

## FREQUENTLY ASKED QUESTIONS

# Use of Portable Air Cleaners and Transmission of COVID-19

1<sup>st</sup> Revision: July 2022

## Introduction

This document is a practical resource on using portable air cleaners as a measure to improve indoor air quality.

## Key Highlights

- Control measures applied together in a layered approach are necessary to mitigate SARS-CoV-2 transmission risk. These include vaccination, appropriate self-isolation, wearing a well-fitted mask, physical distancing, and hand hygiene, as well as indoor air quality improvements using ventilation and/or filtration.
- Source control and outdoor air ventilation and filtration are important strategies to improve indoor air quality. In addition, portable air cleaners equipped with a high efficiency particulate air (HEPA) filter or a filter with a minimum efficiency rating value (MERV) of  $\geq 13$  can reduce SARS-CoV-2 aerosol exposure over time, helping to limit the risk of aerosol transmission.
- Improvements to indoor air quality is a component of a multi-layer strategy to mitigate but not eliminate SARS-CoV-2 transmission. No strategy on its own is sufficient to protect individuals fully from SARS-CoV-2, particularly during close contact interactions.

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## **Q1. What are portable air cleaners and what is their intended use?**

Various air cleaning technologies can either exist as part of a building's central heating, ventilation and air conditioning (HVAC) system or be portable freestanding units. In this document, a portable air cleaner refers to a portable unit that relies on mechanical filtration alone to remove particles from the air. Portable units 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.<sup>1-4</sup>

## **Q2. What makes a good portable air cleaner?**

There are several factors to consider when choosing a good portable air cleaner including filtration, clean air delivery rate (CADR), the potential for other hazards and noise.

Viral particles generated by humans are typically contained in respiratory particles that can be larger in size but typically less than 5  $\mu\text{m}$  in diameter.<sup>5</sup> For a portable air cleaner to be effective at removing viruses from indoor air, the filter should have the ability to remove small airborne particles, in the range of 0.1 to 1  $\mu\text{m}$  in diameter.<sup>5-7</sup> 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  $\mu\text{m}$  with a minimum efficiency of 99.97%.<sup>1,3,8</sup> Particles with a diameter of 0.3  $\mu\text{m}$  represent the most penetrating size with respect to filtration — both larger and smaller particles are trapped by the filter with even greater efficiencies.<sup>8,9</sup> Although not as efficient as HEPA filters, filters with a minimum efficiency reporting value (MERV)  $\geq 13$  are efficient at capturing particles in this size range. Filters with a MERV of 13 can remove  $\geq 85\%$  of particles that are 1-3  $\mu\text{m}$  in diameter. ASHRAE recommends that portable air cleaners be equipped with a HEPA filter or a filter with a MERV  $\geq 13$ .<sup>4,10</sup>

A portable air cleaner that relies on mechanical filtration alone to remove particles from the air is least likely to pose other hazards. For example, some commercially available units may use ultraviolet irradiation, ozone generation, ion generators, or other technologies. These technologies may pose a health hazard to building occupants and provide little added benefit to air cleaning.<sup>1,4,8,10,11</sup> Many of these technologies have been designated as emerging technologies that lack an established body of evidence supporting their efficacy under intended use conditions.<sup>4</sup>

The CADR is used by manufacturers to rate air cleaner performance (see Q5). The higher the CADR, the more particles the air cleaner can filter, and the larger the area it can serve.<sup>1,11</sup> The CADR should be high enough for the area in which it will be used.<sup>5,11</sup>

Noise is also an important consideration with many portable air cleaners, particularly when operating at higher air flow 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 air flow setting. At lower air flow settings, an air cleaner may produce less noise, but it will also be less effective at particle 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.<sup>1,11</sup> Consumer reviews may offer some information on noise production.

Considering all the above factors, it should be noted that maintenance and filter changes should follow the manufacturer's instructions. Ensure good fit of filters in the frame so there is no leakage of air around the filter unit.

### **Q3. How do portable air cleaners affect the transmission of COVID-19 indoors?**

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is transmitted from an infectious person (source or case) to a susceptible person (receptor or contact) across a spectrum of respiratory particle sizes and distances. Infectious respiratory particles are inhaled by individuals or deposited on mucosal surfaces. Evidence supports increased SARS-CoV-2 transmission risk the closer the contact is from the case, with prolonged and unprotected contact; as well, inadequate ventilation, activities that increase expulsion of aerosols (e.g., shouting, exercising) and lack of masking for source control are risk factors.<sup>12</sup>

Portable air cleaners equipped with a HEPA filter (or a filter with a MERV  $\geq$  13) can remove SARS-CoV-2 virus sized particles from indoor air.<sup>5,7,10</sup> Used alone or in combination with existing ventilation systems, they can reduce the concentration of SARS-CoV-2 viral particles in indoor air over time and therefore reduce viral aerosol exposure and help to limit the risk of aerosol transmission.<sup>13-18</sup>

Control measures applied together in a layered approach are necessary to mitigate SARS-CoV-2 transmission risk. These include vaccination, appropriate self-isolation, wearing a well-fitted mask, physical distancing, and hand hygiene, as well as indoor air quality improvements using outdoor air ventilation and/or filtration.<sup>12</sup> The use of a portable air cleaner is one component of a multi-layered strategy to mitigate SARS-CoV-2 transmission and is not a substitute for other public health measures, e.g., physical distancing, masking.<sup>1,7,14,19</sup> No strategy on its own is sufficient to protect individuals fully from SARS-CoV-2, particularly during close contact interactions.

### **Q4. When could the use of a portable air cleaner be considered?**

In the context of SARS-CoV-2 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 – none of which will eliminate transmission risk. Ventilation with outdoor air can be optimized to varying degrees depending on the system to remove and dilute indoor air.<sup>9,10</sup>

A portable air cleaner with an appropriate filter can also be used to clean indoor air and reduce viral concentrations over time, especially if filtration and ventilation with outdoor air are insufficient or cannot be achieved.<sup>5</sup> In addition, the use of portable air cleaners to complement existing HVAC filtration and ventilation can be considered in settings such as schools, offices, and commercial buildings, particularly in areas where sufficient ventilation is difficult to achieve.<sup>13-17</sup> Portable air cleaners are not intended for building-wide application but rather localized areas such as a single room.<sup>1,2,7</sup>

### **Q5. What should be considered when sizing a portable air cleaner for a space?**

The effectiveness of a portable air cleaner in reducing indoor particle concentrations is dependent on both its contaminant removal efficiency and air flow. As an example, a perfectly efficient filter with very low air flow will have no impact on reducing indoor particle concentrations.<sup>4,8</sup>

The CADR rating system is used by manufacturers to rate air cleaner performance. The CADR is the product of the contaminant removal efficiency and air flow rate across the filter.<sup>1</sup> The CADR is a measure of the volume of filtered air delivered by an air cleaner per unit time, with separate ratings for dust, pollen and tobacco smoke.<sup>20</sup> Of these, tobacco smoke contains the smallest sized particles and the CADR for smoke is most applicable to viral particles related to COVID-19.<sup>5</sup> The CADR, often expressed in cubic feet per minute (cfm) or cubic metres per hour (m<sup>3</sup>/hr), is a recognized performance standard defined by the Association of Home Appliance Manufacturers (AHAM).<sup>5,21,22</sup>

To select a portable air cleaner, the CADR should be high enough for the size of the room or area in which it will be used.<sup>5,11</sup> The higher the CADR, the more particles the air cleaner can filter, and the larger the area it can serve. Portable air cleaners often achieve a high CADR by using a HEPA filter.<sup>1,7</sup> The CADR and the maximum recommended room size for the unit is often stated on the packaging, the unit itself and/or the manufacturer's manual.<sup>5,21</sup> If only the CADR is stated, select a portable unit that has a CADR for smoke that is at least two-thirds of the room's floor area.<sup>2,5,20</sup> If the area is larger than that specified for the available model, use of multiple air cleaners can be considered.<sup>1,11</sup> The American Society of Heating, Refrigerating and Air-Conditioning Engineers ([ASHRAE](#)), the United States Environmental Protection Agency ([US EPA](#)) and [AHAM](#) provide guidance on selecting the correct sized portable air cleaner for a space.<sup>4,5,21</sup> AHAM also provides the standard Method for Measuring Performance of Portable Household Electric Room Air Cleaners (ANSI/AHAM AC-1-2020) and has consumer information with a directory of devices that have been tested.<sup>21,23</sup>

#### **Q6. What are Corsi-Rosenthal boxes?**

There have been reports of people constructing Corsi-Rosenthal boxes in an effort to remove SARS-CoV-2 virus sized particles and improve indoor air quality.<sup>24</sup> Corsi-Rosenthal boxes are do-it-yourself (DIY) air cleaners that have purported benefits of being a low cost option with estimated performance ratings similar to commercially available portable air cleaners. The DIY Corsi-Rosenthal boxes (using MERV 13 filters) have been reported in non-peer-reviewed reports to achieve similar CADR estimates to commercial HEPA portable air cleaners.<sup>25,26</sup> Some DIY air cleaners were able to achieve similar CADR estimates due to the greater air flow across the MERV 13 filters relative to the air flow of the portable HEPA unit used for comparison.<sup>26</sup> Rosenthal states that filter efficiency (e.g., HEPA versus MERV 13) is only one component to determining air cleaner effectiveness – rather, it is a combination of filter efficiency, filter fit and air flow.<sup>26</sup> The US EPA has also observed that DIY air cleaners can have performance ratings comparable to some commercial portable air cleaners as it applies to removing wood smoke from indoor air, but also notes the limited research and variability of designs.<sup>5,27</sup> The main drawback of DIY Corsi-Rosenthal boxes is the variation in the quality of materials used and build quality (e.g., check for seal and air flow) which may affect efficacy, though they appear to work well with proper construction and materials.

#### **Q7. What should be considered when placing a portable air cleaner in a room ?**

In addition to the factors discussed in Question 2, placement in the room should take into account air intake (position and height) and outflow to ensure unobstructed air flow, e.g., from furniture, curtains and room corners.<sup>28</sup> The intent is to ensure that as much of the room air volume flows through the filter before it is returned to the room. Placing the portable air cleaner closer to the centre of the room and away from any objects that may block air flow will help to maximize the amount of room air that the portable air cleaner can filter.<sup>21,29</sup> However, the manufacturer's instructions on placement and operation should be followed. If there is localized production of respiratory aerosols, placement of the air purifier to capture these aerosols (near breathing zones) may enhance effectiveness.<sup>22,30</sup> 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.<sup>5,28,31</sup>

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