



Ventilation in Buildings

Updated June 2, 2021

Summary of Recent Changes

Updates as of June 2, 2021

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CDC recommends a layered approach to reduce exposures to SARS-CoV-2, the virus that causes COVID-19. This approach includes using multiple mitigation strategies, including improvements to building ventilation, to reduce the spread of disease and lower the risk of exposure. In addition to ventilation improvements, the layered approach includes [physical distancing](#), [wearing face masks](#), [hand hygiene](#), and [vaccination](#).

SARS-CoV-2 viral particles spread between people more readily indoors than outdoors. Indoors, the concentration of viral particles is often higher than outdoors, where even a light wind can rapidly reduce concentrations. When indoors, ventilation mitigation strategies can help reduce viral particle concentration. The lower the concentration, the less likely viral particles can be inhaled into the lungs (potentially lowering the inhaled dose); contact eyes, nose, and mouth; or fall out of the air to accumulate on surfaces. Protective ventilation practices and interventions can reduce the airborne concentrations and reduce the overall viral dose to occupants.

Reoccupying a building during the COVID-19 pandemic should not, in most cases, require new building ventilation systems. However, ventilation system upgrades or improvements can increase the delivery of clean air and dilute potential contaminants. Consult experienced heating, ventilation, and air conditioning (HVAC) professionals when considering changes to HVAC systems and equipment. Buildings that provided healthy, code-compliant indoor air quality prior to the pandemic can be improved for pandemic occupancy using less costly interventions. Below is a list of ventilation interventions that can help reduce the concentration of virus particles in the air. They represent a list of “tools in the mitigation toolbox,” each of which can contribute towards a reduction in risk. Implementing multiple tools at the same time is consistent with CDC’s layered approach and will increase overall effectiveness of ventilation interventions.

These ventilation interventions can reduce the risk of exposure to the virus and reduce the spread of disease, but they will not eliminate risk completely.

While the list of tools can be universally applied across indoor environments, applying them to different building types, occupancies, and activities under environmental and seasonal changes can be challenging. The specific combination of tools chosen for use at any point in time can change. It will be up to the building owner or operator (with expert consultation as needed) to identify which tools are appropriate for each building throughout the year. In addition to buildings, vehicles – including public transportation such as buses, subways, trains, school buses, carpools, and rideshares – are also areas where ventilation improvements can be applied to reduce the spread of the virus and lower the risk of exposure.

Tools to Improve Ventilation

Some of the following interventions are based on the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) [Guidance for Building Operations During the COVID-19 Pandemic pdf icon](#)[78 KB, 3 pages][external icon](#). Not all interventions will work in all scenarios. Use caution in highly polluted areas when increasing outdoor air ventilation.

The following tools identify ways to improve ventilation:

- Increase the introduction of outdoor air:
 - Open outdoor air dampers beyond minimum settings to reduce or eliminate HVAC air recirculation. In mild weather, this will not affect thermal comfort or humidity. However, this may be difficult to do in cold, hot, or humid weather, and may require consultation with an experienced HVAC professional.
 - Open windows and doors, when weather conditions allow, to increase outdoor air flow. Do not open windows and doors if doing so poses a safety or health risk (e.g., risk of falling, triggering asthma symptoms) to occupants in the building. Even a slightly open window can introduce beneficial outdoor air.
- Use fans to increase the effectiveness of open windows:
 - To safely achieve this, fan placement is important and will vary based on room configuration. Avoid placing fans in a way that could potentially cause contaminated air to flow directly from one person to another (see FAQ below on [indoor use of fans](#)). One helpful

strategy is to use a window fan, placed safely and securely in a window, to exhaust room air to the outdoors. This will help draw outdoor air into the room via other open windows and doors without generating strong room air currents. Similar results can be established in larger facilities using other fan systems, such as gable fans and roof ventilators.

- Ensure ventilation systems operate properly and provide acceptable indoor air quality for the current occupancy level for each space.
- Rebalance or adjust HVAC systems to increase total airflow to occupied spaces when possible.
- Turn off any demand-controlled ventilation (DCV) controls that reduce air supply based on occupancy or temperature during occupied hours. In homes and buildings where the HVAC fan operation can be controlled at the thermostat, set the fan to the “on” position instead of “auto,” which will operate the fan continuously, even when heating or air-conditioning is not required.
- Improve central air filtration:
 - [Increase air filtration external icon](#) to as high as possible without significantly reducing design airflow. Increased filtration efficiency is especially helpful when enhanced outdoor air delivery options are limited.
 - Make sure air filters are properly sized and within their recommended service life.
 - Inspect filter housing and racks to ensure appropriate filter fit and minimize air that flows around, instead of through, the filter.
- Ensure restroom exhaust fans are functional and operating at full capacity when the building is occupied.
- Inspect and maintain exhaust ventilation systems in areas such as kitchens, cooking areas, etc. Operate these systems any time these spaces are occupied. Operating them even when the specific space is not occupied will increase overall ventilation within the occupied building.
- Use portable high-efficiency particulate air (HEPA) fan/filtration systems to enhance air cleaning (especially in higher risk areas such as a nurse’s office or areas frequently inhabited by people with a higher likelihood of having COVID-19 and/or an increased risk of getting COVID-19). See the FAQ below on [HEPA filters and portable HEPA air cleaners](#). (Note: Portable air

cleaners that use filters less efficient than HEPA filters also exist and can contribute to room air cleaning. However, they should be clearly labeled as non-HEPA units.)

- Generate clean-to-less-clean air movement by evaluating and repositioning as necessary, the supply louvers, exhaust air grilles, and/or damper settings. See the FAQ below on [Directional Airflow](#). This recommendation is easier to accomplish when the supply and exhaust points are located in a ceiling grid system.
- Use [ultraviolet germicidal irradiation \(UVGI\)](#) as a supplemental treatment to inactivate SARS-CoV-2 when options for increasing room ventilation and filtration are limited. [Upper-room UVGI systems pdf icon](#)[6.1 MB, 87 pages] can be used to provide air cleaning within occupied spaces, and in-duct UVGI systems can help enhance air cleaning inside central ventilation systems.
- In non-residential settings, run the HVAC system at maximum outside airflow for 2 hours before and after the building is occupied.

The ventilation interventions listed above come with a range of initial costs and operating costs, which, along with risk assessment factors – such as community incidence rates, facemask compliance expectations and room occupant density – may affect the selection of tools. The following are examples of cost estimates for ventilation interventions:

- No cost: opening windows; inspecting and maintaining dedicated exhaust ventilation; disabling DCV controls; repositioning outdoor air dampers
- Less than \$100: using fans to increase effectiveness of open windows; repositioning supply/exhaust diffusers to create directional airflow
- \$500 (approximately): adding portable HEPA fan/filter systems
- \$1500 to \$2500 (approximately): adding upper room UVGI