

Germicidal Ultraviolet

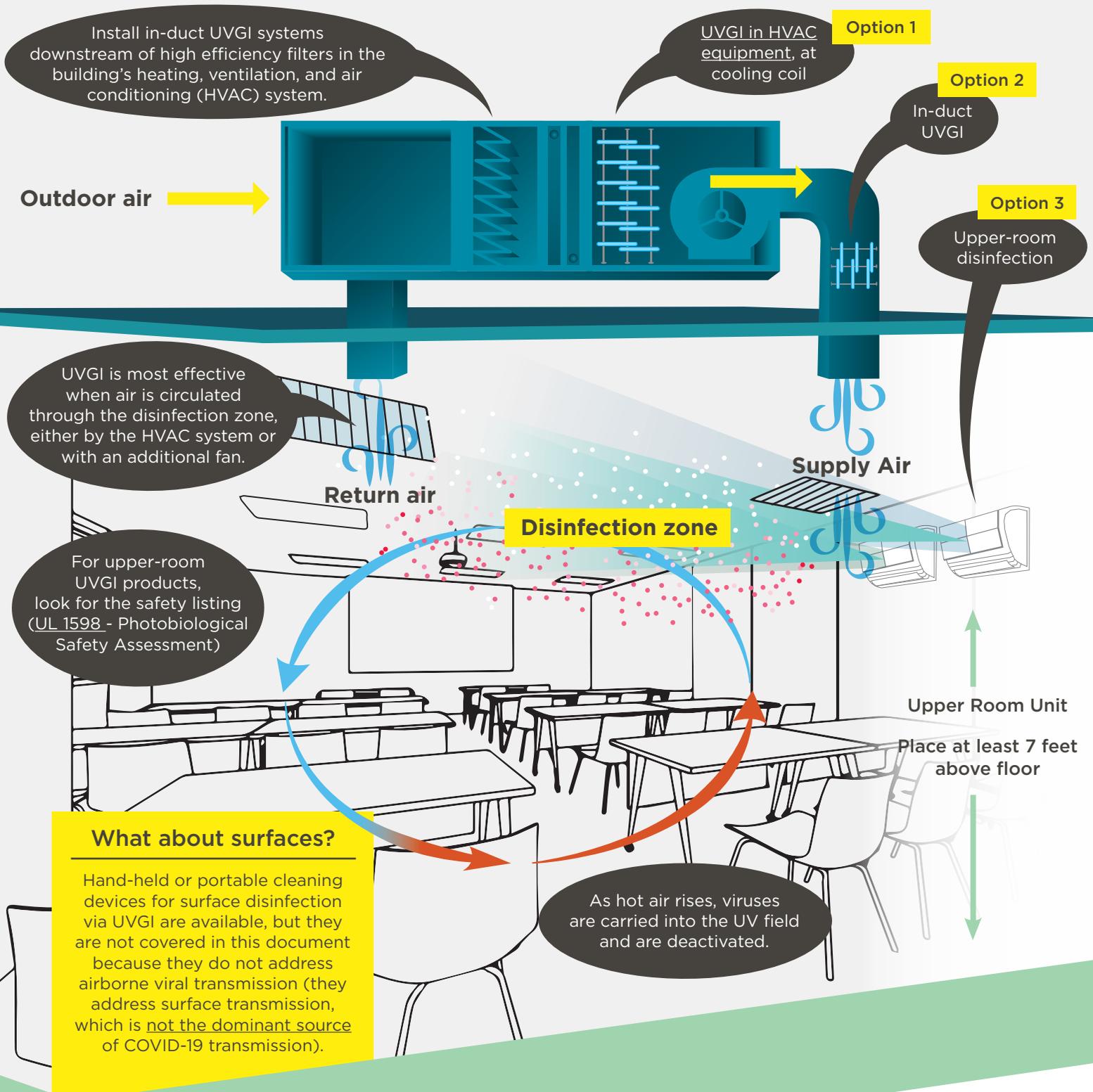
SERIES: Indoor Air Quality Fact Sheets

This fact sheet is one in a series. See [series overview](#) for background information.

Germicidal ultraviolet basics:

Germicidal ultraviolet (GUV), sometimes referred to as ultraviolet germicidal irradiation (UVGI), inactivates viruses, bacteria, and fungi. It is a strategy that has been documented in research and real-world applications to reduce airborne viral transmission by 80% or more when properly applied. The wavelength of light with the most germicidal effect is in the UV-C spectrum. Current technology on the market uses the wavelength 254 nm because it is cost-effective, does not generate ozone, and damages the DNA and RNA of viruses, bacteria, and fungi.

UVGI should be considered when there is a need to provide a large equivalent air change rate, to remove contaminants near a source, and/or to mitigate higher-risk locations such as nurse's suites or places where people are gathering in high density. There are several types of UVGI systems used in locations like schools: in HVAC equipment in-duct, and upper room.



Dose:

The dosage determines the ability of UV-C to inactivate microorganisms. The higher the dose, the higher the ability to disinfect. Dose is calculated by multiplying the germicidal radiation level (how powerful the UV-C energy is, in watts per square meter) by the amount of time a virus, bacteria, or fungi spends in the UV-C field.

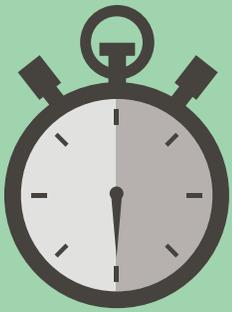
Tips for using UVGI:

- **SAFETY:** UV-C energy can cause skin and eye irritation. Get assistance from a qualified professional to install. Ensure that lamps are off and use protective PPE when cleaning and servicing the unit and anything in the disinfection zone.
- **INSTALLATION:** For systems in the HVAC equipment and/or ducts, UV-C energy can degrade filter material, insulation, and electrical wiring, so an assessment is required before installation. For upper-room systems that are non-shielded, UV-C energy can fade wood and wallpaper and degrade plastics and wire coatings. Place away from ornate elements and plants.
- **VERIFICATION:** After installation, obtain on-site performance testing. For the safe use of upper-room systems, UV-C levels should be no more than 0.4 $\mu\text{W}/\text{cm}^2$ at 6.5 ft above the floor anywhere in the room, measured with a sensitive UV-C meter.
- **MAINTENANCE:** The effective dose of UV-C lamps can degrade over time. Maintain the system by replacing lamps per manufacturer recommendation (usually once per year).

UVGI systems should be installed with on/off switches and interlocks to limit access only to trained personnel and staff.

Using UVGI to reach your air change rate goal:

eACH is equivalent air change rate. It is calculated by adding all ventilation and air cleaning strategies. A reasonable target for air change rate in a classroom is at least 6 eACH.



Example eACH for a typical 1,000 ft² classroom

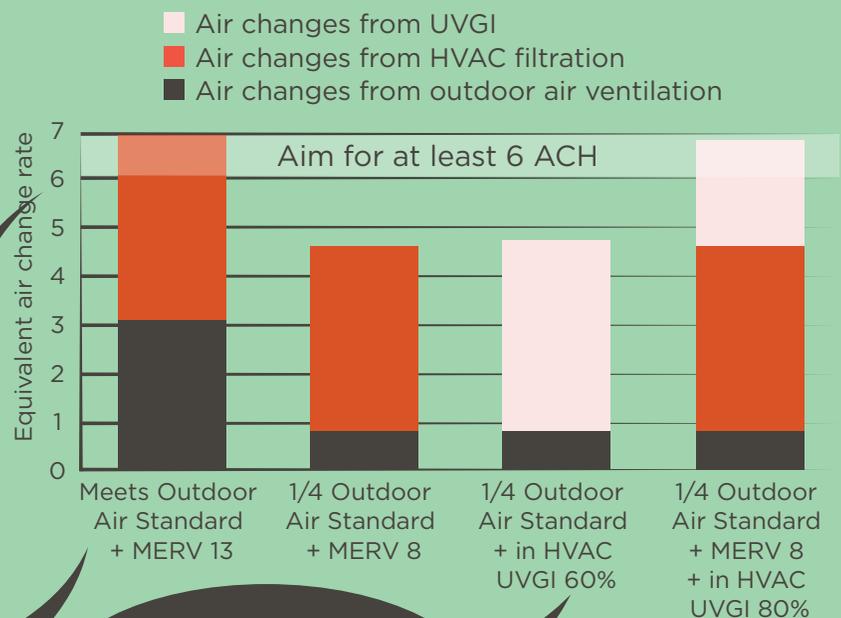
This eACH calculation may vary based on factors such as the amount of air supplied from an HVAC system. The graph is provided as a general comparison between strategies and as an example of how strategies can be combined for infection control.

Imagine measuring contaminants in a space and then starting a stopwatch. At 6 eACH, at the end of 30 minutes, 95% of the original contaminants would have been removed. At a lower eACH, it would take longer to get the same result. At a higher eACH, it would take less time.

Even with limited outdoor air, a combination of strategies can achieve 6 eACH or higher.

Minimum outdoor air is governed by ASHRAE standard 62.1. However, older buildings may not meet this standard, and even newer buildings may not work as intended.

Manufacturers of UVGI use a percentage to show how efficient the system is in removing contaminants in a single pass.



Benefits of UVGI beyond COVID

1

Fights the cause of respiratory illness, including common cold, and influenza.

2

In HVAC (on coil surfaces): Reduced biofilm buildup on the HVAC coil, which can help maintain system performance.

3

Non-chemical approach to disinfection.