

# Indoor Ventilation for Respiratory Infectious Diseases (RIDs)



## Introduction

Indoor ventilation is one of the most effective workplace control measures to protect people from respiratory infectious diseases, including workers, clients, and visitors. Good indoor ventilation benefits everyone in the workplace by decreasing the concentration of pathogens (germs) in the air.

People can become sick with respiratory infectious diseases from pathogens in contaminated air. These pathogens enter the air as respiratory particles when an infected person breathes, speaks, sings, shouts, coughs, or sneezes. The risk of becoming ill increases when individuals gather in enclosed spaces and are in close contact, like in workplaces.

This tip sheet gives information and advice on indoor ventilation in relation to respiratory infectious diseases. Employers can protect their workers and visitors by implementing multiple control measures in a layered approach. Refer to your local public health authority for ventilation requirements and guidance, particularly during a pandemic or similar serious public health occurrence.

## What is Ventilation?

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines ventilation as "the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space."

Ventilation can be natural or mechanical.

## Natural Ventilation

Natural ventilation occurs when air flows into and out of a space through open exterior windows and doors by cross ventilation (e.g., movement of wind into, through, and out the building).

The major advantages of natural ventilation are the simplicity and cost savings. Some disadvantages include a heavy reliance on favourable weather (wind and temperature) and outdoor air quality (air pollution and allergens). There is also no air filtration and little control of airflow direction.

## Mechanical Ventilation

Mechanical ventilation is when air is moved by motor-powered fans or blowers and can be in the form of general (dilution) or local exhaust ventilation (LEV). LEV is used at the source and while it can be useful in some workplaces where pathogens are handled (e.g., a fume hood in a research lab), it cannot be practically used in most workplaces to reduce respiratory infectious disease transmission.

General ventilation is used to reduce the concentration of contaminants in the air by diluting contaminated air with uncontaminated air. Outdoor air typically provides uncontaminated air unless it is more polluted than indoor air. Air can also be filtered and recycled via air re-circulation.

Mechanical ventilation is most often provided by Heating, Ventilation and Air Conditioning (HVAC) systems. Centralized ventilation systems (split, hybrid split, and packaged systems) have motor-driven fans or blowers that condition and circulate air throughout a space using ducts. HVAC systems must comply with local building codes and be appropriately designed according to the size and type of building. They require regular inspections and maintenance such as filter and parts replacement and keeping vents and fans clear. A properly functioning HVAC system will evenly distribute filtered air to all areas of a building at a comfortable temperature and humidity, while preventing areas of stale air from forming.

The makeup air in HVAC systems is comprised of a combination of outdoor and recycled indoor air. To prevent recirculating pathogens, outdoor air must be maximized, and the HVAC filters must be appropriate for the size of particles being filtered, and frequently maintained.

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Some HVAC systems recover energy by transferring heat between the air intake and exhaust streams in a heat exchanger. This does not impact the transmission of respiratory infectious diseases if the two air streams are separated (i.e., they do not mix). If the system does allow some exchange of the outdoor and exhaust air, filters of appropriate size should be used and frequently maintained. It is best to avoid exchanging of the intake and exhaust streams entirely whenever possible.

Decentralized ductless (mini split) ventilation systems do not have the issues associated with ducts. However, these systems do not bring in outdoor air and add no value to dilution ventilation.

Note that re-circulation of stale air within a space when using pedestal fans or ceiling fans is generally not recommended as a protective measure against respiratory infectious diseases when the fans may be blowing the air from one person to another.

## How Ventilation Impacts the Spread of Respiratory Infectious Diseases

- Ventilation dilutes the concentration of contaminants (e.g., viruses, bacteria) in the air by allowing clean outside air into a space and removing potentially contaminated air.
- The accumulation of pathogens in a space depends on:
  - Ventilation rate
  - Humidity
  - Air mixing patterns
  - Room size
  - Number of infected occupants and the amount of respiratory particles they are releasing
  - The type of activity (e.g., singing, speaking loudly, heavy breathing during exercise, etc.)
- Even in a properly ventilated space, respiratory infectious diseases can spread between people in close contact, particularly if public health measures and workplace controls are not followed.
- Large indoor gatherings or heavy exertion activities can cause respiratory particles to accumulate in the air faster than ventilation can dilute them. This effect is more pronounced in small spaces with less air volume.

## Maintenance, Equipment and Other Air Quality Considerations

- Ensure that ventilation systems are properly rated and configured for the layout of the space, type of activity, and maximum occupancy.
- Keep HVAC systems maintained according to manufacturer's recommendations, including using appropriate filters.
- Make sure that maintenance workers are properly trained and protected (e.g., maintenance workers should have appropriate personal protective equipment (PPE) and training for changing contaminated filters).
- Adjust air supply vents and fans to avoid air flowing directly from one person to another.
- If outside air is of low quality (e.g., contains allergens, smoke from wildfires, heavy smog, etc.), it may be necessary to minimize the outside air intake into a building or pre-filter the air as it enters the building.
- Inspect all drains regularly to make sure that all air sources from sanitary sewer systems are not leaking into interior spaces.
- Install lids on all toilet seats and keep the lids closed, particularly during flushing (to prevent the spread of particles that form during flushing).

## Improving Ventilation

Improving ventilation is one layer of protection for the occupants of a space. HVAC systems are complex; consult with an HVAC professional before making any changes.

- Upgrade HVAC system filters to the highest rated Minimum Efficiency Reporting Value (MERV) compatible with your ventilation system(s). Higher MERV ratings indicate better filtration.
- Consider using High Efficiency Particulate Air (HEPA) filters (if the HVAC system supports them) which can remove 99.97% of airborne particles (e.g., spores, bacteria) that are 0.3 microns in size.

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- Run ventilation systems continuously at low speed. Alternatively, run systems for 2 hours at maximum airflow before and after the space is occupied.
- Most ventilation systems recirculate some air. Adjusting the system to maximize outdoor air intake will provide more air dilution in a space.
- Some systems are designed to adjust ventilation according to occupation level such as demand control ventilation (DCV) or variable air volume (VAV). Bypass or reprogram these systems to provide continuous ventilation.
- Open windows and doors to allow outside air in, as weather permits and if it does not pose a safety risk to the occupants (e.g., risk of falling).
- Continuously run exhaust fans in washrooms and kitchens, even when the space is not occupied.

## Additional Considerations for Improving Indoor Air Quality

Consult an HVAC professional about upgrades designed to improve indoor air quality.

- Consider installing ventilation system upgrades such as ultraviolet germicidal irradiation (UVGI).
- Maintain indoor air humidity between 30-50%. Having indoor humidity in this range can decrease the time respiratory particles (which may contain viruses and bacteria) remain suspended in the air.
- The use of portable air cleaners with HEPA filters and a clean air delivery rate (CADR) large enough for the size of the room can be considered in areas with poor ventilation, or where natural or mechanical ventilation is not feasible.
- Circulating air within a space may help spread pathogens. Carefully evaluate all air circulating fans. Ensure that fans are positioned to blow inside air to the exterior and avoid placing fans that blow air from person to person.

## Protect Yourself and Others

- Avoid poorly ventilated spaces. Possible indicators of poor ventilation include:
  - Blocked or missing ventilation ducts
  - Dust or smoke in the air
  - Stuffy, humid air
  - Lingering odours
- Trust your senses: if you see or smell the air quality deteriorating in your surroundings seek fresh air and inform building management about your observations.
- Educate yourself about building ventilation using trusted sources of information (e.g., Health Canada, Public Health Agency of Canada (PHAC), Centers for Disease Control and Prevention (CDC), ASHRAE).
- Monitor air conditions in your workplace. If you notice that air circulation stops or it gets unusually hot, cold, or humid, notify your manager.
- Consider using carbon dioxide (CO<sub>2</sub>) monitors as a tool to track the air quality of an indoor space. High CO<sub>2</sub> levels usually indicate poor indoor air ventilation, and may require a response (e.g., opening a window, reducing the number of people in the space, relocating the activity outdoors or to a better ventilated space). Note that CO<sub>2</sub> levels alone do not reflect risk of respiratory infectious disease transmission.
- For work tasks of a hazardous nature, follow your existing job-specific PPE requirements, such as respiratory protection or other PPE.

For further information on respiratory infectious diseases, including COVID-19, refer to the [Public Health Agency of Canada](https://www.canada.ca/en/public-health/services/respiratory-infectious-diseases.html).

**Disclaimer:** As public and occupational health and safety information may continue to change, local public health authorities should be consulted for specific, regional guidance. This information is not intended to replace medical advice or legislated health and safety obligations. Although every effort is made to ensure the accuracy, currency, and completeness of the information, CCOHS does not guarantee, warrant, represent or undertake that the information provided is correct, accurate or current. CCOHS is not liable for any loss, claim, or demand arising directly or indirectly from any use or reliance upon the information.