

HEALTH & WELLNESS

Key to Preventing Covid-19 Indoors: Ventilation

Reopening schools and businesses should upgrade air systems, open windows and take other measures to ensure clean air, scientists say

By [Caitlin McCabe](#)

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Add this to the [Covid-19 prevention](#) toolbox: strong ventilation.

After urging steps like handwashing, [masking and social distancing](#), researchers say proper ventilation indoors should join the list of necessary measures. Health scientists and mechanical engineers have started issuing recommendations to schools and businesses that wish to reopen for how often indoor air needs to be replaced, as well as guidelines for the fans, filters and other equipment needed to meet the goals.

“We didn’t focus on it enough initially,” said Abraar Karan, a doctor at Brigham and Women’s Hospital in Boston who treated Covid-19 patients. “We told everyone to stay home. We weren’t thinking about people congregating in public spaces.”

SHARE YOUR THOUGHTS

How has your company improved its ventilation systems in preparation for the return to work? Join the conversation below.

Driving the thinking is mounting evidence that the new coronavirus [is transmitted through the air](#) among people with prolonged exposure to the pathogen. Especially troublesome, epidemiologists and other scientists say, is evidence from numerous indoor outbreaks suggesting the virus’s ability to spread to others even when close contact is avoided.

The precise role that airborne transmission plays is still being debated by parts of the scientific community. Yet proponents of aerosol transmission say the evidence so far argues for the need to keep clean air flowing in indoor spaces where people gather.

Ideally, they say, public spaces like a standard classroom should aim to have air replaced with clean air between four to six times an hour to dilute Covid-19 particles that might accumulate.

That can be done, aerosol scientists and building engineers say, through strategies that introduce outdoor air and filter indoor contaminants. Those include opening windows and doors, installing window fans, using portable air purifiers with high-efficiency particulate air, or HEPA, filters and upgrading heating, ventilation and air-conditioning systems to meet certain standards.

Keeping Classroom Air Clean

Scientists say schools and businesses should focus on improving ventilation to help prevent Covid-19's spread. Spaces such as a typical classroom should aim to have air replaced with clean air four to six times an hour, though recommendations can vary by room size and occupancy. That can be done by introducing more outdoor air and enhancing filtration.

Without air conditioning:

Open Windows and Doors

Open windows and doors to introduce outdoor air. Aim for cross-ventilation via windows on opposite walls. If unsafe to open completely, six inches can still help.

Install Window Fans

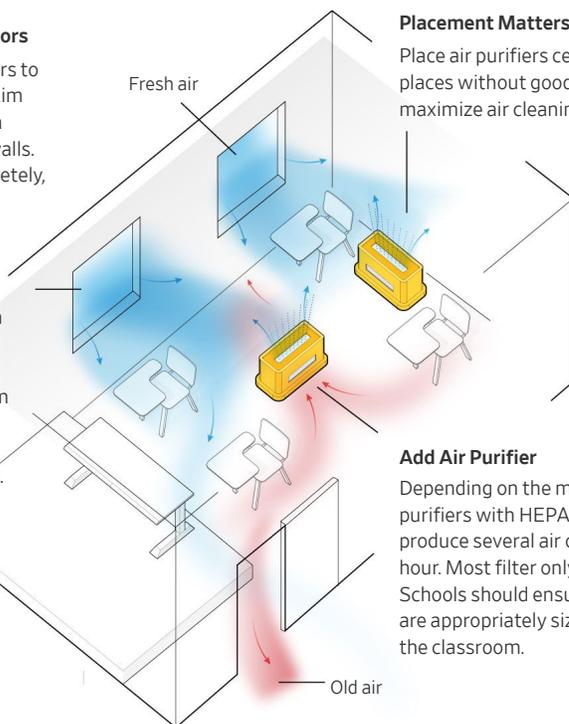
Fans placed inside open windows can increase airflow. Two fans, blowing fresh air in from one window, while pushing air out from another, may be helpful. Avoid positioning that would blow air directly from one person to another.

Placement Matters

Place air purifiers centrally and in places without good ventilation to maximize air cleaning.

Add Air Purifier

Depending on the model, portable purifiers with HEPA filters can produce several air changes per hour. Most filter only small spaces. Schools should ensure purifiers are appropriately sized relative to the classroom.



With air conditioning:

Start Earlier

Keep HVAC systems, such as this unit ventilator, running frequently, and start earlier than usual to allow more time for airflow and filtering before the school-day begins.

Increase Outdoor Air

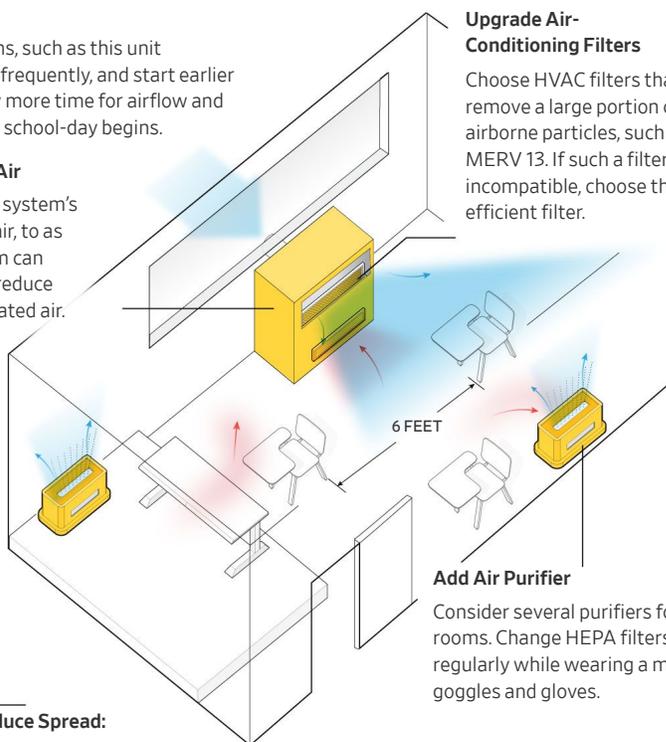
Increase the HVAC system's supply of outdoor air, to as much as the system can handle, in order to reduce reliance on recirculated air.

Upgrade Air-Conditioning Filters

Choose HVAC filters that can remove a large portion of airborne particles, such as a MERV 13. If such a filter is incompatible, choose the most efficient filter.

Add Air Purifier

Consider several purifiers for larger rooms. Change HEPA filters regularly while wearing a mask, goggles and gloves.



Other Tools to Reduce Spread:

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Keep desks spaced at least six feet apart
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Have students, teachers and staff wear masks whenever possible
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Reduce class sizes

Some businesses have begun taking such steps, including malls and gyms in New York, where reopening guidelines list enhanced air filtration as mandatory for the spaces. But in aging schools nationwide, strengthening ventilation may be difficult.

About 41% of U.S. public-school districts need to update or replace their HVAC systems in at least half their schools, representing about 36,000 schools nationwide, according to [a report published in June](#) by the U.S. Government Accountability Office, a federal watchdog.

Repairs can be costly. Denver Public Schools plans to spend nearly \$5 million before students return to improve HVAC systems across roughly 185 buildings, including upgrading filters, repairing broken parts and increasing the amount of outdoor air in the systems, it said.

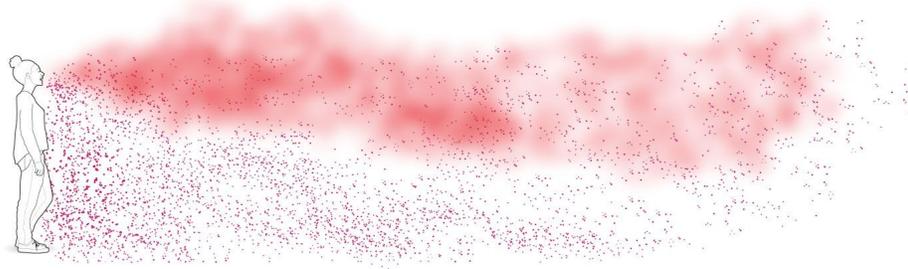
Public health officials and scientists studying the virus are still working to better understand how Covid-19 is transmitted. Some argue it is predominantly spread by large droplets, transmitted by coughing, talking or sneezing, which people nearby can inhale. The droplets, which tend to fall to the ground quickly, can also splatter on surfaces that bystanders touch and transfer to their mouths, noses and eyes.

Other scientists argue a significant role is played by smaller particles invisible to the naked eye, called aerosols, that linger in the air and travel. A recent study—which found that particles extracted almost 16 feet from hospitalized Covid-19 patients [could infect cells in a lab](#)—suggests aerosols as a potential source of spread, aerosol scientists say. The study, posted on the preprint server medRxiv, hasn't been peer reviewed.

How Droplets Move

Droplets of all sizes are emitted when a person coughs, talks or sneezes. How they travel depends on many factors. Some research has found that droplets will be carried by a moist gas cloud, which a Massachusetts Institute of Technology researcher has said can travel up to about 26 feet after a sneeze. Some of the droplets will fall as the cloud moves. Others ultimately evaporate, producing aerosols that can linger in the air and travel with airflow patterns, a March article by the researcher published in the Journal of the American Medical Association said.

Emissions from a sneeze



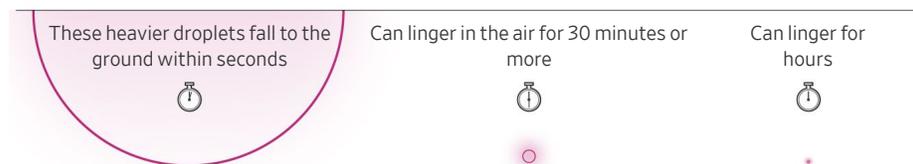
The cloud may travel as far as almost 20 feet after a cough, and about six feet after exhalation, according to the MIT researcher.

Scientists emphasize there is no distinct size cut-off between droplets and aerosols. Some disagree about size ranges for each. Researchers are working to better understand the infectiousness of various-sized droplets and aerosols, and how it may change over time.

Large Droplet: **100 microns (diameter) or larger**

Small Droplets and Large Aerosols: **100 microns or smaller**

Small Aerosols: **3 microns or less**



Source: WSJ research; Linsey Marr, Virginia Tech University; Lydia Bourouiba, Massachusetts Institute of Technology
Caitlin McCabe, Alberto Cevantes, Josh Ulick/THE WALL STREET JOURNAL

“Based on the evidence we have on hand, it seems wildly irresponsible to me not to recommend strategies” for ensuring strong ventilation, said Joseph Allen, director of Harvard University’s Healthy Buildings program, which studies how buildings affect human health.

He and other health-science and mechanical engineering experts recently released [a tool to help schools](#) determine how to attain several air changes an hour. Currently, he said, some schools may only be achieving one or two.

Poor ventilation may have played an important role in several indoor Covid-19 cases, researchers said.

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Five people sitting at tables adjacent to an infected but presymptomatic diner inside a Guangzhou, China, restaurant in January later tested positive for Covid-19, despite video that indicates the separate parties didn’t have close contact, [according to an April study](#) published on a preprint server. Some patrons who contracted the virus, the authors said, were seated as far as 15 feet away from the infected diner.

The third floor of the restaurant, where the patrons were seated, had no outdoor air supply, exhaust fans in the walls weren’t running

and ventilation was mostly provided by an occasionally opened door, the study found.

Likewise, a coronavirus outbreak at a choir rehearsal in Washington state was likely exacerbated by poor ventilation, a study showed. Some 53 of 61 attendees were confirmed or strongly suspected to have Covid-19, including two who died.

Doors were closed at the church's fellowship hall where the March rehearsal took place, the study, published on a preprint server in June, found. One of the authors said the research team believes that a furnace wasn't likely operating for most of the rehearsal, providing no filtration or outdoor air supply through the system when it was off.



Students at Pine Grove Area High School in Pine Grove, Pa., were spaced 6 feet apart in class last week.

PHOTO: JACQUELINE DORMER/REPUBLICAN-HERALD/ASSOCIATED PRESS

The studies demonstrate the importance of introducing outdoor air and having HVAC systems equipped with filters that can remove viral particles, according to scientists who have examined indoor outbreaks of Covid-19. Mechanical engineers recommend increasing a HVAC system's outdoor air supply and installing a MERV13 filter if the system can handle it. That filter, they say, can trap and remove a substantial number of small and large particles before recirculating air back into a room.

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Absent a well-functioning HVAC system—or if no HVAC system exists—researchers who have studied ventilation say there are relatively inexpensive strategies that schools and businesses can implement to dilute virus-laden air, such as opening windows and doors.

Installing fans in windows, so long as they aren't positioned to directly blow air from one person to another, can also increase airflow.

Both strategies, however, may be difficult to rely on during the winter. As a result, researchers proposed using portable air purifiers with HEPA filters.

HEPA filters, which trap contaminants pulled in by purifiers before pushing clean air back out, are almost 100% efficient at capturing all airborne particles, including the very smallest sizes.

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