Epidemic Task Force Core Recommendations

I expected more specifics and evidence-based recommendations from the Epidemic Task Force (ETF) than noted in May's IEQ Applications column, "ASHRAE Epidemic Task Force Core Recommendations: Reducing Airborne Infectious Aerosol Exposure" by William Bahnfleth, Ph.D., P.E., and Jason DeGraw, Ph.D.

Without specifics, I am afraid these will lead to more misuse than benefit. For example, without more specifics on wavelengths and caution, I am afraid anyone with any ultraviolet lamp will claim it works.

Or, since many HVAC-grade filters are charged, at a minimum they should be tested per ASHRAE Standard 52.2 Appendix J. Besides, since most IAQ systems are recirculating air, the effect of upgrading filters rated for single pass will not be appreciable.

I hope ASHRAE is not adding to the noise on this subject instead of being the brain trust the HVAC market depends on. I look forward to more specifics for nonexperts.

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The Authors Respond

We thank Dr. Vijayakumar for his comments. We agree the Core Recommendations are not complete in themselves, but they were not intended to be, as our column stated.

The column's first paragraph notes the Core Recommendations are a "concise summary of the most current task force recommendations." Those recommendations and their application are detailed in nearly 400 pages of detailed and widely referenced guidance that can be found at the ASHRAE COVID-19 resources page (www.ashrae.org/COVID19). It is based as much as possible on good practice for airborne infection control and our currently incomplete knowledge about SARS-CoV-2.

To address the specific issues raised in the letter, first, the Core Recommendations clearly state that only air cleaners for which there is clear evidence of effectiveness and safety should be used. Further discussion of what this means can be found in task force guidance on filtration and disinfection, the "ASHRAE Position Document on Filtration and Air Cleaning" (https://tinyurl.com/t5m4t3xn) , and—specifically for ultraviolet air disinfection equipment—ASHRAE Standards 185.1 and 185.2.

Likewise, the task force Filtration and Disinfection (https://tinyurl.com/jyfyvuw) and Building Readiness (https://tinyurl.com/899sfp7s) guidance documents include extensive discussion of mechanical filter ratings according to ASHRAE Standard 52.2-2017 and other guidance for effective application of enhanced filtration.

We are unclear about the meaning of the comment on recirculation. The only reason filters in central air distribution systems have potential to reduce exposure to infectious aerosols is that indoor air recirculates through them. Without recirculation, filters in air-handling units only remove particulate matter of outdoor origin, and their total removal increases as the indoor air recirculated through them increases.

It is straightforward to estimate the effect of a filter of known single-pass efficiency in a recirculating system. The combined effect of outdoor air, filtration and air cleaning can be estimated using a spreadsheet tool for which a link is provided in the previously referenced Building Readiness guidance.

We hope this response clarifies that the Core Recommendations are a point of entry into the extensive guidance developed by the task force. To date it has proved a useful tool for explaining the key points to a variety of audiences.

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Virus Transmission Modes and Mitigation Strategies

We read with great interest "Virus Transmission Modes and Mitigation Strategies, Part 1 and Part 2" by Jonathan Burkett, P.E., in the March and April issues.

In minimizing airborne transmission, ventilation provision is the most important. The ventilation requirement expressed in terms of the number of air changes per hour (ach) was worked out based on acceptable CO_2 levels for general applications and the CO concentration for parking lots or vehicular tunnels.

On the other hand, ventilation design guides on virus control indoors can be developed using the Wells-Riley model.[1,2] The probability, P, of infection risk for a susceptible is expressed in terms of the air change rate, Q, through a parameter, A, by:

$$P = 1 - e^{-A/Q} \quad (1)$$

Based on available literature results, P is plotted against Q (*Figure 1*), and the data are fitted with *Equation 1* to yield A = 0.8054 h^{-1}, with a very low correlation coefficient of 0.4621. From *Figure 1* it can be seen that the values of P deviate appreciably from *Equation 1* for Q less than 5 ach.

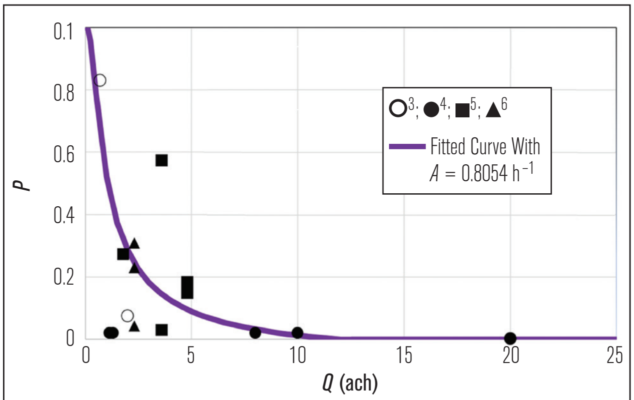

Figure 1 *P* vs. *Q*.

Very few updated data exist for the novel coronavirus SARS-CoV-2, especially for the more infectious mutant coronavirus strains. A value of 6 ach adopted in many indoor places including restaurants led to many challenges, particularly from the catering industry with respect to normal business operation. Keeping the ventilation requirements of 6 ach minimum should be further justified. As shown in *Figure 1*, it appears difficult to justify this requirement.

Ventilation requirements for buildings should be reviewed[7] by including the indoor airflow pattern for developing ventilation codes. Local air speeds and turbulence are the key factors affecting virus transmission and can be predicted by computational fluid dynamics (CFD). Numerical simulations can be performed to examine the transport mechanism, particle path and a suggested control strategy for reducing airborne infectious agents. CFD is now rather mature and in general cheaper than other methods. Correlation relations among the key macroscopic design parameters could then be obtained.

Airborne transmission of SARS-CoV-2 is brought about by virus-laden aerosols, which originate from expiratory liquid droplets,[1,2] and humidity has an important role to play. There are very few studies in design guides on the evaporation effect of droplets under different air humidities. The life cycle of aerosol droplets, including formation, evaporation and time staying in air are all important parameters that affect the infectivity of the virus, especially indoors.

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The Author Responds

I would like to first thank you for your comments and for highlighting the importance of ventilation in minimizing airborne transmission. After source control, ventilation is considered one of the most important factors in infection reduction.

Ventilation is often referred to in studies, but the term is not always defined. ASHRAE Standard 62.1-2019 defines ventilation air as "that portion of supply air that is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable IAQ."

The World Health Organization (WHO) in their *Natural Ventilation for Infection Control in Health-Care Settings* study concludes that "lack of ventilation or low ventilation rates are associated with increased infection rates or outbreaks of airborne diseases."[1] However, research has not yet agreed on a minimum ventilation rate required to reduce airborne infection.[2]

A study by Mousavi, et al.,[3] compared outside air ratios and filter efficiencies and found that as filtration efficiency increased, the contaminant decay time was less affected by providing more outdoor air. Another study by Nardell, et al.,[4] explored the relationship between infections quanta generation (disease infectiousness) and outside air cfm. They found that as quanta generation per hour increased, the impact of providing additional outside air decreased.

As you mentioned it is hard to justify a minimum ventilation rate that is suitable for all spaces. Since the airborne transmission of diseases in spaces is greatly affected by air distribution, ventilation, filtration and other cleaning methods, environmental factors (such as temperature, humidity, thermal currents and occupant movement), as well as concentration and virulence of the pathogen, length of exposure and occupant susceptibility, a minimum ventilation rate that incorporates all of these factors is difficult to calculate. As you also mentioned, a better approach is CFD modeling or a simple risk analysis.

Due to the COVID-19 pandemic, additional research on airborne disease transmission has a renewed focus. With this renewed focus, I am hopeful that as we learn more about airborne disease transmission, improved guidance will be forthcoming.

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