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Reducing the risk of Covid-19 transmission through the use of air purifiers

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Indoor environments increase the risk of transmission for the virus that causes Covid-19 (SARS-CoV-2) by containment and concentration of the airborne virus. However, to reduce such transmission, the particles that carry the virus can be diluted by bringing in as much outdoor air as possible. When good ventilation is not possible, air purifiers can be used as an additional preventative measure to reduce the number of virus-laden particles. Ventilation and purification of indoor air needs to be used alongside public health measures, such as vaccination, staying home when unwell and mask use. This blog outlines some basic principles of using air purifiers to reduce the risk of Covid-19 transmission.

Examples of air purifiers (source Mark Jermy)

Indoor spaces with low levels of ventilation are high-risk settings for Covid-19 transmission, as an infected person can breathe out virus particles which spread through the air.[1] The most effective way to remove these particles is by replacing the contaminated indoor air with as much clean outdoor air as possible, as we recently reported. The Centers for Disease Control and Prevention (CDC) recommend that to reduce the risk of Covid-19 transmission, carbon dioxide (CO_2) levels, which are used as a proxy measurement for ventilation, should stay below 800 ppm. If it is not possible to achieve these levels that represent adequate ventilation, cleaning the air with the use of an air purifier will give additional protection.[2]

Portable air purifiers (also called air filters or air cleaners) contain a fan that pushes air through a filter, which traps pollutants that pass through them. If the filter is effective, it will collect most of the virus-bearing particles, leaving the air free of these particles.[3] Air purifiers suitable to use in a living room, bedroom, small office, or work breakroom can be bought for around $300-$1000. Schools in Victoria, Australia have recently purchased 51,000 portable air purifiers to be installed into schools to reduce the risk of Covid-19 transmission.

To work effectively, air purifiers need to be placed so that they can process as much of the air in the room as possible.[4] If there is more than one person in the room, they should be

left on continuously, allowing up to an hour to filter the room, depending on the size of the room. Air purifiers should be used at their highest fan speed, which will mean they make some noise, similar to that of a desk fan.

The best place to position a portable air purifier ideally is:

- Roughly in the centre of the room
- At table top height
- At least a metre from walls, curtains or furniture
- Away from open windows (so they are not filtering the already relatively clean air from outside, or blowing the cleaned air out of the room)

Users should avoid placing the air purifier in areas where people are likely to walk and take care of electrical cords, which should be taped down to carpets or floors if they cross passage-ways.

When choosing an air purifier, users should consider the filtration performance and the flow. Many of the exhaled particles which can carry SARS-CoV-2 are microscopic. It is best to choose a filter that is High-Efficiency Particulate Arresting (HEPA) to H13 level or better. True HEPA filters should have been tested to reach the official HEPA standard. H13 filters remove 99.97% of particles down to 0.3 microns in size. Some filters are advertised as "HEPA like", which does not guarantee their ability to filter small particles. As portable air purifiers are unable to clean all of the air in a room at the same time, a lower standard of filter (E10 or MERV 13) is acceptable. Such a filter will remove at least 75% of the virus-bearing particles with each pass of air through the unit.

Air purifier adverts often give a clean air delivery rate (CADR).[4] This is the volume of clean air blown out of the device each hour and is usually given in cubic metres per hour, or cubic feet per hour. The CADR number should be two to four times the volume of the relevant room. More than one air purifier in a room can be used to add up to enough CADR.[5] If more than one air purifier is used, they should be placed with at least a couple of metres of space between them (otherwise they might largely just be cleaning the same air twice).

Many portable air purifiers have an ioniser as well as the filter. The health effects of ionizers are not yet clear. Given this, if an air purifier with an ionizer has been purchased, we recommend switching the ionizer off. The fan and filter can continue to run normally. We also don't recommend the use of electrostatic precipitators in rooms with people present.

Cleaning the air in larger buildings

In buildings that have mechanical ventilation, such as heating, ventilation and air conditioning (HVAC) units, additional systems and filters can usually be fitted. Most ventilation ducts have filters, but these might only be good enough to filter large objects, such as leaves. Fitting systems that recirculate air (rather than bring in outdoor air) with additional filters may be worthwhile, provided the system has a powerful enough fan to blow air through the thicker filter. As with the portable air purifiers, any additional filter should be MERV-13 or HEPA H13 rated.

Ultraviolet (UV) sterilizers for air (also called germicidal UV, UV germicidal irradiation, GUV or UVGI) can inactivate the viruses in air. Despite the term "germicidal irradiation", these systems do not produce the ionizing radiation that is a danger with radioactive materials. The only radiation they produce is UV light. UV systems can be fitted to the ducts of

mechanical ventilation systems to sterilise recirculated air. Companies that specialise in heating, ventilating and air conditioning (HVAC) can supply and fit these units. The cost is likely to be $20,000-$200,000 (it varies with complexity of the duct system) for a space where there are 20 people or more.

Alternatively, and sometimes less expensive, UV lamps can be mounted high on walls, shining across the room rather down onto people. This type of system is called an upper room UV and are often used within hospitals. If properly installed, these systems are very safe.[6] There are also systems that use UV to sterilise surfaces, such as benchtops or equipment. These are better suited to environments such as laboratories where infectious materials are handled regularly. Extra care is required with these systems so that people are not exposed directly to the UV light. Just as with portable air cleaners, we don't recommend the use of ionizers or electrostatic precipitators, or any system which directly exposes people to UV light.

Air purification alone is not enough to fully protect people from Covid-19 transmission, mainly because purification units/systems are not able to clean the entire room's air, at the same time. However, when used alongside other public health measures, including vaccination, staying home when unwell, ventilation, and mask wearing, air purification can be part of a plan to reduce the potential for indoor airborne transmission of Covid-19.

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Notes

5. For example, if the floor area of a room measures 4 metres x 5 metres, the floor is 4×5=20 square metres. If the ceiling is 3 metres high, the room volume is 20 x 3=60 cubic metres. If an air cleaner has a CADR of 300 cubic metres per hour, it will give

300/60=5 extra air changes per hour. This is in addition to the air changes that the ventilation system makes, which is usually at least 1-2 air changes per hour, so this room now has 6-7 air changes per hour, which is good. A room twice this size could have two air cleaners. If CADR is stated in cubic metres per hour, make sure your room volume is also measured in cubic metres. If CADR is stated in cubic feet per hour, either convert it to cubic metres per hour, or measure the relevant room volume in cubic feet.

6. If properly installed by a good company, these indoor systems have almost no risk of causing skin cancer. This is because the lamps and reflectors are installed so that they only shine through the upper air, and not into the places where people work. Also, the damaging UV in ultraviolet light is UV-B and the steriliser systems use UV-C, which is a different set of wavelengths, and which does not reach through to sensitive parts of the skin.

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