04
Cleaner, Safer Indoor Air
Getting to and Sustaining the Next Normal: A Roadmap for Living with Covid

It’s in the Indoor Air

Aerosols are the main vehicle for spreading Covid.9,10 Infected individuals expel particles containing SARS-CoV-2 when they speak, sing, cough or breathe.11,12 When non-infected individuals inhale these particles, they may become infected. Aerosols are concentrated in close proximity to the infected person, and many infections are traced to such encounters. But aerosols also move with air, can travel far, and remain airborne for long periods. When inhaled, aerosol particles with viruses can deposit anywhere from the nose to the deep lung.13 Indoor aerosol transmission in shared-room air, especially from people with few symptoms and who often don’t know they are infected, is a key reason Covid transmission has been so difficult to control. Super-spreadling is an important contributor to the spread of the pandemic14 and is only explained by inhalation of aerosols in shared-room air in poorly ventilated locations.15 Multiple cases of long-range transmission (when people were not present in the same room at the same time) have been documented but are thought to be less common.16 Outdoors there is substantially less risk of virus exposure because wind and air currents efficiently disperse virus particles and environmental stressors like ultraviolet light are more likely to be present.17

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Summary

SARS-CoV-2 is primarily spread through indoor air. Ventilation and air filtration lower virus concentrations and reduce the likelihood of transmission. Fans and filters should be used far more to protect children, workers, and others from Covid and other viral infections.

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14 Lewis D. Superspreading drives the Covid pandemic — and could help to tame it. Nature. 2021;590:544-546. doi: https://doi.org/10.1038/d41586-021-00460-x
Covid and Attention to Indoor Air Quality

Huge progress has been made in reducing pollution levels in outdoor air, but comparatively little attention has been devoted to indoor air. Schools, homes, bars, and workplaces often have limited supply of clean air and allow viruses to spread in aerosols. Unfortunately, improving indoor air quality has not been a consistent societal objective for more than half a century. Indeed, the quality of indoor air has not only failed to improve in recent decades, but by some measures has worsened.

Throughout much of the pandemic, the importance of improved ventilation and filtration was unrecognized or unacknowledged in guidance issued by the CDC, WHO, and other governmental bodies. This reflects a fundamental misunderstanding of the ways in which SARS-CoV-2 is transmitted, and as a result there has been almost no systematic effort to improve indoor air quality to reduce viral transmission. Additionally, when airborne infection transmission is acknowledged, building owners and operators often refuse to measure indoor air quality and remediate it because doing so could be seen as an admission of past failures and open them to liability.

Better Air Brings Benefits Beyond Covid

Increasing access to clean indoor air will have many benefits. First, it reduces transmission of Covid. Second, it reduces transmission of other respiratory viruses such as influenza, rhinovirus, or a possible future respiratory pandemic. Third, it can reduce indoor particulate matter and allergens that can exacerbate other respiratory illnesses such as asthma. Improving indoor air quality — especially in schools and workplaces — will reduce health care costs and absenteeism, and it will improve productivity, academic performance, and cognitive function. Improving indoor air quality also addresses equity concerns because...
the negative effects of poor indoor air disproportionately impact low-income communities, minority communities, and rural populations.27

Improving indoor air quality will have significant benefits in indoor workplaces where employees spend 8 to 12 hours every day in environments where they have little control over how closely they stand to their coworkers or customers, particularly since personal respiratory protection may be difficult or ineffective for the full workday.

Effectively limiting exposure to respiratory pathogens requires following traditional industrial hygiene principles and applying a hierarchical and layered approach. The emphasis must be on providing clean air generally instead of personal protective equipment such as respirators and face masks (see Chapter 5: Personal Protective Equipment).

To prevent viral transmission through indoor aerosols, three methods can be applied to the air to reduce the chance of infection:

- **Ventilation**
  - Expel air with aerosols outside and introduce virus-free air from the outdoors. This can be achieved by opening doors and windows or adjusting HVAC systems to introduce more outdoor air. But moving air around with a recirculating forced air system, window air conditioner, mini-split air conditioner unit, or fan doesn’t work because these simply mix contaminated air and are not ventilation.28

- **Filtration**
  - Keep the air indoors but remove the floating aerosols. In environments where air is recirculated or there is inadequate flow of outside air, stationary HVAC systems or portable HEPA filters can remove the virus and other contaminants from the air.29,30,31

- **Disinfection**
  - Keep the air and floating aerosols indoors, but “kill” (inactivate) the virus.32

Finally, necessary investments in ventilation, filtration, and disinfection are expensive and often cost-prohibitive for low-income communities. Specific funds must be allocated to low-income communities to enable these investments for small businesses, schools, and other public buildings. Additionally, income-linked subsidies should be provided to households, to promote residential upgrades to filtration and ventilation systems.

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Clean Air Strategic Goals

1. Empower the EPA Office of Radiation and Indoor Air to better regulate indoor air quality.
   
   a. Educate building owners and operators, employers, and the public generally on the importance of indoor air quality and ways to improve it.
   b. Require regular monitoring, reporting, and posting of indoor air quality by building owners and operators.
   c. Create a standard indoor air labeling system, similar to a restaurant hygiene assessment, that communicates results of building air quality assessment to the public and occupants.
   e. Establish a product rating and certification system that evaluates products’ abilities to improve indoor air quality.
   f. Establish a certification program for manufacturers and installers of germicidal UV light technology.
   g. Establish incentives and a ratings system to advance energy-efficient portable filtration technology, prioritizing Clean Air Delivery Rate per kilowatt hour, as HEPA filtration systems may not be the most optimally energy efficient solutions.

2. Direct the EPA to fund and/or mandate improvements in indoor air quality.
   
   a. Immediately fund school systems to make needed improvements in ventilation and air filtration or direct them to do so with currently available funds. The objective should be to have clean air in every classroom.
   b. Require federal buildings, airports, train stations, schools, and other public buildings to improve air quality by maximizing existing HVAC systems, increasing the flow of outside air, or installing higher efficiency filters to clean air that is recirculated.
   c. Incentivize revision of local building codes to meet updated indoor air quality standards.
   d. Establish ventilation requirements for indoor work environments, including HVAC system maintenance and minimum performance requirements.
   e. Provide funding to reconfigure ventilation systems in high-risk settings with inadequate ventilation and filtration systems.
   f. Provide income-linked subsidies for households to purchase portable air filtration to improve air quality in homes.
   g. Provide income-linked subsidies for households to purchase low-cost CO2 infrared meters to monitor quality of ventilation.
   h. Provide funding to low-income zip codes to support investments in filtration and ventilation systems in small businesses, schools, and other public buildings.

   
   a. Create a lead agency to fund basic and clinical research on airborne infection and indoor air quality and to coordinate research, education, and training between EPA, HHS (CDC, NIOSH, NIH, and BARDA), Labor, Homeland Security, and Defense.
   b. Create a new national research office, including a dedicated research facility, to conduct intramural and fund extramural airborne infection clinical research, educate the public about the importance of indoor air quality, and support training.
   c. Focus research on controlling aerosol transmission of respiratory viruses, particularly in occupational settings and commercial buildings.