

# The Efficacy of Portable Air Purifiers in the Reduction of COVID-19 Transmission

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Our world plunged into a new set of uncomfortable norms in 2020. Mere months ago, life for much of the planet chugged along at its customary monotonous pace. Then, without forewarning, an insidious health threat thrust upon us. COVID-19, colloquial for SARS-CoV-2, is a novel coronavirus that originated in China in late 2019. It quickly burned around the globe like a dry brush fire. Not since a hundred years ago has humanity confronted mask wearing and social distancing in efforts to prevent suffering on a pandemic scale.

A single COVID-19 viral particle is extremely small at 0.06 microns. This pure form of COVID-19 is not found outside a laboratory and would not survive even if it made its way into the environment. Instead, SARS-CoV-2, when expelled by infected human hosts, is encapsulated by mucus material. Hosts shed airborne viral particles in two modalities: droplets and aerosols. Droplets are about 1 micron while aerosols approximate 0.5 microns. Millions of viral droplets and aerosols are sloughed-off by talking, laughing, coughing, sneezing, singing or simply by breathing. A single sneeze can eject 200 million COVID-19 particles into the air.

Portable air purifiers provide a potent tool in the fight to reduce the spread of COVID-19. The selection and deployment of an appropriate purifier are instrumental in lessening airborne viral droplets and aerosols. Advanced purification units can sterilize air as well as trap pathogens. This best-of-both-worlds approach to disease prevention is vitally important.

## HEPA Filtration

An air purifier must have a medical-grade HEPA filter if the goal is trapping airborne pathogens. HEPA filters remove 99.97% of particles down to 0.3 microns in size. HEPA has different levels. The H-values of HEPA range from H10 through H14. Medical-grade HEPA is H13 or higher and provides filtration efficiencies of 99.95% of 0.1 micron-size particles per liter of air. As a result, medical-grade HEPA is highly effective in COVID-19 droplet and aerosol elimination.

## Clear Air Delivery Rate

Clean Air Delivery Rate (CADR) is a critical metric of a purifier's ability to remove particles of a given size and is measured in Cubic Feet per Minute (CFM.) This drastically differs from a CFM metric alone. CFM as a standalone value demonstrates only the volume of air moved through a system without regard to particle removal. CADR is a compulsory and precise method of comparing air purifiers in a standardized manner. Choosing a purifier with the highest CADR is always preferable. Experts recommend devices with a CADR that moves the total air volume of a room through the purifier 5 to 6 times per hour.

## Air Sterilization

As described, air purifiers that sterilize air as well as trap pathogens are a best-of-both-worlds approach to disease prevention. Solely relying upon medical-grade HEPA filtration is a half-measure. A COVID-19 infected individual could expel billions of viral particles in the air in just 20 minutes. At medical-grade filtration efficiencies, 99.95% of viral particles are trapped on the first pass. However, this allows for small but infectious amounts of pathogens to be redistributed into the air. Air sterilization degrades or destroys active pathogens that are not trapped by the HEPA filter stage.

## Ultraviolet Light

Ultraviolet Light (UV) is a powerful sterilization strategy. UV is used in medical settings worldwide for this purpose. While utilizing UV in a purifier is advantageous, selecting a device with UV in 254 nm wavelength is paramount. UV outside of this wavelength can excite oxygen into creating harmful ozone molecules consisting of 3 oxygen atoms. Cutting-edge air purifiers have 254 nm UV bulbs formulated with doped quartz. Such doping precludes secondary harmonic UV wavelengths from radiating from the bulb. UV is an invaluable element of air decontamination if ensured UV is 254 nm and doped bulbs are utilized.

## Photocatalysis

Some air purifiers employ photocatalytic Titanium Dioxide (TiO<sub>2</sub>) membranes to complement their UV. The resulting photocatalysis dramatically enhances the sanitizing effects of UV alone. A TiO<sub>2</sub> photocatalytic reaction under UV radiation provides additional disinfection pathways in addition to UV directly acting upon pathogens. Thus, both direct UV and photocatalysis provide exceedingly effective methods of microorganism degradation and destruction.

## Other Technologies

Other technologies are found in purifiers, such as sophisticated filters to thwart VOC/TVOC compounds and negative ion generation. Negative ions have antibacterial properties, including marked reductions of acinetobacter transmission. Also, negative ions have the beneficial capacity to precipitate airborne PM1.0 and PM2.5 particulate matter, which are impurities that affects health.

With the COVID-19 age upon us, portable air purifiers provide enormously powerful weapons in protecting the health of persons inside enclosed spaces. Air purification coupled with other air quality measures -- such as ensuring a suitable amount of outside air exchange, air agitation with fans and upgrading existing HVAC filters with MERV-13 -- present an effective and comprehensive approach to health and safety.

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