In HEPA we trust: making the indoors safer during COVID

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As schools prepare to reopen and more people are heading back to their offices and shared work spaces, Syracuse University Professor Jianshun "Jensen" Zhang offers a three-step plan to improve indoor air quality (IAQ) and help prevent the spread of COVID indoors.

Zhang's plan is detailed in a recent editorial published in the journal "*Science and Technology for the Built Environment*" called "Integrating IAQ control strategies to reduce the risk of asymptomatic SARS CoV-2 infections in classrooms and open plan offices."

"Classrooms and open-space offices present a special challenge because of their relatively large occupant density, which can lead to a higher chance of person-to-person cross infection in the space via airborne transmission as well as through direct or indirect contacts," Zhang says. "As schools and businesses are making plans to reopen, how can the risk of such cross infection be minimized or prevented?"

The coronavirus disease is a respiratory illness that can spread from person to person. The virus that causes COVID-19 spreads, typically through respiratory droplets from coughing, sneezing, or talking. Some people without symptoms are able to spread the disease without knowing that they have it.

Dr. Zhang, a professor in the Department of Mechanical and Aerospace Engineering and Director of the Building Energy and Environmental Systems Laboratory, writes that source control, ventilation and air cleaning—and combinations of all three—can offer important tools in preventing the spread of COVID within indoor spaces.

Here's a look at his three-step plan:

Source Control

Source control is the first and most important among all IAQ strategies. For preventing the spread of the coronavirus, that means detecting, tracking, and isolating infected persons; and preventing transmission from asymptomatic virus carriers.

"The latter is more challenging in open space office or classroom settings in which air is typically well mixed," Zhang writes. "To reduce the number of virus-containing aerosols emitted to the space from any possible virus carriers present, universal face masking, as well as hand sanitizing before entering the space is essential."

Ventilation

The next step in air quality is ventilation with a focus on supplying enough clean outdoor air to rooms and offices and effectively diluting the concentration of pollutants.

"Mechanically ventilated classrooms and offices typically have about 20 percent of their air supplied from outdoors, and the rest is recirculated air. This

is done to save heating and cooling energy while maintaining acceptable levels of IAQ," Zhang says. "To reduce the risk of the SARS CoV-2 virus infection, the outdoor ventilation rate should be increased to the maximum operational capacity of the building ventilation system, which can be two or more times of that under the normal operation mode per the existing standard."

He also writes that any recirculated air needs to be filtered with HEPA filters or MERV 14 filters, to minimize cross-contamination.

Zhang says that proper air distribution is essential for making sure the filtered air is reaching the people where they are. He says, "this is an area so far has been largely neglected in existing guidelines or recommended practices for reducing the SARS CoV-2 virus infection."

He points out that most classrooms and open plan offices in the United States use mixing ventilation (MV) for fresh air delivery. Air diffusers in MV are typically located close to the ceiling level, but Zhang recommends that air supply should be brought in through ground ventilation. The difference is that filtered air from the ceiling mixes with the exhaled breath of people who could be asymptomatic carriers of COVID.

He said to prevent filtered air becoming contaminated, it should be pumped into a room through ground-level vents. Zhang recommends using "displacement ventilation," which simply delivers the air supply at the floor level but exhausts it through vents in the ceiling.

Air cleaning

Air cleaning strategies involve applying air filtration or purification within a building, rooms, or at a personal level, such as a properly worn mask. But among all three, there must be high efficiency filters and sufficient airflow, writes Zhang.

At the building level, high efficiency particulate (HEPA) filters in the recirculated or mixed air duct can reduce the cross contamination between rooms and increase the total clean air delivery rate (outdoor plus filtered air) for diluting the virus concentration in the ventilated space.

Standalone room air cleaners with HEPA filters can also be used as a supplementary measure to further reduce the concentration of virus in the occupied space. Research has shown a range of clean air delivery rate (CADR) from 170 to 800 m^3/h (or 100 to 470 CFM) with a median cost of $361 based on a comprehensive survey of off-the-shelf air cleaners available from the most popular online shopping sites. The results were consistent with an earlier laboratory study in which 6 portable air cleaners were tested for both particulate and volatile organic compounds removal performance. Zhang says that an air cleaner with a CADR of 722 m^3/h (425 CFM) can double the clean air supply for 25 people in a classroom or open plan office.

Zhang says this can be considered as a cost-effective supplementary measure for rooms where total ventilation airflow rate is insufficient. However, for spaces with displacement ventilation (DV), a room air cleaner should only be used with caution so that the desirable airflow pattern of DV is not disturbed.

Conclusion

Zhang writes that these IAQ strategies can be used and implemented across multiple scales from an entire building to a room to an individual's cubicle or personal space. In his editorial, Dr. Zhang also includes a table that shows the efficiency of different combinations of IAQ strategies and the associated costs.

More information: Jensen Zhang, Integrating IAQ control strategies to reduce the risk of asymptomatic SARS CoV-2 infections in classrooms and open plan offices, *Science and Technology for the Built Environment* (2020). DOI: 10.1080/23744731.2020.1794499

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