

Ventilation in the Time of COVID-19

by enVerid Systems

April 1, 2020

Some key questions regarding HVAC systems have emerged with the rise of COVID-19: What role does air circulation in buildings play in propagating viruses like the one underlying COVID-19? What guidelines should be adopted in the design and operation of HVAC systems to minimize exposure? And perhaps in particular, what is the impact of air replacement – a.k.a. outdoor ventilation – on the spread of the coronavirus in buildings?

Our conclusion, based on a review of the available research on COVID-19, is that central air systems in commercial buildings play a very small role in spreading the virus that causes COVID-19. Nevertheless, to minimize the chance the virus could spread through HVAC systems, experts unanimously recommend implementing and maintaining proper particle filtration in HVAC system. Early research also suggests, perhaps counterintuitively, that **increasing outdoor ventilation** to mitigate the spread of viruses **is not necessarily a good idea** for several reasons, including the impacts of increased ventilation on humidity management and the potential intake of airborne particles that may serve as carriers of viruses.

The COVID-19 virus is primarily spread person-to-person

According to the World Health Organization (WHO), the most significant mechanisms of virus dissemination are direct person-to-person contact and indirect contact through inanimate objects like doorknobs. This is why social distancing, surface cleaning, and handwashing are the first line of defense against the virus.

Recommendation #1: Rigorously follow WHO recommendations to minimize direct person-to-person proximity spreading of the virus that causes COVID-19.

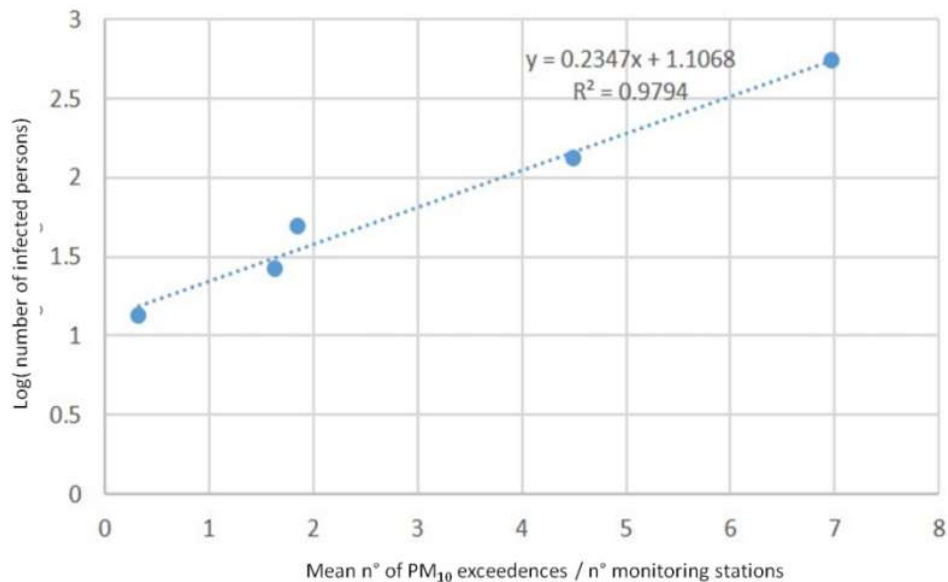
The impact of ventilation on the spread of the COVID-19 virus

The WHO guidance does not address the potential spread of the virus through air circulation. However, there is emerging evidence that the SARS-CoV-2 virus that causes COVID-19 can be carried as an aerosol

— small particles suspended in a gas like air — though perhaps only under limited conditions.^{1,2} This suggests that HVAC systems can potentially play a small role in spreading COVID-19.

Even if the role of HVAC systems is small, it seems reasonable that – all else being equal – more outdoor ventilation would be better to dilute any potential virus-carrying indoor air with virus-free outside air. However, as we dug into the research further, we found that increased outdoor ventilation can have unintentional effects that may actually *increase* the spread of the virus due to the intake of airborne particles that serve as carriers of viruses and due to the impact on humidity control.

Interestingly, some research implies that increasing ventilation can *increase* the spread of COVID-19 if you live in a polluted city or your outside air intake is close to a source of outdoor pollution.³ This is because viruses like SARS-CoV-2 have been shown to attach to small droplets or fine particles (whose concentration is expressed as particulate matter or PM levels) that serve as a carrier of the virus. For example, a new study out of Northern Italy showed a strong correlation between outdoor PM and the rate of COVID-19 infections⁴, including the chart below (from the same reference).



(Reproduced from reference 4)

Similarly, Dr. Giovanni Ghirga, a member of the International Society of Doctors for the Environment, has drawn a link between the major cases of severe COVID-19 infection in China, South Korea, Iran, and northern Italy (and recently New York and California) and a high outdoor air quality index. According to Dr. Ghirga, “Air pollution has been associated with increase occurrence of respiratory tract infections”.⁵

¹ “If it could easily exist as an aerosol, we would be seeing much greater levels of transmission,” said epidemiologist Michael LeVasseur of Drexel University. “And we would be seeing a different pattern in who’s getting infected.”

² Active Monitoring of Persons Exposed to Patients with Confirmed COVID-19 — United States, January–February 2020. CDC. Weekly / March 6, 2020 / 69(9);245–246.

³ “Guidance for Building Operations During the COVID-19 Pandemic”. Lawrence J. Schoen, P.E., Fellow/Life Member ASHRAE. ASHRAE Journal Newsletter, March 24, 2020

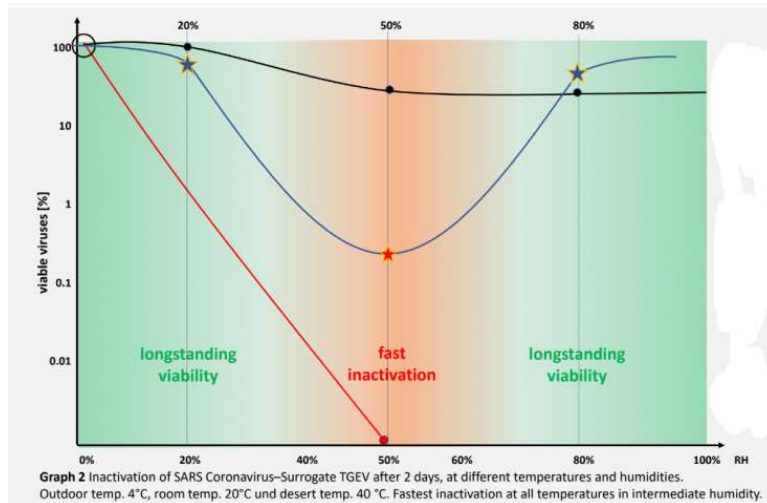
⁴ Setti L et al, 2020. “Evaluation of the potential relationship between Particulate Matter (PM) pollution and COVID-19 infection spread in Italy”, <http://www.simaonlus.it/wpsima/wp-content/uploads/2020/03>

⁵ Ghirga, G: “Covid-19 and air pollution”, March 2020, <https://www.bmi.com/content/368/bmi.m627/rr-3>

Based on these findings, we believe that the second-best defense against COVID-10 is implementing good filtration systems to capture particulate matter that may be carrying viruses.

Recommendation #2: Filtration matters - make sure your HVAC system includes high rated filters and maintain them properly.

Finally, it turns out that airborne viruses are quite sensitive to humidity, but in a complicated way: they spread faster or survive longer under both high (>60%) and low (<40%) relative humidity, whereas they do not do as well when humidity is the middle range⁶. This is shown in the following chart



(Reproduced from reference 6)

HVAC systems try to maintain relative humidity (RH) near 50% while maintaining comfortable temperature. This is hard to do because the constant inflow of outside air through ventilation changes both temperature and humidity indoors. As a result, RH is either too high when it is hot or rainy, and too low when it is cold or dry. The upshot: increasing ventilation modifies humidity and unintentionally exacerbates the spread of airborne viruses.

Recommendation #3: Maintain good humidity control, rather than increase outside air, to minimize the spread of the virus.

The Bottom Line: More may be Less

The understanding of COVID-19 is far from complete and evolving rapidly, but based on presently available information, our conclusion is that (a) outdoor ventilation plays at most a very small role in spreading the virus that causes COVID-19 and (b) the initial impulse to increase ventilation may be misguided, and in fact increase the spread the virus in some cases. Even before taking into account the mechanical constraints and energy costs of increased ventilation, more outside air may cause more harm than good. As new data emerges, we will continue to update the HVAC community.

⁶ Casanova LM et al, Effects of Air Temperature and Relative Humidity on Coronavirus Survival on Surfaces, Applied and Environmental Microbiology, May 2010, p. 2712–2717