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# COVID-19: Guidance on indoor ventilation during the pandemic

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## Preamble

The Public Health Agency of Canada (PHAC) has developed this guide to inform Canadians about how indoor ventilation, in combination with

other recommended public health measures, can reduce the spread of COVID-19. This guide also provides practical tips on how to improve indoor air, ventilation and filtration to help reduce the spread of COVID-19. While this guidance is intended to be used generally across indoor environments, its application will depend on:

- occupancy
- the type of building
- the type of activity undertaken in the indoor setting

Canadian public health guidance related to COVID-19 has evolved as our understanding of COVID-19 improves. We continually review the evidence as it's produced and work with our partners across the country and around the world. This ensures that we integrate the most up to date and highest quality information into our guidance.

## Key messages

The virus causing COVID-19 is known to spread through droplets and aerosols, which represent a risk particularly to people who are in:

- enclosed spaces
- indoor situations where people are in close proximity

The most important elements in reducing the risk of COVID-19 are preventive measures, such as:

- minimizing the number of persons in a place at the same time
- maintaining a physical distance of at least 2 metres
- using well-constructed, well-fitting masks
- practising good hand and respiratory hygiene

In addition to these practices, adequate ventilation can contribute to

reducing the risk of COVID-19 transmission in indoor settings. It's important to remember that good indoor ventilation alone cannot protect people from exposure to the virus, particularly:

- during close unprotected contact
- in the absence of other protective measures

We recommend the following actions to help protect you and others from COVID-19 infection in indoor settings.

## **Limit indoor gatherings**

Limit gatherings to your immediate household only. When interacting with those who do not live with you:

- do so outside when possible
- maintain physical distancing
- wear well-constructed and well-fitting masks
- consider changing your plans if inclement weather suddenly arises

Always check with your local public health authority on the specific advice for indoor gatherings for your location.

## **Open windows and doors**

You can improve natural ventilation by opening windows and doors to the outside:

- as weather permits
- if it does not pose a safety risk to occupants

## **Consult an HVAC professional**

If possible, consult a heating, ventilation and air conditioning (HVAC)

professional to determine whether your HVAC system:

- is suitable for the:
  - type of setting
  - type of activity
  - number of occupants
  - length of time the space is occupied
- is operating properly
- can be adjusted to increase air exchange rates if needed
- is using filters of the highest Minimum Efficiency Reporting Value (MERV) rating the system can sustain

## Consider avoiding the area

If fresh air input from mechanical ventilation is not adequate and natural ventilation isn't possible, consider avoiding the area and moving to a better-ventilated space. If this isn't possible, the use of portable air filtration devices with High Efficiency Particulate Air (HEPA) filters could be considered, if used in combination with established public health infection control measures. We recommend following the manufacturer's direction and, if possible, the advice of an experienced professional before installing these devices in your setting.

## Introduction

Coronavirus disease (COVID-19) is a respiratory illness caused by the SARS-CoV-2 virus. COVID-19 spreads from a person who is infected to others through respiratory particles created when an infected person:

- breathes
- talks

- sings
- shouts
- coughs
- sneezes

Your first line of defence against COVID-19 continues to be:

- reducing contact with persons outside your household
- interactions of short duration
- maintaining physical distancing
- proper use of well-fitting masks
- proper hand hygiene

Improving indoor air quality through increased ventilation is an additional step. Ventilation, whether through opening windows or the use of heating, ventilation, and air conditioning (HVAC) systems, can increase the amount of outside air brought inside. This will dilute the number of viral particles in the air, and help to reduce the risk of exposure.

## Transmission modes for COVID-19

SARS-CoV-2, the virus that causes COVID-19, spreads from a person who is infected to others through respiratory droplets and aerosols created when a person who is infected:

- breathes
- talks
- sings
- shouts
- coughs

- sneezes

The droplets vary in size from large droplets that fall to the ground rapidly near the person who is infected, to smaller droplets, sometimes called aerosols, which may linger in the air under some circumstances. Aerosols laden with infectious virus increase the risk of spreading COVID-19, particularly if a person stays within an enclosed indoor space with little air circulation for a long time. Thus, indoor air quality may play a role in COVID-19 transmission and other health conditions by affecting the concentration of pollutants, as well as viral and bacterial particles suspended in the air.

Infectious droplets or aerosols may:

- come into direct contact with the mucous membranes of a person's nose, mouth or eyes
- be inhaled into the nose, mouth, and airways, with smaller aerosols penetrating deeper into the lungs

The virus may also spread when a person touches another person (like a handshake) or the surface of an object (also referred to as a fomite) that has the virus on it, and then touches their mouth, nose or eyes with unwashed hands.

## Importance of the different transmission routes

Transmission may vary depending on multiple factors such as:

- age
- infectivity
- hand hygiene

- illness severity
- respiratory etiquette
- presence of symptoms
- how long people are congregating
- how close people are to each other
- proper use of well-constructed and well-fitting masks

This is why we recommend various public health measures to Canadians as a layered approach to prevent the spread of the virus. The most important are:

- reducing contacts outside of immediate household
- maintaining physical distancing
- wearing well-fitting masks

Other environmental factors can contribute to the risk of virus transmission. It's important to avoid:

- closed spaces
- crowded places
- close interactions such as close-range conversations
- settings where there is singing, shouting or heavy breathing (like aerobic exercise)

Proper ventilation should always be present in any setting. When indoors, good ventilation can decrease the concentration of aerosols that may be suspended in the air, helping reduce the chance of COVID-19 spread.

## Ventilation

In addition to other public health measures, ventilation has an important

role in reducing the transmission of COVID-19 indoors. Outbreaks have been linked to poor ventilation where the virus appears to have been transmitted through aerosol production from infected individuals that became concentrated in the air over time. It is important to note that adjusting ventilation is not likely to reduce transmission between individuals in close proximity. Individuals who are physically near a person who is infected remain at risk from both droplet and aerosol transmission. This is due to their close proximity to the infectious source. For this reason, it is important to:

- maintain physical distance from people you do not live with
- wear a well-constructed, well-fitting non-medical mask

Ventilating a room or indoor space replaces the indoor air with outdoor air. This will dilute and replace any air contaminated with SARS-CoV-2 virus or other air pollutants. Ventilation systems in non-residential settings (like office buildings) may recirculate air through the HVAC system. In this case, some of the indoor air is diluted with outdoor air and filtered before returning to the occupied space. The risk from recirculating the virus through a space serviced by a single HVAC unit is unknown. You can decrease the risk and improve your indoor air quality overall by:

- drawing air from outside
- making sure your filters are good quality

## **Influence of ventilation on risk of aerosol transmission**

If a person who is infected is in an indoor space, build-up of viral particles will depend on:



- how infectious the person is
- the activities the person undertakes
- the size of the space and its ventilation

The smaller the room, the faster the build-up of particles containing SARS-CoV-2 virus. In larger spaces, it may take longer for virus-containing aerosols to build up throughout the room. Good ventilation will:

- move outdoor air into the space
- dilute potentially contaminated air
- remove contaminated air through vents or open windows

In any size of room, close proximity can result in high-risk exposure, regardless of ventilation.

## **Impact of ventilation depends on activities and setting**

It's important to seek public health advice before undertaking indoor activities that potentially generate more infectious respiratory droplets or particles than more passive activities. Increased production of aerosols and droplets can be caused by:

- singing
- speaking loudly, or yelling
- heavy breathing when exercising

Limit or avoid these situations where possible. Ventilation systems in settings where these aerosol-generating activities take place may not dilute the air quickly enough to reduce the risk of spread.

## **Impact of crowd size on ventilation**

To reduce transmission of COVID-19 in indoor settings, it is important to ensure that occupancy is reduced to minimum levels. The likelihood that both an infected individual is present and that a higher number of people become infected increases:

- as the total number of occupants increases
- the closer together people are

Increased occupancy levels can greatly increase the probability of viral-laden droplet and aerosol exposure. When rooms are in use, maximum ventilation rates must be maintained regardless of the number of occupants.

## Improving ventilation

There are many ways to improve ventilation to mitigate the transmission of infectious diseases. The most appropriate measures depend on the characteristics of the particular setting. One way to improve ventilation is by opening exterior doors and windows for a few minutes, ideally with more than one open at a time.

Opening windows in winter may not always be comfortable or possible. Doing so for a few minutes at a time during the day can still improve air quality, with minimal impact on the indoor temperature. If occupants will be indoors for longer periods, for example at schools, occupants should have regular outdoor breaks, to allow for ventilation of the room.

An HVAC system will exchange indoor air a certain number of times per hour as a part of regular operation. To increase ventilation, run your HVAC system fan continuously at a low speed to provide air movement and filtration without unwanted draft. Within non-residential buildings,

run the system for 2 hours at maximum outside airflow before and after the building is occupied. Bathroom and kitchen exhaust fans that are vented to the outside can also be used to help remove potentially contaminated air, where appropriate.

Most HVAC systems will recirculate some air through the indoor space, making it important to:

- ensure that filters are well sealed without a bypass
- clean or change your filters regularly per manufacturer's recommendations
- select filters with higher MERV ratings that are more efficient at removing particles

This should be done within the specifications of your HVAC system and in consultation with an HVAC professional.

Portable or ceiling fans, or single unit air conditioners may circulate air within the room, but they do not exchange air or improve ventilation. If using a window air conditioner unit or a fan is necessary, aim the air stream away from people to reduce the spread of potentially infectious droplets or particles.

## Options if ventilation cannot be improved

When properly used, portable air filtration devices with high-efficiency particulate air (HEPA) filters have been shown to reduce the concentration of some viruses from the air. The use of these devices could be considered as an additional protection in situations where enhancing natural or mechanical ventilation is not possible and when physical distancing can be achieved.

It's important to note that the effectiveness of portable air filtration devices in reducing the transmission of the SARS-CoV-2 virus hasn't yet been demonstrated. As such, they should not be used alone or as replacement for adequate ventilation, physical distancing and hygienic measures. Whenever possible, consider the use of an alternative space, or preferably gathering outdoors rather than indoors, when interacting with people from outside your household.

To select the right air filtration device, it is important to consult an experienced professional to:

- assist in identifying ventilation needs
- explain the steps for proper maintenance
- ensure that the unit has a high enough clean air delivery rate and is installed properly

When in use, ensure that the air released by the device is not blown directly at individuals as it can increase the spread of droplets.

While humidifiers do not remove SARS-CoV-2 virus from the indoor air environment, they could impact the duration that particles that contain virus are suspended in the air. It is therefore important to maintain an optimal humidity level, between 30% and 50% in indoor settings.

Humidifiers can be:

- part of an existing HVAC system
- standalone units designed to maintain adequate humidity in a space
- used to add extra humidity to the air to help alleviate respiratory symptoms

Lower humidity levels can cause droplets to shrink, and smaller droplets can stay suspended in the air for longer. However, increasing humidity too much can lead to condensation on surfaces, as well as inside walls

and building areas where it cannot be seen. This can lead to mould growth and the proliferation of mites.

In spaces that are continuously used, like classrooms, windows and doors should be opened regularly where possible. The space should be cleared of people regularly to limit the potential build up of potentially infectious respiratory droplets or particles over time.

## Conclusion

Good ventilation includes:

- avoiding recirculating air
- increasing indoor/outdoor air exchange
- air filtration
- opening windows and doors (where possible)

This can help reduce spread of COVID-19 in indoor spaces by preventing the accumulation of droplets and aerosols indoors, but must be combined with other public health measures. We recognize that the ability of the general public to follow this guidance may be limited by various factors.

In addition to improving indoor ventilation, be sure to:

- limit indoor gatherings to members of your immediate household if possible
- when around people from outside your household:
  - maintain physical distancing of more than 2 metres from others
  - wear a well-constructed, well-fitting mask
- stay home and away from others if you are not feeling well
- continue to practise good respiratory and hand hygiene (like

washing your hands or using an alcohol-based hand sanitizer)

- clean and disinfect surfaces and objects regularly

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## Resources

### ASHRAE

- [Residential healthcare guidance on COVID-19 \(Residential Care Task Group\)](#)
- [Guidance for building operations during the COVID-19 pandemic](#)
- [Guidance for residential buildings](#)

### Canadian Agency for Drugs and Technologies

- [CADTH Technology Review: Heating, ventilation and air conditioning systems in public spaces](#)

### Canadian Committee on Indoor Air Quality

- [Addressing COVID-19 in buildings – module 15](#)

### Centers for Disease Control and Prevention (CDC)

- [Ventilation](#)

## **ECCDC**

- [Heating, ventilation and air-conditioning systems in the context of COVID-19: first update](#)

## **Environmental Protection Agency (USA)**

- [Indoor air in homes and coronavirus \(COVID-19\)](#)

## **Federal Environment Office, Germany**

- [Infectious aerosols in indoor spaces](#)

## **Federation of European Heating, Ventilation and Air Conditioning Associations**

- [REHVA COVID19 Guidance Version 4.0: How to operate HVAC and other building service systems to prevent the spread of the coronavirus \(SARS-CoV-2\) disease \(COVID-19\) in workplaces](#)

## **Health Canada**

- [Ventilation and the indoor environment](#)
- [Maintain and improve indoor air quality](#)
- [Addressing moisture and mould in your home](#)

## **Independent Scientific Advisory Group for Emergencies (SAGE)**

- [An urgent plan for safer schools](#)

## **Institut national de santé publique du Québec**

- [COVID-19 : Indoor environment](#)

## National Collaborating Centre for Environmental Health (NCCEH)

- [Air cleaning technologies for indoor spaces during the COVID-19 pandemic](#)
- [COVID-19 and outdoor safety: considerations for use of outdoor recreational spaces](#)
- [COVID-19 in indoor environments – air and surface disinfection measures](#)
- [COVID-19 Precautions for Multi-unit residential buildings](#)
- [High-humidity environments and the risk of COVID-19 transmission](#)
- [Role of heating, ventilation, and air conditioning systems in the public health response to COVID-19](#)
- [Role of ventilation in influencing COVID-19 transmission risk](#)

## Public Health Ontario

- [Evidence brief: humidifier use in health care](#)
- [COVID-19: Heating, ventilation and air conditioning \(HVAC\) systems in buildings](#)

## Scientific Advisory Group for Emergencies (UK)

- [Role of ventilation in controlling SARS-CoV-2 transmission \(30September 2020\)](#)
- [Potential application of air cleaning devices and personal decontamination to manage transmission of COVID-19 \(4November2020\)](#)

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