirculation dampers to minimize or eliminate air transfer from one space to another. 5. Increase ventilation rates and run-times in elevators and other public spaces, if possible. In public toilet and laundry rooms, ensure that existing exhaust ventilation is operating continuously.	1. Install UL2998-listed UltraViolet Germicidal Irradiation (UVGI) in appropriate common areas. Follow manufacturer's operation instruction for appropriate protection of residents. Refer to "ASHRAE Position Document on Filtration and Air Cleaning" and 2019 ASHRAE Handbook – HVAC Applications, Chapter 62, Ultraviolet Air and Surface Treatment. 2. Install toilet lids on fixtures without them in public areas. Refer to

	6. Operate economizers while maintaining normal thermal comfort conditions. 7. Consider hiring an indoor air quality (IAQ) specialist to diagnose the IAQ in your building. 8. Operate UltraViolet Germicidal Irradiation (UVGI), if present. However, avoid operating UVGI devices that generate ozone. The "ASHRAE Position Document on Filtration and Air Cleaning" has more advice on this topic. Note that this only applies to UVGI systems installed in HVAC ducts or engineered ceiling-mounted systems. UVGI systems must be designed and installed by licensed professionals. Refer to "UV-C In-Duct Surface Disinfection" at www.ashrae.org. 9. Keep common corridors at a positive pressure relative to the dwelling units, when possible. This will reduce the likelihood of air in one dwelling unit transferring through the corridor to other units.	“Transmission through Air in Toilet Rooms” at www.ashrae.org.

It is important to note that in cases where an isolation room is created, it may be necessary to provide alternate sources of heating or cooling to maintain comfort.

Finally, it is important to note that this article is providing guidance. These actions do *not* guarantee any outcome—they simply reduce the risk of infection. Also, it is not necessary to follow all the guidance perfectly. Some recommendations may be difficult to follow in some homes. Instead, focus on doing the best you can in your home and in the homes of your clients in these difficult times.

For information about how to organize isolation spaces in homes, and other good information, see www.ASHRAE.org/covid19

"ASHRAE Position Document on Infectious Aerosols"
www.ashrae.org/about/position-documents