

FREQUENTLY ASKED QUESTIONS

Use of Portable Air Cleaners and Transmission of COVID-19

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Introduction

Public Health Ontario has received questions concerning the use of portable air cleaners as it relates to COVID-19 transmission in indoor environments, including: schools, medical clinics and dental offices. This document is intended to be a technical resource on the use of a portable air cleaner where it is considered as a supportive measure to improve indoor air quality.

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Summary

An overall risk mitigation strategy against COVID-19 transmission indoors includes public health measures (e.g., physical distancing, masking, cough and sneeze etiquette, cleaning and disinfection) and may be supported by indoor air quality improvement using ventilation and filtration. Portable air cleaners often provide localized (as opposed to central) filtration and can play a role in this strategy, particularly in areas where ventilation is inadequate. Although no direct scientific evidence was identified that demonstrates the effectiveness of portable air cleaners in reducing COVID-19 transmission, based on what we know, portable air cleaners equipped with a HEPA filter could remove COVID-19 virus particles from indoor air and potentially reduce exposure. Portable air cleaners should not be relied upon as the only mitigating measure where source control and ventilation are available.

Overall, strategies for indoor air quality improvement, even when optimal, will not eliminate the risk of COVID-19 transmission, particularly from close contact exposures.

Questions and Answers

Q1. What is the difference between ventilation and filtration?

Ventilation and filtration are important components to a multi-pronged strategy to exhaust or capture airborne particles, including virus-containing dust and aerosols.¹

Ventilation can be defined as the supply/distribution or removal of air from space by mechanical or natural means. The purpose of ventilation is to provide outdoor air while removing pollutants, humidity, and extra heat from occupied indoor spaces in an effort to meet health and/or comfort requirements.² Ventilation has been associated with infectious disease outcomes. A 2007 systematic review of 40 studies, conducted by a multidisciplinary panel, found an association between building ventilation and air movement within buildings, and the transmission of various infectious diseases, including tuberculosis, influenza, chickenpox, measles, smallpox, and SARS; however, evidence was lacking to support specific minimum ventilation requirements in hospitals and isolation rooms to mitigate against transmission of airborne infectious diseases. Similarly, no evidence was found to support specific ventilation requirements in offices, schools and other non-hospital environments.³

Mechanical filtration involves the use of different types of fibrous media designed to remove particles from the airstream. A portion of the particles in air entering a filter attach to the fibrous media and are removed from the air as it passes through the filter.⁴

Q2. What are portable air purifiers/cleaners and what is their intended use?

Various air purifying/cleaning technologies can either exist as part of a building's central heating, ventilation and air conditioning (HVAC) system or be portable. Portable units, which are the focus of this document, are available as large console and smaller tabletop devices and are intended for use in localized areas within a building, such as a single room.^{5,6,7}

Particles that may be found in an indoor environment include: particles from cooking, dust, particles from outdoor sources, smoke from cigarettes and other indoor combustion sources and biological contaminants (e.g., animal dander, dust mites, bacteria, viruses, pollen, fungal spores).⁵ There are no standard definitions of portable air purifying or cleaning devices. For the purpose of this document, portable air "purifiers" refer to an entire class of portable devices which may use technologies such as ultraviolet (UV) lamps, electrostatic precipitation (ESP), plasma air cleaners, ozone generators, and/or ion generators to remove particles and/or inactivate airborne pathogens.^{5,6,8} Portable air purifiers that utilize UV lamps (with wavelengths below 238nm), ESP, plasma air cleaners, ozone generators, and ion generators, may (unintentionally) generate ozone as a by-product of their operation. Although UV systems can be effective in central and upper-room configurations, there is limited evidence on effectiveness for UV in portable air purifiers.^{9,10} ASHRAE indicates that 'extreme caution is warranted' when using units that may produce significant ozone, a respiratory irritant, as a by-product of their operation.⁴ The US EPA and the ASHRAE recommend avoiding the use of portable units that intentionally produce ozone as a method of cleaning indoor air in occupied spaces due to human health concerns associated with exposure to ozone.^{4,5,6}

In this document, a portable air "cleaner" refers to a portable unit that does not produce ozone either intentionally or unintentionally as a by-product of its operation and relies on mechanical filtration to remove particles from the air. Portable air cleaners often have a high efficiency particulate air (HEPA) filter. A HEPA filter is a type of pleated mechanical filter. Under standard testing conditions, a certified

HEPA filter can remove dust, pollen, mold, bacteria and particles with a size of 0.3 μm with a minimum efficiency of 99.97%.^{4,5,6} Particles with a diameter of 0.3 μm represent the most penetrating size — both larger and smaller particles are trapped by the filter with even greater efficiencies.^{4,11} For a portable air cleaner to be effective at removing viruses from indoor air, the unit should have the ability to remove small airborne particles, in the range of 0.1 to 1 μm in diameter, although viruses may also be carried in larger droplets.¹²

Q3. What makes a good portable air cleaner?

The effectiveness of a portable air cleaner in reducing indoor particle concentrations is dependent on both its contaminant removal efficiency and air flow. The efficiency also varies with filter design and filter maintenance.⁴ The rate of airflow through the filter is also an important factor in performance.⁴ As an example, a perfectly efficient filter with very low air flow will have no impact on reducing indoor particle concentrations.

The product of contaminant removal efficiency and air flow is the clean air delivery rate (CADR). To effectively filter particles, it is important to select a portable air cleaner that has a CADR large enough for the size of the room or area in which it will be used.⁹ The higher the CADR, the more particles the air cleaner can filter, and the larger the area it can serve. Most portable air cleaner packaging will indicate the largest size area or room it should be used in. Portable air cleaners often achieve a high CADR by using a HEPA filter.^{5,13} If the area is larger than that specified for the available model, use of multiple air cleaners may be considered.⁵ The Association of Home Appliance Manufacturers (AHAM) provides the standard Method for Measuring Performance of Portable Household Electric Room Air Cleaners, AHAM AC-1 for CADR testing often used in the industry and has consumer information with a directory of devices that have been tested.^{14,15} If a CADR is not listed on the product label, consumers can request this and the testing details from the manufacturer prior to purchase.

Noise is also an important issue with many portable air cleaners, particularly when operating at higher airflow rates, because users may turn them off to avoid the noise. The CADR label on product packaging is typically the highest CADR achievable, which generally occurs at the highest airflow setting. At lower airflow settings, an air cleaner may have lower noise production, but it will also be less effective at pollutant removal. Since noise is seldom quantified or reported in a standardized manner on consumer packaging, it can be challenging to compare devices on the basis of noise rating.⁵ Consumer reviews may offer some information on noise production.

The frequency of air filter replacement should follow the manufacturer's recommendation. Saturation can affect air flow across the filter which in turn affects filter efficiency.¹⁶ Exposure to pollutants on the old filter should be minimized, e.g., from re-suspension during filter change. Maintenance and any performance testing should be carried out according to manufacturer's instructions.

Q4. Can portable air cleaners reduce the transmission of COVID-19 indoors?

COVID-19 is primarily transmitted during close unprotected contact.¹⁷ Transmission of COVID-19 via inhaled aerosols (i.e., smaller respiratory droplets and particles that may remain suspended in air and travel distances greater than 2 metres) has been documented; however, these events appear to be less common. Circumstances which have implicated this route usually involve an infectious individual generating respiratory droplets over an extended period of time within an enclosed space, often with inadequate ventilation, where individuals may have been exposed at the same time or shortly after the infected person had left the enclosed space.^{18,19,20,21}

Although no direct scientific evidence has demonstrated the effectiveness of portable air cleaners in reducing COVID-19 transmission, portable air cleaners equipped with a HEPA filter should be able to remove COVID-19 virus sized particles from indoor air which may contribute to a reduction in exposure and an overall improvement in indoor air quality. However, the precise role of HEPA filtration outside of a healthcare setting in preventing infectious diseases is unclear.²² The use of a portable air cleaner on its own (or other strategies to improve indoor air quality, e.g., ventilation) is not sufficient to protect individuals from COVID-19, particularly during close contact interactions. It is one supportive measure to improve indoor air quality and reduce transmission and is not a substitute for other public health measures, e.g., physical distancing, masking.^{5,23,24}

Q5. When could the use of a portable air cleaner be considered?

While not the dominant mode of transmission for COVID-19, measures to reduce aerosol transmission risk involve strategies to improve general indoor air quality. The most effective methods to improving indoor air quality are to remove or reduce indoor sources of pollutants and to ventilate with outdoor air.^{5,6} Air cleaning alone cannot ensure adequate indoor air quality and is generally less preferable to source control and/or ventilation, where available.

In the context of COVID-19 transmission, source control approaches may include screening and exclusion of symptomatic individuals, applying limits on the number of occupants within an enclosed space, physical distancing, and masking – however, none of these measures will eliminate transmission risk. Ventilation can also contribute to reducing overall risk, and can be optimized to varying degrees depending on the system.²⁵ If these methods are insufficient or cannot be achieved, the use of a portable air cleaner can be considered. In addition, the use of portable air cleaners to complement existing HVAC filtration and ventilation in schools, offices, and commercial buildings may be considered particularly in areas where sufficient ventilation is difficult to achieve. Portable air cleaners are not intended for building-wide application but rather localized areas such as a single room.^{5,6,24} Directing air flow from a portable unit such that the air does not directly blow from one individual to another will help reduce the potential spread of respiratory droplets.¹²

Q6. What factors should be considered when placing the portable unit within the space?

In addition to the factors discussed in Question 3, placement in the room should take into account air intake (position and height) and outflow to ensure unobstructed airflow, e.g., from furniture, curtains and room corners.²⁶ Air cleaners tend to perform best when they are positioned in a central space²⁷, however manufacturer's instructions on placement and operation should be followed. While many portable units are designed to be placed on the floor, some may be designed for tabletops. Elevating air cleaners (e.g., on a stool) can help prevent re-suspension of droplets from the tabletop surface or floor if the outflow for the filter points downwards.

Improperly placed devices may simply continue to recirculate the same volume of air. Therefore, while these devices suggest a certain volume of cleaned air every minute, this is only true if the air pulled in by the unit has not already been cleaned.²⁶ Some portable units may also generate strong air currents and care should be taken to ensure that they do not create strong air flows directly between individuals.²⁶

If there is localized production of respiratory aerosols, placement of the air purifier to capture these aerosols (near breathing zones) may enhance effectiveness.²³

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