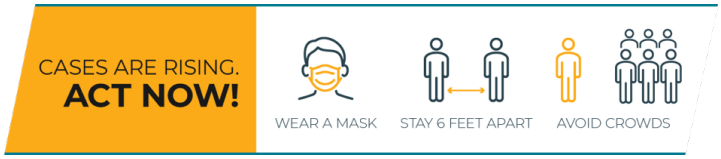
COVID-19 (Coronavirus Disease)



Ventilation in Buildings

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CDC recommends a layered strategy to reduce exposures to SARS-CoV-2, the virus that causes COVID-19. This includes using multiple mitigation strategies with several layers of safeguards to reduce the spread of disease and lower the risk of exposure. While it may not be necessary to apply every consideration to be protective, implementing multiple mitigation strategies is recommended, if possible, to improve effectiveness. In addition to ventilation, the layered approach includes efforts to improve social distancing, wearing face masks, and hand hygiene.

SARS-CoV-2 viral particles spread between people more readily indoors than outdoors. When outdoors, the concentration of viral particles rapidly reduces with the wind, even a very light wind. When indoors, ventilation mitigation strategies help to offset the absence of natural wind and reduce the concentration of viral particles in the indoor air. The lower the concentration, the less likely some of those viral particles can be inhaled into your lungs; contact your eyes, nose, and mouth; or fall out of the air to accumulate on surfaces. Protective ventilation practices and interventions can reduce the airborne concentration, which reduces the overall viral dose to occupants.

Below is a list of ventilation interventions that can help reduce the concentration of virus particles in the air, such as SARS-CoV-2. They represent a list of "tools in the mitigation toolbox," each of which can be effective on their own. Implementing multiple tools at the same time is consistent with CDC mitigation strategies and increases overall effectiveness. These ventilation interventions can reduce the risk of exposure to the virus and reduce the spread of disease, but they will not eliminate risk completely.

While the list of tools is intended to be universally applicable across indoor environments, applying them to different building types, occupancies, and activities under environmental and seasonal changes can be challenging. The specific combination of tools chosen for use at any point in time can change. It will be up to the building owner/operator (obtaining expert consultation as needed) to identify which tools are appropriate for each building throughout the year.

Considerations to Improve Ventilation

Consider ventilation system upgrades or improvements and other steps to increase the delivery of clean air and dilute potential contaminants. Obtain consultation from experienced Heating, Ventilation and Air Conditioning (HVAC) professionals when

experienced Heating, Ventilation and Air-Conditioning (HVAC) professionals when considering changes to HVAC systems and equipment. Some of the recommendations below are based on Guidance for Building Operations During the COVID-19 Pandemic from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). In addition to buildings, ventilation considerations are also important when you have multiple persons within vehicles, including public transportation (buses, subways, trains, school buses, carpools, and rideshares). Not all considerations are applicable for all scenarios.

Ventilation improvements may include some or all of the following considerations:

- Increase outdoor air ventilation, using caution in highly polluted areas.
- When weather conditions allow, increase fresh outdoor air by opening windows and doors. Do not open windows and doors if doing so poses a safety or health risk (e.g., risk of falling, triggering asthma symptoms) to occupants in the building.
- Use fans to increase the effectiveness of open windows. To safely achieve this, fan placement is important and will vary based on room configuration. Avoid placing fans in a way that could potentially cause contaminated air to flow directly from one person over another. One helpful strategy is to use a window fan, placed safely and securely in a window, to exhaust room air to the outdoors. This will help draw fresh air into room via other open windows and doors without generating strong room air currents.
- Decrease occupancy in areas where outdoor ventilation cannot be increased.
- Ensure ventilation systems operate properly and provide acceptable indoor air quality for the current occupancy level for each space.
- Increase airflow to occupied spaces when possible.
- Turn off any demand-controlled ventilation (DCV) controls that reduce air supply based on occupancy or temperature during occupied hours. In homes and buildings where the HVAC fan operation can be controlled at the thermostat, set the fan to the “on” position instead of “auto,” which will operate the fan continuously, even when heating or air-conditioning is not required.
- Open outdoor air dampers beyond minimum settings to reduce or eliminate HVAC air recirculation. In mild weather, this will not affect thermal comfort or humidity. However, this may be difficult to do in cold, hot, or humid weather.
- Improve central air filtration:
  - Increase air filtration to as high as possible without significantly reducing design airflow.
  - Inspect filter housing and racks to ensure appropriate filter fit and check for ways to minimize filter bypass.
  - Check filters to ensure they are within their service life and appropriately installed.
- Ensure restroom exhaust fans are functional and operating at full capacity when the building is occupied.
- Inspect and maintain local exhaust ventilation in areas such as kitchens, cooking areas, etc. Operate these systems any time these spaces are occupied.

Consider operating these systems, even when the specific space is not occupied, to increase overall ventilation within the occupied building.

- Consider portable high-efficiency particulate air (HEPA) fan/filtration systems to help enhance air cleaning (especially in higher risk areas such as a nurse's office or areas frequently inhabited by persons with higher likelihood of COVID-19 and/or increased risk of getting COVID-19).
- Generate clean-to-less-clean air movement by re-evaluating the positioning of supply and exhaust air diffusers and/or dampers (especially in higher risk areas).
- Consider using ultraviolet germicidal irradiation (UVGI) as a supplement to help inactivate SARS-CoV-2, especially if options for increasing room ventilation are limited. Upper-room UVGI systems can be used to provide air cleaning within occupied spaces, and in-duct UVGI systems can help enhance air cleaning inside central ventilation systems.

*Note: The ventilation intervention considerations listed above come with a range of initial costs and operating costs which, along with risk assessment parameters such as community incidence rates, facemask compliance expectations and room occupant density, may affect considerations for which interventions are implemented. Cost estimates per room for the listed ventilation interventions in cost. Here are some examples:

In non-residential settings, consider running the HVAC system at maximum outside airflow for 2 hours before and after the building is occupied.

- No cost: opening windows; inspecting and maintaining local exhaust ventilation; disabling DCV controls; or repositioning outdoor air dampers
- Less than $100: using fans to increase effectiveness of open windows; or repositioning supply/exhaust diffusers to create directional airflow
- $500 (approximately): adding portable HEPA fan/filter systems
- $1500 (approximately): adding upper room UVGI

Ventilation FAQs

Can COVID-19 be transmitted through HVAC (ventilation) systems?

The risk of spreading the virus that causes coronavirus disease 2019 (COVID-19) through ventilation systems is not well-known at this time. Viral RNA has reportedly been found on return air grilles, in return air ducts, and on heating, ventilation, and air conditioning (HVAC) filters, but detecting viral RNA alone does not imply that the captured virus was capable of transmitting disease. One research group reported that the use of a new air-sampling method allowed them to find viable viral particles within a COVID-19 patient's hospital room with good ventilation, filtration and ultraviolet (UV) disinfection (at distances as far as 16 feet from the patient). However, the concentration of viable virus detected was believed to be too low to cause disease transmission. There may be some implications for HVAC systems associated with these findings, but it is too early to conclude that with certainty. While airflows within a particular space may help spread disease among people in that space, there is no evidence to date that viable virus has been transmitted through an HVAC system to result in disease transmission to people in other spaces served by the same system.

Healthcare facilities have ventilation requirements in place to help prevent and control infectious diseases that are associated with healthcare environments. For more information, see the CDC Guidelines for Environmental Infection Control in Health-Care Facilities.

Non-healthcare (businesses and schools) building owners and managers should maintain building ventilation systems according to state/local building codes and applicable guidelines. Ensuring appropriate outdoor air and ventilation rates is a practical step building owners and managers can take to ensure good indoor air quality.

How long will it take to dilute the concentration of infectious particles in a room once they are generated?

While large droplets (100 micrometers [μm] and larger) will settle to surrounding surfaces within seconds, smaller particles can stay suspended in the air for much longer. It can take several minutes for particles 10 μm in size to settle, while particles 5 μm and smaller may not settle for hours or even days. Dilution ventilation and particle filtration are commonly used to remove these smaller particles from the air. Larger particles can also be removed using these strategies, but since they fall out of the air quickly, they might not have a chance to get captured by filtration systems. The time required to remove airborne particles from a space can be estimated once the source of infectious particles is no longer present and the dilution air is free of new infectious particles (e.g. it is uncontaminated supply air or it is the clean exhaust from a High Efficiency Particulate Air (HEPA) fan/filtration system [See HEPA filtration discussion below]). Table B.1 in the CDC's Guidelines for Environmental Infection Control in Health-Care Facilities (2003) provides estimates of the time required to remove airborne

contaminants, including airborne viral particles, from the air through ventilation dilution, exhaust and filtration. The table provides estimates of the time required for airborne-contaminant removal based upon the room's ventilation rate, measured in air changes per hour (ACH) and the desired removal efficiency (99% or 99.9%).

Although there are some highly contagious airborne diseases (like measles) where CDC provides specific guidance for 99.9% clearance wait times, the general recommendation in CDC's Guidelines for Environmental Infection Control in Health-Care Facilities is to wait to allow for a 99% reduction of any generated airborne particles before re-entering the room. In the absence of specific guidance specifying a longer wait period for the virus that causes COVID-19, SARS-CoV-2, the wait time associated with 99% clearance is appropriate for healthcare and other spaces. Regardless of whether the 99% or 99.9% column on Table B.1 is used, the value in the table is usually an under-estimation of the actual dilution clearance time as noted in the table's footnotes which include the following statement: "The times given assume perfect mixing of the air within the space (i.e., mixing factor = 1). However, perfect mixing usually does not occur. Removal times will be longer in rooms or areas with imperfect mixing or air stagnation." Appropriate use of Table B.1 to establish clearance times from any space requires multiplying the time in the table by a mixing factor (k) that ranges between 1 and 10. This factor represents how well the ventilation system mixes and dilutes the concentration of airborne particles within the room. As a rule of thumb, rooms with higher airflow rates (6 ACH and higher) and good placement of supply and exhaust grilles (hospital airborne infection isolation rooms) are considered to have "good" mixing and thus a mixing factor of k = 3 is often used for these spaces. In that case, the time identified from Table B.1 should be multiplied by 3 in order to determine the actual clearance time prior to re-entry. Nonventilated or poorly ventilated spaces have typical values of k ranging from 8 to 10. Increased ACH generally leads to reductions in k, although k can also be reduced by the use of a fan in the space, which does not have an impact on ACH. Ultimately, wait times can be reduced by increasing ACH, reducing k, or a combination of both.

Example 1: A room measuring 12 feet x 10 feet with a ceiling height of 9 feet is served with a 100% outdoor air ventilation system that delivers 65 cubic feet per minute (cfm) of supply air (Q_s = 65 cfm) and exhausts 72 cfm of air from the room (Q_e = 72 cfm). The room has average air mixing, so assign k = 5. How much time is required to reduce the airborne particle concentration by 99 percent?

Since Q_e is larger than Q_s by 7 cfm, the heating, ventilation, and air conditioning (HVAC) system is pulling 7 cfm of air into the room from adjacent areas (i.e., the room is under negative pressure). For this example, the 7 cfm of transfer air is assumed to be free of infectious airborne particles. The clean volumetric air flow rate (Q) is the larger value between Q_s and Q_e, so Q = 72 cfm. Now, calculate the air changes per hour:

ACH = [Q x 60] / (room volume) = (72 cfm x 60) / (12' x 10' x 9') = 4320/1080 = 4.0 ACH

Using Table B.1 the perfect mixing wait time based on 4 ACH and a 99% reduction of airborne particles is 69 minutes.

Using the mixing factor of 5, the estimated wait time for 99% reduction of airborne contaminants in the room is 5 x 69 = 345 minutes or 5 hours and 45 minutes.

Note: Determining the true value of the mixing factor is difficult and requires special equipment to measure air flows and conduct tracer gas decay testing. Thus, conservative estimates of k are often used (as described above). Also, the addition of an air cleaning device (e.g., a portable HEPA filtration unit) within the same room will reduce the wait time. The flow rate from the air cleaning device can be added to Q determined above, which will increase the overall ACH in the room. The air movement created by the air cleaning device can also decrease the value of k. Together, the increased ACH and decreased k can help substantially reduce wait times. See Example 2 for more information, including an example of the calculations.

Can ventilation filters effectively capture SARS-CoV-2 viral particles?

Filters for use in heating, ventilation, and air conditioning (HVAC) systems are generally tested under procedures outlined in ANSI/ASHRAE Standard 52.2-2017-Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. To access the standard, the end user typically must purchase it, but ASHRAE, which is a global society focused on building systems, indoor air quality, and sustainability in the built environment, has made it available for free online viewing during the ongoing pandemic. Based on the filtration efficiency determined by the testing procedures, filters are assigned a Minimum Efficiency Reporting Value (MERV). The MERV provides a measure of the "filter efficiency" over the range of particle sizes prescribed in the test procedure. MERV values range from 1 to 16 and higher MERV values correspond to more efficient filters.

Research shows that the particle size of SARS-CoV-2, the virus that causes COVID-19, is around 0.1 micrometer (µm). However, the virus generally does not travel through the air by itself. These viral particles are human-generated, so the virus is trapped in respiratory droplets and droplet nuclei (dried respiratory droplets) that are larger than an individual virus. Most of the respiratory droplets and particles exhaled during talking, singing, breathing, and coughing are less than 5 µm in size. CDC recommends using the highest efficiency ventilation filters possible, without having detrimental effects on overall HVAC system performance. ASHRAE, has similar guidance, however, they recommend a minimum filtration efficiency target of MERV 13, provided there are not substantial negative impacts on the HVAC system performance and occupant comfort. A MERV 13 filter is at least 50% efficient at capturing particles in the 0.3 µm to 1.0 µm size range and 85% efficient at capturing particles in the 1 µm to 3 µm size range. Collectively these particles are capable of remaining airborne for hours and are most associated with deep lung penetration. A MERV 14 filter is at least 75% and 90% efficient, respectively, at capturing those same particles. Efficiencies for MERV 15 and MERV 16 filters are

even higher. Thus, the recommended filters are significantly more efficient at capturing particles of concern than a typical MERV 8 filter, which is only around 20% efficient in the 1 µm to 3 µm size range and is not rated for capture efficiency of the smaller 0.3 µm to 1.0 µm particles.

Increasing filtration efficiency can increase the pressure drop across the filters. This can lead to increased fan energy, reduced airflow rates, and/or issues controlling indoor temperature and relative humidity levels. Scientific developments in filter design have reduced the amount of the increased pressure drop and its resulting impact on HVAC operations, but not all filters have adopted the newer technology. Prior to a filtration upgrade, the specific filter under consideration should be investigated for its pressure drop ratings at the flow rate(s) of intended use and the potential impacts of that pressure drop evaluated against the capabilities of the existing HVAC system.

High-efficiency particulate air (HEPA) filters are even more efficient at filtering human-generated infectious particles than MERV 16 filters. However, outside of a few unique applications, HEPA filters are rarely used in central HVAC systems. [See the question on Portable HEPA Filtration to learn more about them and their application in protective air cleaning].

What is meant by “directional airflow?” How and where should we use it?

Directional Airflow is a protective ventilation concept where air movement flows in a clean-to-less-clean direction. This ventilation concept is applied to areas where the “clean” environment requires a higher level of protection and/or where the “less-clean” environment has a higher risk of containing airborne contaminants (activities or occupancy by individuals with a higher risk of being infectious). Examples of “clean” spaces might include healthcare facility triage stations or rooms/corridors adjacent to higher risk activities. Examples of “less-clean” spaces might include spaces that contain known/suspect infectious persons or spaces where a known activity has increased likelihood of generating infectious airborne particles.

The creation of directional airflow can be accomplished within a particular space or between two adjacent spaces. This can be done passively, through intentional placement of supply and exhaust heating, ventilation, and air conditioning (HVAC) grills or by the intentional creation of pressure differentials between adjacent spaces through specification of offset exhaust and supply air flow rates. Creation of the directional airflow can also be done actively, through the use of fans exhausting through open windows, strategic placement of ductwork attached to portable HEPA filtration units, or dedicated exhaust systems (installed or portable) that generate a desired airflow by exhausting air out of windows, doorways, or through temporary ducts. In specific settings, specialized local control ventilation interventions that establish the desired airflow directions can also be used (see the NIOSH Ventilated Headboard).

Directional airflows must be evaluated carefully. Testing of the directional airflow effectiveness can be accomplished using visual tracer techniques that use “smoke tubes” or handheld “fog generators.” Other tools, such electronic monitors or visual aids to monitor pressure differences can be used when directional airflow is established between two adjacent spaces. To reduce the potential for directing airflow from infectious towards non-infectious space occupants, it is important that the “clean” and “less-clean” space determinations be established using infection control risk assessment considerations.

What is a HEPA filter and why would I want to use a portable HEPA air cleaner?

Research shows that the particle size of SARS-CoV-2, the virus that causes COVID-19, is around 0.1 micrometer (µm). However, the virus generally does not travel through the air by itself. These viral particles are human-generated, so the virus is trapped in respiratory droplets and droplet nuclei (dried respiratory droplets) that are larger. Most of the respiratory droplets and particles exhaled during talking, singing, breathing, and coughing are less than 5 µm in size. By definition, a High Efficiency Particulate Air (HEPA) filter is at least 99.97% efficient at capturing

particles 0.3 μm in size. This 0.3 μm particle approximates the most penetrating particle size (MPPS) through the filter. HEPA filters are even more efficient at capturing particles larger **and** smaller than the MPPS. Thus, HEPA filters are no less than 99.97% efficient at capturing human-generated viral particles associated with SARS-CoV-2.

Portable HEPA filtration units that combine a HEPA filter with a powered fan system are a great option for auxiliary air cleaning, especially in higher risk settings such as health clinics, medical testing locations, workout rooms, or public waiting areas. Other settings that could benefit from portable HEPA filtration can be identified using typical risk assessment parameters, such as community incidence rates, facemask compliance expectations and room occupant density. In choosing a portable HEPA unit, you want to select a system that is appropriately sized for the area in which it is installed. One way to do this for room air cleaners is to select a HEPA fan system with a Clean Air Delivery Rate (CADR) [See EPA's Guide To Air Cleaners In The Home] that meets or exceeds the square footage of the room in which it will be used. The larger the CADR, the faster it will clean the room air. If the room in which the air cleaner will be used is taller than 8 feet, choose an air cleaner with a proportionally higher CADR than that based simply on square footage. While these systems do not bring in outdoor dilution air, they are very effective at cleaning air within spaces to reduce the concentration of airborne particulates, including SARS-CoV-2 viral particles. Thus, they give effective air exchanges without the need for conditioning outdoor air.

HEPA fan systems can be used as stand-alone units, or many larger units allow flexible ductwork to be attached to the air inlet and/or outlet (note that larger ducted units don't fall under the "room air cleaner" description and may not have a CADR rating). Using ductwork and placing the HEPA system strategically in the space can help provide desired clean-to-less-clean airflow patterns where needed. Ducted HEPA systems can also be used to establish direct source capture interventions for patient treatment and /or testing scenarios (See CDC/NIOSH discussion on Ventilated Headboard). Depending on the size of the HEPA fan/filter units and how the facility in which they are being used is configured, multiple small portable HEPA units deployed to high risk areas may be more useful than one large HEPA unit serving a combined space.

Example 2: The room described in Example 1 is now augmented with a portable HEPA air cleaning device with a CADR of 145 cfm (Q_{hepa} = 145 cfm). The added air movement within the room improves overall mixing, so assign k = 3. How much time is saved to achieve the same 99% reduction in airborne contaminants by adding the portable HEPA device to the room?

The addition of the HEPA filter device provides additional clean air to the room. Here, the clean volumetric air flow rate (Q) is: $Q = Q_e + Q_{hepa}$ = 72 cfm + 145 cfm = 217 cfm.

ACH = [Q x 60] / (room volume) = (217 cfm x 60) / (12' x 10' x 9') = 13,020/1080 = 12.06 ACH (round down to 12).

Using Table B.1, the perfect mixing wait time based on 12 ACH and a 99% reduction of airborne particles is 23 minutes.

Using the mixing factor of 3, the estimated wait time for 99% reduction of airborne contaminants in the room is 3 x 23 = 69 minutes. Thus, the increased ACH and lower k value associated with the portable HEPA filtration unit reduced the wait time from the original 5 hours and 45 minutes to only 1 hour and 9 minutes, saving a total of 4 hours and 36 minutes before the room can be safely reoccupied.

In conclusion, adding the portable HEPA unit increased the effective ventilation rate and improved room air mixing, resulting in an 80% reduction in time for the room to be cleared of potentially-infectious airborne particles.

Does germicidal ultraviolet (GUV) disinfection kill the virus that causes COVID-19?

Yes.

Germicidal Ultraviolet (GUV), or Ultraviolet Germicidal Irradiation (UVGI), is a disinfection tool used in many different settings, such as residential, commercial, educational, and healthcare. The technology uses ultraviolet (UV) energy to inactivate (kill) microorganisms, including viruses, when designed and installed correctly.

There is still a lot to learn about SARS-CoV-2, the virus that causes COVID-19, and the possibility of airborne viral particles and spread. However, GUV can inactivate viruses in the air and on surfaces*. The design and sizing of effective GUV disinfection systems requires specific knowledge and experience.

Be sure to seek consultation with a reputable GUV manufacturer or an experienced GUV system designer prior to installing GUV systems. These professionals can assist by doing necessary calculations, making fixture selections, properly installing the system, and testing for proper operation specific to the setting.

*Note: CDC's recommendation for primary surface disinfection in occupied environments is to follow the CDC/EPA guidance for surface disinfection.

What are types of germicidal ultraviolet (GUV) for cleaning and disinfection in the workplace?

- **Upper-room GUV**
  Upper-room (or upper-air) GUV uses specially designed GUV fixtures mounted on walls or ceilings to create a disinfection zone of ultraviolet (UV) energy that is focused up and away from people. These fixtures disinfect air

as it circulates from mechanical ventilation, ceiling fans, or natural air movement. The advantage of upper-room GUV is that it disinfects the air closer to and above people who are in the room. Since the 1980s, GUV systems have been widely used for control of tuberculosis (TB). The CDC guidance Environmental Control for Tuberculosis: Basic Upper-Room Ultraviolet Germicidal Irradiation Guidelines for Healthcare Settings provides information on appropriate GUV system design, related safe operation, and maintenance. Based on data from other human coronaviruses, a GUV system designed to protect against the spread of TB should be effective at inactivating SARS-CoV-2, the virus that causes COVID-19, and therefore prevent spread. GUV systems usually require a few GUV fixtures to be effective. For example, a rectangular-shaped waiting room with 10–30 occupants will require 2–3 upper-air GUV fixtures. Of note, the potential for reflection of UV energy into the lower occupied space is a potential safety concern with upper-room GUV systems. However, a reputable GUV manufacturer or an experienced GUV system designer should know the precautionary techniques to prevent harmful UV exposures to people in the space. [**Potential Application:** Can be used in any indoor environment; most useful in spaces highly occupied with people who are or may be sick.]

- **In-Duct GUV**
  In-duct GUV systems are installed within a heating, ventilation, and air-conditioning (HVAC) system. These systems are designed to serve one of two purposes:
  - **Coil treatment GUV** keeps HVAC coils, drain pans, and wetted surfaces free of microbial growth. These devices produce relatively low levels of UV energy. This energy is continually delivered 24 hours a day, which is why they are effective. Coil treatment GUV devices are not designed for disinfecting the air and should not be installed for the purpose of air disinfection. [**Potential Application:** Can be used to reduce HVAC maintenance and improve operational efficiency within large, commercial HVAC systems or residential HVAC systems; not recommended for inactivating airborne pathogens.]
  - **Air disinfection GUV** systems can be effective at inactivating airborne pathogens as they flow within the HVAC duct. HVAC air disinfection GUV systems generally require more powerful UV lamps or a greater number of lamps, or both, to provide the necessary GUV required to inactivate pathogens in a short period of time. Air disinfection systems are often placed downstream of the HVAC coils. This location keeps the coil, drain pan, and wetted surfaces free of microbial growth and also disinfects the moving air. [**Potential Application:** Can be used inside any HVAC system to disinfect infectious airborne pathogens.]
- **Far-UV (or Far-UVC)**
  Far-UV is one of many emerging technologies that have become popular during the COVID-19 pandemic. While standard GUV fixtures emit UV energy at a wavelength around 254 nanometers (nm), far-UV devices use different lamps to emit UV energy at a wavelength around 222 nm. Aside from the wavelength, a major difference between the two technologies is that standard GUV systems are specifically designed to avoid exposing people to

the UV energy, while many far-UV devices are marketed as safe for exposing people and their direct environment to UV energy. A review of peer-reviewed literature indicates that far-UV wavelengths can effectively inactivate microorganisms, including human coronaviruses, when appropriate UV doses are applied. Questions remain about the mechanisms of killing microorganisms and overall safety. Far-UV might prove to be effective at disinfecting air and surfaces, without some of the safety precautions required for standard GUV. Far-UV devices are best viewed as new and emerging technology. [**Potential Application**: Yet to be determined.] Consumers considering an emerging technology such as Far-UV can research the proposed system. Ask the vendor to provide proof of effectiveness and performance that demonstrates a clear protective benefit. Engage with a ventilation engineer, and if the engineer recommends installing such a system, obtain a guarantee as to expected disinfection performance. When evaluating evidence of system effectiveness, place emphasis on research publications over anecdotal claims and consider the following questions:

- Are there independent studies that prove the desired performance of the technology?
- Did the study environments represent your environment and intended use?
- Have performance results been published in a scientific or medical journal?
- Was the technology evaluated for potential adverse health effects or occupational exposures?
- Where is the technology being used?

Many new air disinfection devices are being marketed for their ability to inactivate the virus that causes COVID-19. How can I tell if they work as advertised?

CDC does not provide recommendations for, or against, any manufacturer or product. There are numerous devices being heavily marketed to provide air cleaning during the ongoing COVID-19 pandemic. Some of the most common are ionization and/or dry hydrogen peroxide devices. Some devices even include both technologies. While variations of these technologies have been around for decades, relative to other air cleaning or disinfection technologies, they have a less-documented track record when it comes to cleaning/disinfecting large and fast volumes of moving air within heating, ventilation, and air conditioning (HVAC) systems or even inside individual rooms. This does not necessarily imply the technologies do not work as advertised. However, in the absence of an established body of peer-reviewed evidence showing proven efficacy and safety under as-used conditions, the technologies are still considered by many to be “emerging.” As with all emerging technologies, consumers are encouraged to exercise caution and to do their homework. Consumers should research the technology, attempting to match any specific claims against the intended use of the product. Consumers should request testing data that quantitively demonstrates a clear protective benefit and occupant safety under conditions consistent with the intended use. Preferably, the documented performance data under as-used conditions should be available from multiple sources, some of which should be independent, third party sources. Unsubstantiated claims of performance or limited case studies with only one device in one room and no reference controls should be questioned. At a minimum, if you are considering the acquisition and use of these devices, you will want to be sure the equipment meets UL 867 standard certification (Standard for Electrostatic Air Cleaners) for production of acceptable levels of ozone, or preferably UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners) which is intended to validate that no ozone is produced.

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