Scientists sets out seven steps to achieve clean indoor air post-pandemic

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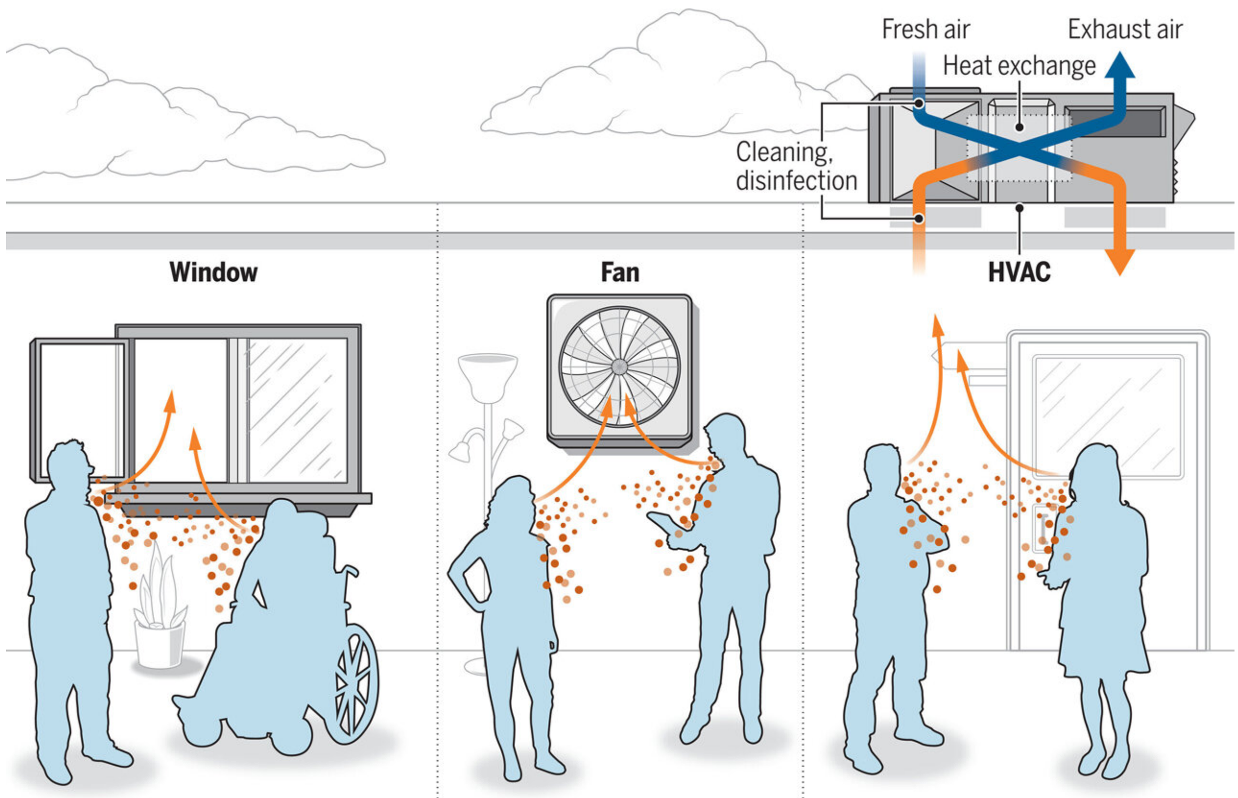

Dilution and removal of exhaled bioaerosols in the indoor environment through ventilation measures. Credit: *Science* (2024). DOI: 10.1126/science.adp2241.

Seven lessons learned from the COVID-19 pandemic about ventilation's crucial role in preventing the spread of airborne pathogens have been set out by world-leading air quality scientist Professor Lidia Morawska, Professor Yuguo Li from The University of Hong Kong and Professor Tunga Salthammer from the University of Surrey, UK.

"Ventilation and indoor airborne infection transmission: Lessons learned from the COVID-19 pandemic" was published in *Science*.

Professor Morawska, director of THRIVE, from QUT's School of School of Earth and Atmospheric Sciences said the rapid global spread of COVID-19 had soon made it clear the world was unprepared to respond appropriately.

"In the early days of the pandemic, the World Health Organization and many national health authorities claimed the virus was 'not in the air' but rather present in large quantities on surfaces. This led to a misconception about how the virus was transmitted," Professor Morawska said.

"Public health authorities rejected existing knowledge which led to misguided control measures aimed at cleaning surfaces, instead of ventilation, filtration, face-masking and deactivation of airborne viruses.

"However, for science and building engineering experts there was no doubt from the beginning that the virus was transmitted predominantly through the air and the most important control measure to reduce infection risk was to remove the viruses from the air through ventilation or inactivate them through UVC radiation."

Based on scientific and advisory activities of the co-authors of the paper, they identified seven lessons of particular importance to indoor air quality (IAQ):

1. The first lesson is to develop means for interdisciplinary knowledge to contribute to public health decision-making.

The experts who advised the WHO at the beginning of the pandemic were mostly public health experts and the value of physical, chemical and engineering expertise was seen as less relevant.

For example, current epidemiological studies of outbreaks commonly do not include the measurement of ventilation rates, which results in incomplete assessment.

2. Ventilation beyond the "open window" solution: modern society cannot rely solely on natural ventilation in buildings that are not designed to provide sufficient and effective air supply.

Mechanical ventilation must be part of the solution—they offer various air supply techniques such as mixing, displacement and personal ventilation and air disinfection using germicidal ultraviolet and filtration.

3. Building design and ventilation performance: different types of buildings—housing, offices, shopping centers, airports, railway stations, school buildings, etc.—are becoming increasingly complex, but are mostly planned and built with design and operation constraints.

Sufficient ventilation, which is the basic function to make a building livable, is often not considered among the key criteria. Building and ventilation design are closely related and equally important in planning and operation.

4. Equivalent ventilation for existing buildings: Buildings such as aged care facilities and schools that are naturally ventilated cannot be easily or cost effectively retrofitted. In such cases, equivalent ventilation is needed using the techniques of air filtration and germicidal ultraviolet radiation.

Filtering does not remove water, carbon dioxide and gaseous pollutants from the air but it is "equivalent to ventilation" for particulate matter. Germicidal UV deactivates pathogens in the air so it may be "equivalent to ventilation" in relation to infection control.

5. Ventilation control and risk assessment tools: risk assessment tools have value in estimating the probability of airborne infection but are too complex as a day-to-day control measure in modern buildings. New technologies are being researched, developed or optimized to control the ventilation of buildings.

6. Monitoring ventilation performance: we learned that ventilation performance should be monitored at all the times when buildings are occupied to dynamically to inform ventilation control in response to building occupancy and use.

Numerous CO_2 monitors are installed in modern buildings and a proliferation of low-cost CO_2 sensors are available for continuous monitoring of ventilation performance in housing and transport cabins, with the preferred method for measuring CO_2 being non-dispersive infrared (NDIR).

Modern devices are calibrated against reference methods and their performance can be improved using machine learning tools. The combination with other relevant parameters is possible and recommended.

7. IAQ mandated in public buildings: IAQ must be mandated and controlled, like water and food, by the relevant authorities. We learned that without regulations, good IAQ cannot be assured by volunteer occupants' efforts or even building operators if the building was not designed with this as an objective and/or equipped with adequate engineering systems.

The COVID-19 pandemic showed us that not only is ventilation a key control measure to lower the risk of airborne infection transmission of any pathogens, but also that ventilation must be considered as part of the control of IAQ from outdoor generated pollution, beyond infection transmission.

More information: Lidia Morawska et al, Lessons from the COVID-19 pandemic for ventilation and indoor air quality, *Science* (2024). DOI: 10.1126/science.adp2241. www.science.org/doi/10.1126/science.adp2241

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