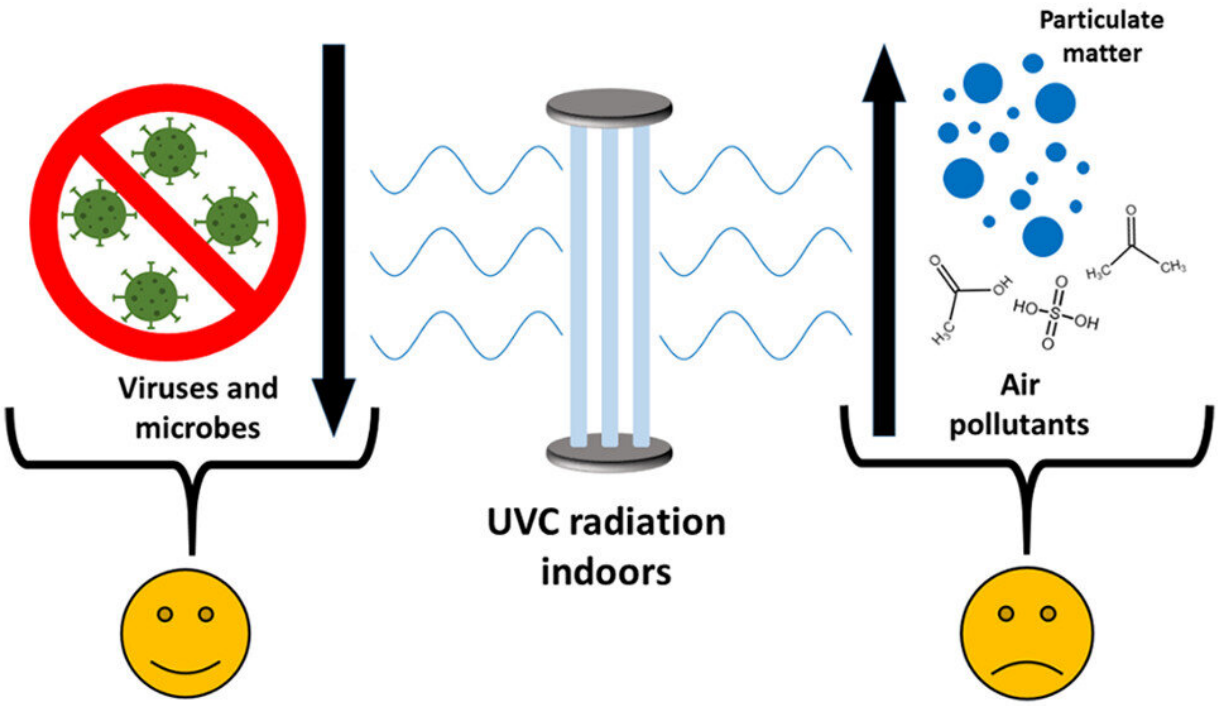
UV lamps used for disinfection may impair indoor air quality

January 27 2023



Graphical abstract. Credit: *Environmental Science & Technology Letters* (2023). DOI: 10.1021/acs.estlett.2c00807

Using ultraviolet germicidal radiation (UVGI) to disinfect indoor spaces is a demonstrably effective way of deactivating various pathogens (including the SARS-CoV-2 coronavirus). It deactivates bacteria and viruses by exposing them to high-energy UV radiation through the use of UV lamps.

As the COVID-19 pandemic has increased the need to disinfect large quantities of both air and various surfaces, hospitals, among other operators, have recently increased the use of UVGI disinfection robots. However, the method may have previously unexplored indirect adverse effects on people. These effects relate to reduced indoor air quality caused by the UV radiation used.

"To our knowledge, we conducted the first experimental study of the effects of UVGI devices on indoor air quality," says Doctoral Researcher Frans Graeffe from the University of Helsinki's Institute for Atmospheric and Earth System Research (INAR).

"We focused on the effects of UVGI disinfection robots on indoor air quality to better understand the potential adverse effects."

Switching on UV lamps for disinfection considerably increased concentration of gases and small particles

Solar ultraviolet radiation enables most of the chemical reactions occurring in the atmosphere, including the formation of oxidizers such as ozone (O_3) and the hydroxyl radical (OH). Bringing UV radiation indoors in the form of UVGI disinfection robots makes it possible for outdoor reactions to take place indoors. Reactions caused by radiation can form a range of gases and small particles that, when inhaled, are harmful to human health. High particle concentrations have been associated with several diseases (e.g., respiratory diseases).

"We brought a UVGI device used in hospitals to the aerosol physics laboratory at the University of Helsinki where, utilizing spectrometers and other modern measuring equipment, we were able to measure the concentration, size and chemical composition of the gases and small particles formed," Graeffe says.

"Our measurements clearly show that every time the UV lamps were switched on, as the disinfection was initiated, the amount of both gases and small particles increased considerably."

Although both particle and gas concentrations started to decrease, for example, through ventilation, immediately after the UV lamps were switched off, the concentrations returned to their original levels only until 30 to 40 minutes later.

"After disinfecting the room, it would be better to wait for a while before entering, or to enter wearing protective gear, such as a sufficiently effective respirator," Graeffe says.

Because of the complexity of the formation of gases and small particles caused by UV lamps, the results cannot be applied directly to different environments. The effect of various UVGI devices on air quality depends at least on the intensity, duration and wavelength of the UV radiation emitted by the device, as well as the size, ventilation and air quality of the space to be disinfected.

A similar UVGI solution is now also increasingly used in private and public spaces. Even though the radiation in such cases is less intense than that emitted by the device tested, the irradiation last longer.

Based on the findings, the effects on air quality must be further investigated before the use of such devices becomes widespread, in order to understand how different UVGI devices affect indoor air quality and how their benefits (control of viruses) compare with their adverse effects (degradation of air quality).

The research is published in the journal *Environmental Science & Technology Letters*.

More information: Frans Graeffe et al, Unwanted Indoor Air Quality Effects from Using Ultraviolet C Lamps for Disinfection, *Environmental Science & Technology Letters* (2023). DOI: 10.1021/acs.estlett.2c00807

Provided by University of Helsinki