Devices for disinfecting surfaces and air

Many new devices that make claims to disinfect have entered the market in the past decade. Manufacturers are required by the EPA to document that their product does what it claims to do. If a device manufacturer makes false or misleading claims, this is illegal. But, there is very little published research on many of these devices. There is a need for both more research by independent scientists on devices and better oversight by the EPA of devices and their manufacturers' disinfection claims.

Since they do not have an EPA registration number, these disinfection devices may not satisfy state child care licensing regulations for disinfection. They are not a 'hospital grade disinfectant.' The laws haven't kept up with the technology.

Many scientists are voicing concerns about the "unintended chemical consequences" of the chemical by-products created by many of these devices. These by-products may have health effects. We recommend only considering devices that have had thorough evaluations by scientists who do not work for the manufacturers. If you decide to use a device that makes disinfection claims, you will need to review the manufacturer's efficacy data and any research done by independent scientists, then decide whether the device will work for your purposes.

The EPA does not:

- license devices the way it does chemical disinfectants (which are registered pesticides).
- require device producers to submit any data to the EPA concerning either safety or efficacy of a device prior to distribution or sale.

The EPA does not require that devices for disinfection ("pesticidal devices") be registered (like chemical disinfectants), but devices must be produced in registered pesticide-producing establishments and must meet certain labeling requirements; for example, an establishment number is required on the label. Even if manufacturers prominently display their establishment number, this is not an indication of safety, effectiveness or EPA approval of the product. The establishment number is simply a way for the EPA to know how many establishments are producing pesticide products and devices and in what numbers.

Until we know more, it is best to:

- use surface disinfectants with safer active ingredients.
- apply in a way least likely to cause these chemicals to become gases in the air: with a microfiber cloth (unless the product label requires spraying directly on the surface). Always use the stream option on a sprayer rather than the spray or mist option to reduce breathable aerosols in the air.

Some of these devices include:

Steam cleaners These devices can be used on many surfaces, including bathroom fixtures, floors and countertops, carpeting, and upholstery. **Dry vapor steam cleaners** use super-heated low moisture steam – no chemicals – for disinfecting, sanitizing, and cleaning surfaces.

The benefits of water-based devices include reduced exposure to hazardous chemicals for children, staff and the environment, reduced cost and reduced staff time for education, as well as purchasing, storing and disposing of chemicals. They are very effective and approved for food contact as well as other surfaces including carpets and upholstery. They are one of the most effective ways to remove bacteria that have formed a biofilm (see Curriculum for more information on biofilm) and are also effective against mold. They are able to disinfect hard to reach surfaces. One example of a steam cleaner, the TANCS Steam Vapor System, effectively kills a broad range of microorganisms within 3 to 5 seconds. This is both asserted by the manufacturer and verified by independent researchers such as the Toxics Use Reduction Institute.

Electrolyzed water These devices use a variety of capsules or tablets that contain an acid and a salt which is mixed inside the device and electrolyzed. One of these devices uses salt and vinegar as the active ingredients. This creates a hypochlorous acid solution. While Green Seal has certified one electrolyzed water device that produces hypochlorous acid that meets their health, safety and performance standards, some scientists have raised concerns that hypochlorous acid can evaporate out of a solution and exist as a gas. As a gas, it reacts with other chemicals in the indoor environment, producing chemical by-products. Some are harmful to human health. More research needs to be done on these chemical by-products of gaseous forms of disinfectant chemicals before we can really know their effects on human health.

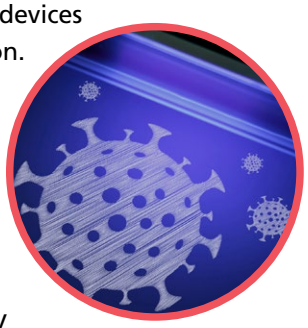
Electrostatic sprayers (ESs) create an electrical charge on disinfectants as they pass through a sprayer nozzle. These charged droplets repel one another and are attracted to neutral surfaces, which they stick to on all sides. The result is a uniform coating of disinfectant on sprayed objects, including areas that are hard-to-reach with manually applied disinfectants, or where gravity makes adherence of liquid products difficult. There are many problems with ESs,

including that very few products are approved for use with ESs, and many of the products that are approved use harmful active ingredients such as QUATS. Spraying of surfaces is often indiscriminate and can lead to exposure to unsafe disinfectants on surfaces (including children's backpacks, toys, furniture etc.) as well as airborne exposure. It is unclear how long electrostatically sprayed disinfectants can remain in the air, and likely is related to the building ventilation. We don't yet know what the unintended consequences are of sending an electric current through these chemical disinfectants and then spraying them indoors. Finally, ESs are often marketed as a faster alternative for disinfection, but you still have to clean the surfaces first in order to achieve adequate disinfection. This is a fact that is often overlooked when describing the advantages of all sprayers. For these reasons, ESs that use harmful disinfectant chemicals should be avoided. Even those using chemical disinfectants from Design for the Environment's list of safer disinfectants that are also on List N and approved for use in ESs should only be considered cautiously, with attention to issues such as a cleaning plan, protective equipment for the worker and ventilation of the space.

At a minimum, the following PPE should be worn while using an electrostatic sprayer:

- Protective clothing: disposable gown, Tyvek coveralls or lab coat
- Chemical goggles (non-vented)
- Face shield (if splash or spray to face possible)
- Disposable gloves (nitrile ≥ 5 mil)
- Respiratory protection

Liquid ozone is created by introducing an extra oxygen atom to an oxygen molecule and water molecules. The contact time to kill salmonella and E.coli is 30 seconds. There is no residue for these devices so rinsing is not necessary. It is being tested for effectiveness against SARS CoV-2. It is Green Seal certified to meet their health, safety and performance standards. Do not spray liquid ozone in the air. If ozone vaporizes and becomes a gas it is harmful to human health. Health effects of gaseous ozone include respiratory symptoms, reduced lung function, and airway inflammation. People with asthma are especially susceptible to gaseous ozone exposure. Given the potential for liquid ozone to vaporize, these devices are not considered a safer option.



UV Light has been used to disinfect the air for many years in hospitals. It must be done when the room is unoccupied. UV light can cause cancer, damage the cornea and DNA. Because of these safety risks, UV light is not a recommended technology for early care and education at this time. New forms of UV light, and new technologies may make them safer and less expensive to use in the future, but at this time these devices are not considered a safer option for disinfecting the air in ECE. Ventilation and filtration are effective and cheaper alternatives. Recent research by the EPA on the use of UV light for surface disinfection suggests that it is not a reliable device for this purpose at this time.

Foggers are sprayers that apply chemical disinfectants to large surface areas. They depend on getting enough chemical into the air that gravity pulls it down to coat surfaces with chemical disinfectants. Application may be uneven and contact time may not be long enough to kill germs. Surfaces must also be cleaned before they can be fogged, a step that is often overlooked.

The person doing the fogging is highly exposed to chemical disinfectant and must wear complicated personal protective equipment. Foggers also change some liquid disinfectant into gases in the process. Some of these gases react with chemicals in the indoor environment to form compounds that are harmful to human health. For all these reasons, foggers are not recommended in early care and education.

Electronic air cleaning devices (EACs) Many electronic air cleaning technologies are not evaluated by any federal agency or national industry standards organizations for their efficacy or for potential unintended consequences, including the generation of hazardous chemical byproducts. There is very little literature in scientific journals that evaluates efficacy and safety. Two recent studies demonstrate the potential for air ionization to be effective in reducing particulate matter by causing it to fall on to surfaces, but they also suggest the potential for ionization to generate potentially harmful chemical byproducts during their operation. And, while ionization of air can increase the deposition rates of particulates onto indoor surfaces (thus removing them from the air), this effect is small compared to the overall removal that can be accomplished with ventilation and filtration. Ventilation and filtration are proven technologies that are safe and effective. Recent guidance from the CDC considers ionization and other air disinfection technologies as "emerging" technologies. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) says, with regard to Bipolar Ionization, Corona Discharge, Needlepoint Ionization, and other Ion or Reactive Oxygen Air Cleaners, "Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered."

Resources

ASHRAE, (2021) Filtration/Disinfection
EPA, "Health Effects of Ozone in the General Population"
EPA, "Pesticide Devices: A Guide for Consumers"
EPA, (1/21/2021) "COVID-19: UV-C Devices and Methods for Surface Disinfection Webinar"
Collins, D., Indoor Chem, (2020) Spraying Chemicals for Disinfection
Mattila, J./Home Chem, (2020) Bleach cleaning: indoor emissions, chemistry, and impacts on air quality
Offerman, F, Indoor Environmental Engineering (2020) Beware The COVID-19 Snake Oil Salesmen Are Here
Toxics Use Reduction Institute, (2021) "Safer Cleaning and Disinfection for Schools"
Toxics Use Reduction Institute, (2020) "NaDCC Tablets for Disinfection"
University of Washington: Environmental Health and Safety, (2021) "Electrostatic Sprayers"

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