

COVID & IAQ: New Best Practices Webinar Series



enVerid Systems develops products that deliver cost savings and healthier indoor air quality (IAQ) for the built environment.

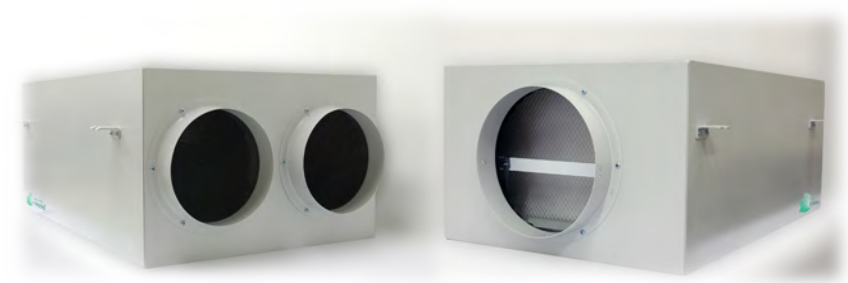


enVerid HLR Modules



- ✓ Save on HVAC equipment first cost
- ✓ Reduce HVAC energy use up to 30%
- ✓ Lower carbon emissions & improve IAQ
- ✓ Earn LEED and WELL points
- ✓ ASHRAE 62.1 & IMC compliant (IAQP)

enVerid Air Purifier



- ✓ HEPA filter captures 99.99% of aerosols
- ✓ Boost clear air changes by 3-5x hour
- ✓ Optimize air flow and minimize sound
- ✓ Commercial grade, permanent solution

enVerid Systems develops products that deliver cost savings and healthier indoor air quality (IAQ) for the built environment.



Insights & Education

- Expertise in IAQ, ventilation, filtration, and energy efficiency
- Over 70 patents related to IAQ, HLR and filtration technology
- View our white papers, webinars, videos, blogs, and byline articles at enVerid.com

Recent News



enVerid Webinar Series

THURSDAY, OCTOBER 22, 2020 | 2:00 – 2:45 PM EDT

ASHRAE Epidemic Task Force Recommendations

The Latest Research on **COVID-19** & Indoor Air Quality (IAQ) from Industry-Leading Experts



**William Bahnfleth, Ph.D., P.E.,
FASHRAE, FASME, FISIAQ**

Dr. Bahnfleth chairs the ASHRAE Epidemic Task Force and is a professor of Architectural Engineering at Penn State University. He will share the latest core recommendations for COVID-19 mitigation from the ASHRAE Epidemic Task Force

LEARN MORE AND REGISTER NOW

UPCOMING: THURSDAY, NOVEMBER 11



Marwa Zaatari, Ph.D., P.E.

ASHRAE Distinguished Lecturer; Member, ASHRAE Epidemic Task Force Commercial Buildings Subcommittee, Chief Science Officer, Blue Box Air

AVAILABLE NOW FOR REPLAY ON ENVERID.COM



Luke Leung, P.E., LEED® Fellow

Chair, ASHRAE Epidemic Taskforce Commercial Buildings Subcommittee; Member, UK Royal Academy of Engineering COVID-19 Task Force



PennState
College of Engineering

**ARCHITECTURAL
ENGINEERING**

enVerid Webinar Series - Covid & IAQ: New Best Practices

ASHRAE's COVID-19 Mitigation Recommendations for HVAC Systems

William Bahnfleth, PhD, PE, FASHRAE, FASME, FISIAQ
Professor, The Pennsylvania State University
Chair, ASHRAE Epidemic Task Force

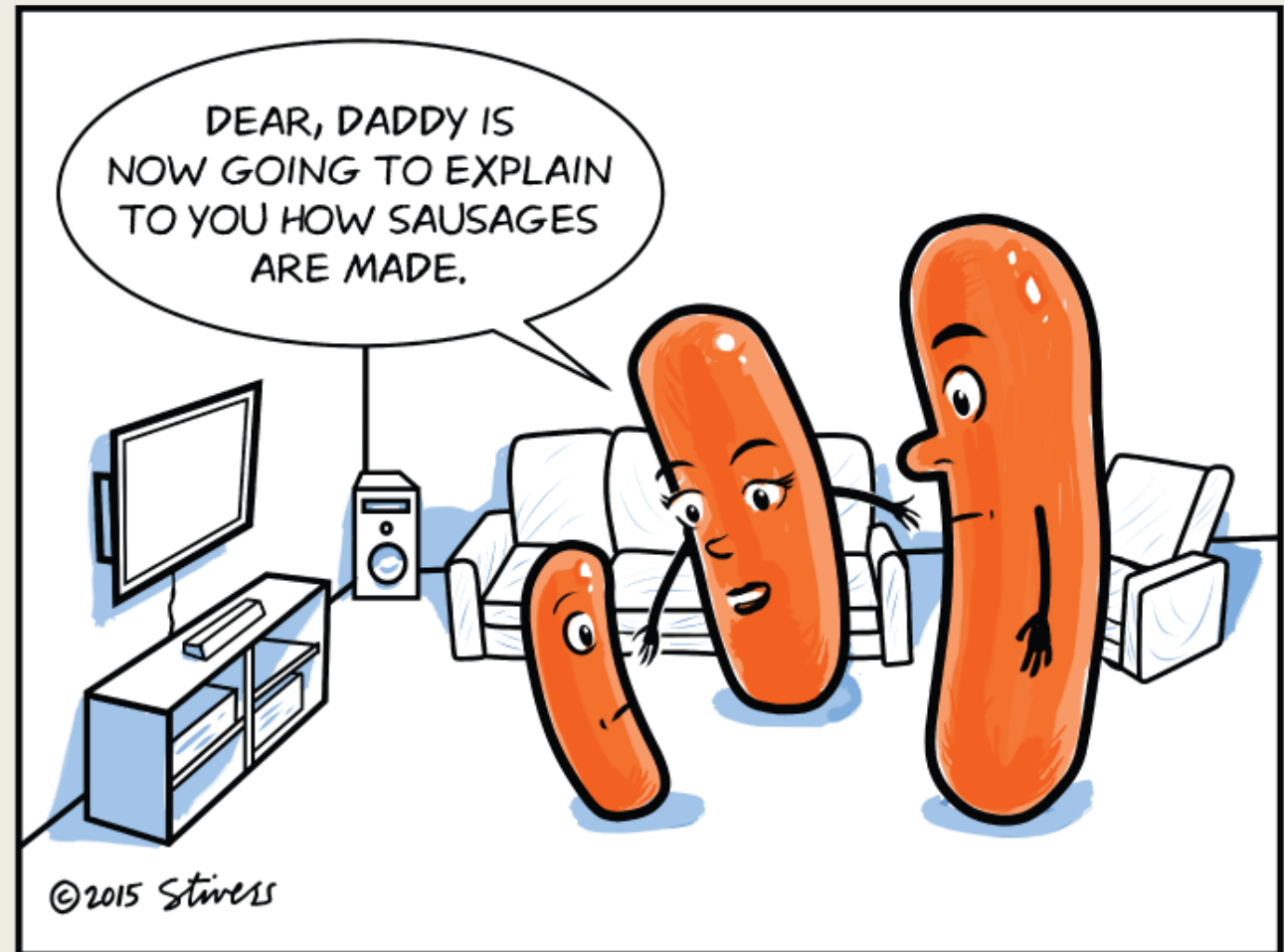


ASHRAE recommendation overview

- Public health guidance – masks, distancing, hygiene, etc.
- HVAC system assessment – verify design intent
- Ventilation rate (outdoor air), filtration, and air cleaning
 - *Required minimum OA (e.g., ASHRAE 62.1)*
 - *MERV 13 for recirculated air*
 - *HEPA, GUV or other air cleaners if needed*
 - *Use equivalent outdoor air approach*
- Air distribution – mixing without strong drafts
- Controls
 - *Maintain T & RH set points*
 - *Maintain design OA flow*
 - *Occupied mode when people are present*
 - *Flush pre-occupancy 3 equivalent air changes*
- At-risk populations/high risk activities
 - evaluate need for additional risk mitigation

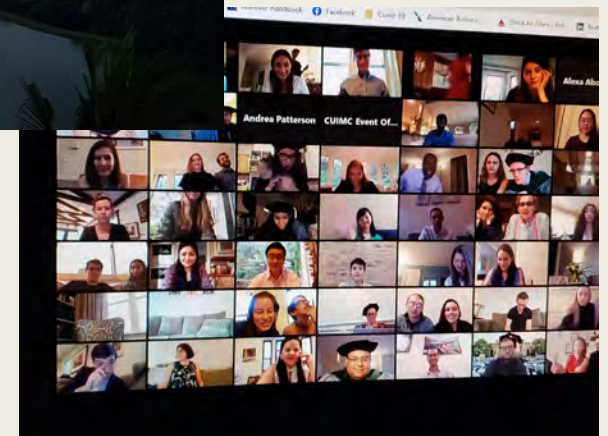
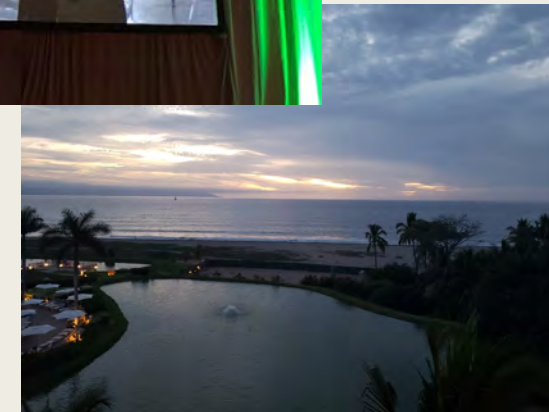
Outline

- A brief history of the ASHRAE Epidemic Task Force in context
- Where to find ASHRAE's guidance/ what is NOT ASHRAE's guidance
- Where recommendations started
- Where they are now and why they have evolved



Inception of the pandemic and ASHRAE's Response – a personal time line

- December 31, 2019 – WHO receives first report of “viral pneumonia” in Wuhan
- January 11, 2020 – First reported death in China
- January 21, 2020 – First reported case in US
- January 30, 2020 – ASHRAE Winter Meeting begins
- February 1 – Diamond Princess cruise ship outbreak
- March 2 – ASHRAE EHC tasked with organizing ASHRAE response (221 cases/6 deaths in US)
- March 6 – 16 Penn State Spring Break
 - *March 12 – Initiation of ASHRAE Epidemic Task Force (147,974/41)*
 - *March 16 - Penn State moves to remote instruction “until at least April 3”*
- March 29 – First meeting of task force (1,074,110/3,284)
- April – First ETF guidance posted




ASHRAE Epidemic Task Force






- 26 members/staff + liaisons
- ETF members organize and lead teams – team membership now >150 involved in total
- Some teams meet weekly, full task force meets bi-weekly
- Scope – HVAC Guidance
 - *Initial, expedited guidance*
 - *Refined guidance, re-opening guidance*
 - *Post-pandemic recommendations*
 - Research
 - Standards
 - Education
 - Guidance
- Activities
 - *Guidance development*
 - *Responses to questions*
 - *Communications*
 - *Partnerships*
 - *Advocacy*
 - *Education*
- Exposure
 - *State, congressional briefings*
 - *> 6 billion media impressions*
 - *~300 news articles*
 - *~150 media requests*

ASHRAE Epidemic Task Force Teams

- Communications
- Developing economies
- External partnerships
- Literature review
- Science applications
- Research
- Filtration and disinfection
- Building readiness
- Healthcare
(including long-term care)
- Residential
(including multi—unit)
- Commercial/retail
- Schools
- Laboratories
- Industrial
- Transportation



CORONAVIRUS (COVID-19) RESPONSE RESOURCES FROM ASHRAE AND OTHERS


SHARE THIS     

Questions?
Email COVID-19@ashrae.org

FULL ETF ROSTER


Please support ASHRAE's continuing work to combat the transmission of COVID-19

DONATE NOW



Guide to the COVID-19 Pages
Follow the links on the Infographic







LEARN MORE




Questions Answered
Frequently Asked Questions and Glossary of Terms

FAQ / GLOSSARY


This page is updated as new information becomes available.

 [Main](#)  [Reopening](#)  [Buildings](#)  [Filtration/Disinfection](#)  [Transportation](#)  [Resources](#)



There's one data center for every 100 people in the United States and thousands of facilities worldwide

ANSI/ASHRAE Standard 90.4-2019 –
Energy Standard for Data Centers


ashrae.org/904



General Information

- [Building Readiness Intent](#)
- [Building Readiness Team](#)
- [Building Readiness Plan](#)

Epidemic Conditions in Place (ECiP)

- [Systems Evaluation](#)
- [Building Automation Systems \(BAS\)](#)
- [Increased Ventilation](#)
- [Increased Ventilation Control](#)
- [Building and Space Pressure](#)
- [Pre- or Post-Occupancy Flushing Strategy](#)
- [Upgrading and Improving Filtration](#)
- [Energy Savings Considerations](#)
- [Exhaust Air Re-entrainment](#)
- [Energy Recovery Ventilation Systems](#)
- [Operation Considerations](#)
- [UVGI Systems](#)
- [Domestic Water & Plumbing Systems](#)
- [Maintenance Checks](#)
- [Shutdown a Building Temporarily-FAQ](#)
- [System Manual](#)
- [Reopening During Epidemic Conditions in Place](#)

Post-Epidemic Conditions in Place (P-ECiP)

- [P-ECiP: Prior to Occupying](#)
- [P-ECiP: Operational Considerations once Occupied](#)
- [P-ECiP: Ventilation](#)
- [P-ECiP: Filtration](#)
- [P-ECiP: Building Maintenance Program](#)
- [P-ECiP: Systems Manual](#)


Additional Information

- [Acknowledgements](#)
- [References](#)
- [Disclaimer](#)

Information in this document is provided as a service to the public. While every effort is made to provide accurate and reliable information, this is advisory, is provided for informational purposes only, and may represent only one person's view. They are not intended and should not be relied upon as official statements of ASHRAE.

Currently, 119 pages

One-page summaries – re-opening, schools, residential, polling places, more in development



GUIDANCE FOR RE-OPENING BUILDINGS

ASHRAE is a global professional society of over 55,000 members committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration and their allied fields. ASHRAE has established a Task Force to help deploy technical resources to address the challenges of the COVID-19 pandemic and possible future epidemics as it relates to the effects of heating, ventilation, and air-conditioning (HVAC) systems on disease transmission. Guidance and building readiness information for different operational conditions have been developed for several building types, including commercial; residential; schools and universities; and healthcare facilities, as well as general guidance for re-opening buildings.


ASHRAE's [reopening guidance](#) provides practical information to help your HVAC system mitigate the transmission of SARS-CoV-2. Some general recommendations are provided below. *Please consult the full guidance for important details and consider reaching out to qualified design professionals for additional analysis as needed.*

- **Systems Evaluation:** Inspect equipment, systems, and controls to check for existing issues. Evaluate outdoor air ventilation for compliance with design requirements. Make note of existing filters' MERV rating. Analyze each HVAC system for appropriate engineering controls to improve its potential to reduce virus transmission. Check calibration per the guidance in ASHRAE Guideline 11-2018, *Field Testing of HVAC Control Components*.
- **Inspection and Maintenance:** Verify HVAC systems function per design intent using ASHRAE Standard 180-2018, *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*, or equivalent. Ensure that energy recovery devices can be operated safely.
- **Ventilation and Filtration:** Confirm systems provide required minimum amounts of outdoor air for ventilation and that the filters are MERV 13 or better filters for recirculated air. Combine the effects of outdoor air, filtration, and air cleaners to exceed combined requirements of minimum ventilation and MERV-13 filters.
- **Building Readiness Plan:** Create a plan to document the intended operation for the building, highlighting the mitigation strategies, temporary and permanent, to be implemented for the facility.
 - Non-HVAC Strategies: Note if face masks are required or recommended; implement social distancing, establish occupancy levels, and establish cleaning and handwashing requirements.
 - HVAC Strategies: Increased ventilation, improved filtration, and/or air cleaning technologies.
- **Pre- or Post-Occupancy Flush with Outdoor Air:** Focus on removing bio-burden pre- or post-occupancy of the building. Flush building for a time required to achieve three air changes of outdoor air (or equivalent, including effect of outdoor air, particulate filtration, and air cleaners).
- **Modes of Operation for the Building:** Operate in Occupied Mode when people are present in the building, including times when the building is occupied by a small fraction of its allowable capacity.
- **Water Systems:** In general, building water systems should be flushed before they are reopened. Refer to EPA Guidance on this topic [here](#) and ASHRAE Standard 188-2018, *Legionellosis: Risk Management for Building Water Systems*, and Guideline 12-2020, *Managing the Risk of Legionellosis Associated with Building Water Systems*.
- **Energy Savings:** During Evaluation and Inspection, determine optimized control strategies that can be implemented per ASHRAE Guideline 36-2018, *High-Performance Sequences of Operation for HVAC Systems*.

HVAC&R systems play an important role in minimizing the spread of harmful pathogens, and ASHRAE is ready to provide technical resources and answer questions.

The most up-to-date ASHRAE COVID-19 guidance can be found [here](#).
The most up-to-date information on building re-opening can be found [here](#).
For further assistance, please contact GovAffairs@ashrae.org.

The information above is provided as a service to the public. While every effort is made to provide accurate and reliable information, this is advisory, and is provided for informational purposes only. They are not intended and should not be relied upon as official statements of ASHRAE.



GUIDANCE FOR RESIDENTIAL BUILDINGS

ASHRAE is a global professional society of over 55,000 members committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration and their allied fields. ASHRAE has established a Task Force to help deploy technical resources to address the challenges of the COVID-19 pandemic and possible future epidemics as they relate to the effects of heating, ventilation, and air-conditioning (HVAC) systems on disease transmission. Guidance and building readiness information for different operational conditions have been developed for several building types, including commercial; residential; schools and universities; and healthcare facilities.

Home is usually the safest indoor space and we stay there as much as possible to protect ourselves and to help mitigate the spread of COVID-19. ASHRAE recommends following [CDC guidance](#) on minimizing contact, wearing cloth face masks and creating a household plan. ASHRAE's [residential building guidance](#) supplements the CDC guidance with general recommendations for minimizing virus transmission through the air using the home's HVAC equipment and controls. ASHRAE's website provides additional details and the most up-to-date [information on residential buildings](#), as well as answers to [Frequently Asked Questions](#). *Please consult the full guidance for important details and consider reaching out to qualified design professionals for detailed analysis as needed.*

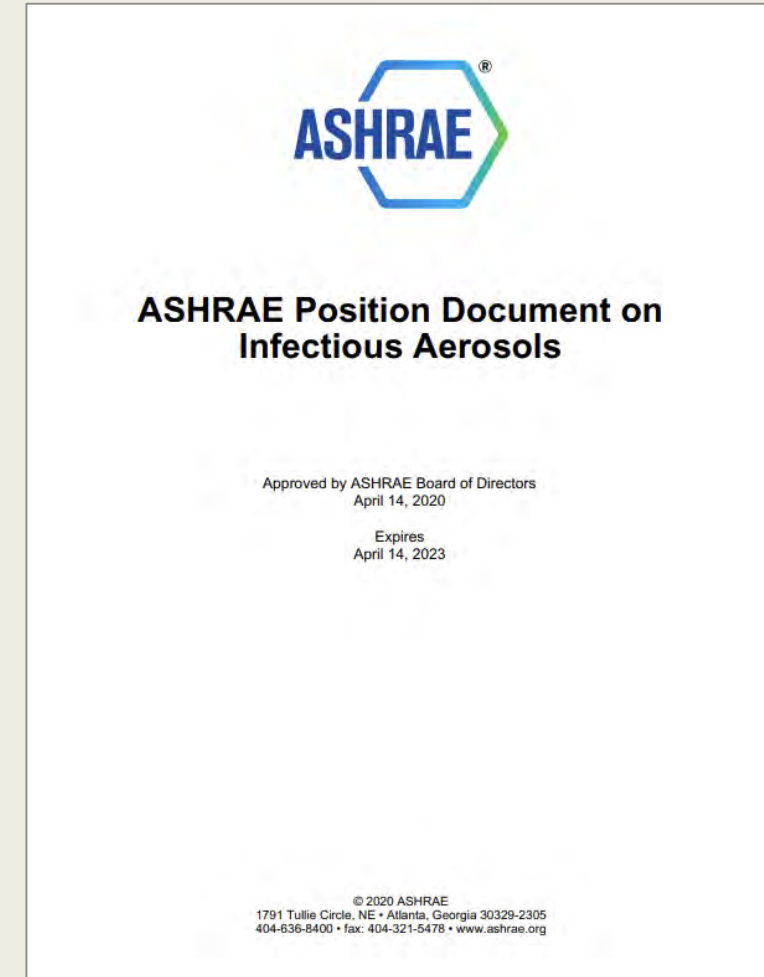
- **Maintain thermal comfort:** Avoid extremes of temperature by operating and maintaining the building and the heating and cooling equipment to keep temperature and humidity in normal ranges, which are generally 68-78 Fahrenheit (20-25 Celsius) and 40-60% relative humidity.
- **Filtration for Homes with Forced-Air Systems:** Upgrade filters to high-efficiency filters (MERV 13 or the best the system can accommodate), if practical. Adjust the fan setting to run even if not currently heating or cooling.
- **Ventilation (with outdoor air):** Increase mechanical ventilation, if practical. If the house is not equipped with a mechanical system that provides whole house ventilation opening multiple windows is an acceptable alternative for a single-family home. Whole-house "summer cooling" fans or economizers may also be used to increase outdoor air ventilation. Weather may make this impractical at times.
- **Restrooms:** Operate exhaust fans in bathrooms, toilets and lavatories preferably continuously. Toilet lids should normally remain closed, especially prior to flushing. Do not allow plumbing traps to become dry.
- **Air Purifiers:** Stand-alone air cleaners (often called air purifiers) with HEPA particle filters can help remove suspended small airborne particles that can contain viruses and the fine particles typical of wildfires. When either is a risk, operate the device(s) continuously. In general, the larger the flow the better. Those with ultraviolet disinfection can further reduce virus risk.
- **Multi-Family Homes:** Minimize the use of open windows to limit the potential transfer of infective air from nearby apartments. Seal any large openings in walls or ceilings or gaps around plumbing or electrical penetrations that could allow air to flow into the dwelling unit from other units in the building.
- **Create an Isolation Space for Infected Household Members:** Barriers should be used between the isolated and common spaces. The isolation space should have flow into it from other spaces which can be achieved using exhaust fans temporarily installed in windows or bathroom exhaust fans if the isolation space has its own bathroom. Air purifiers should be considered.
- **Create a Protected Space for High-Risk Household Members:** Barriers should be used between the protected and common spaces. The protected space should have air flow out of it to other spaces which can be achieved using supply fans temporarily installed in windows. Air purifiers should be considered.

For further assistance, please contact GovAffairs@ashrae.org.

The information above is provided as a service to the public. While every effort is made to provide accurate and reliable information, this is advisory, and is provided for informational purposes only. They are not intended and should not be relied upon as official statements of ASHRAE.

The ASHRAE *Position Document on Infectious Aerosols* is not ASHRAE's COVID-19 Guidance

- First issued as *Airborne Infectious Diseases* in 2009
- Latest update in April 2020
- Expedited completion at a time when ETF had not issued its first recommendations
- Good background, but recommendations superseded by ETF guidance



Foundation of guidance – the precautionary principle applied to *airborne* transmission

“One should take reasonable measures to avoid threats that are serious and plausible.”

D. Resnik. 2004. The Precautionary Principle and Medical Decision Making. *Journal of Medicine and Philosophy*, 29(3):281-299.

If transmission is airborne, HVAC systems impact risk

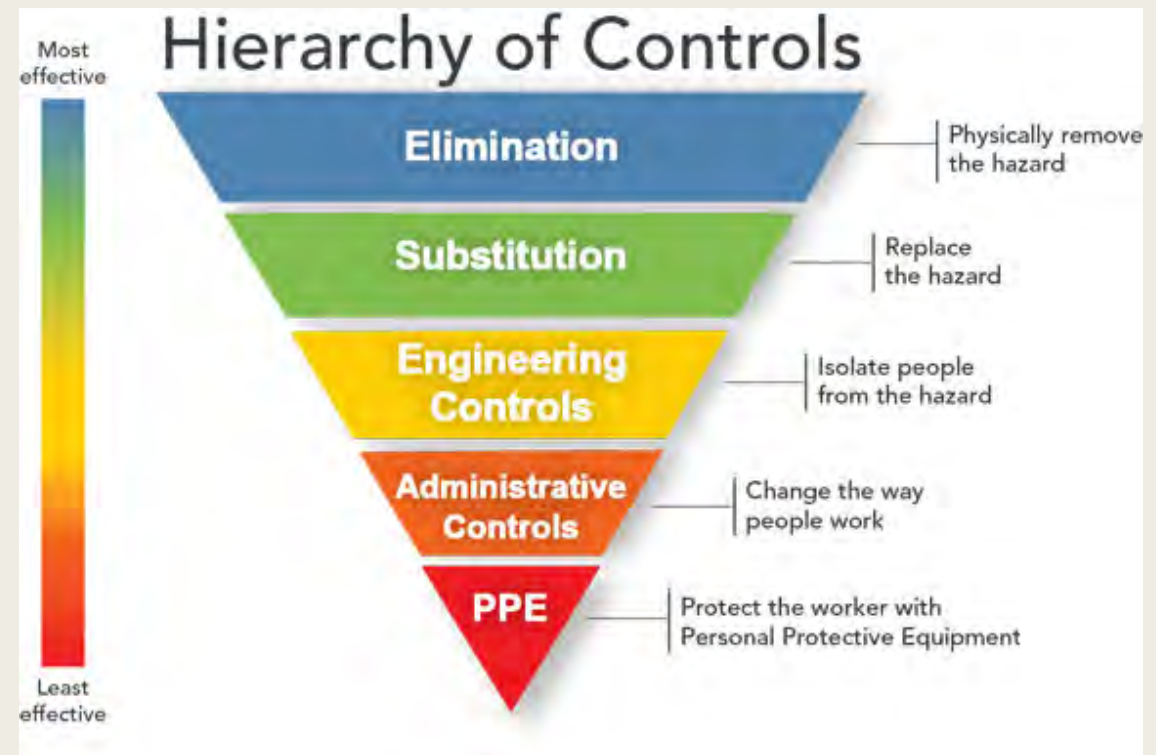
Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.

Guidance was, and is, being developed in spite of significant knowledge gaps

- Infective characteristics of SARS-CoV-2 are not well established
 - *Viral shedding rate*
 - *Distribution of virus by droplet size*
 - *Infectious dose*
- Relative weight of infection modes is not well established
 - *Short range/droplet*
 - *Aerosol/Airborne*
 - *Fomite*
 - *Other?*
- Fundamental problem – risk cannot be quantified very accurately

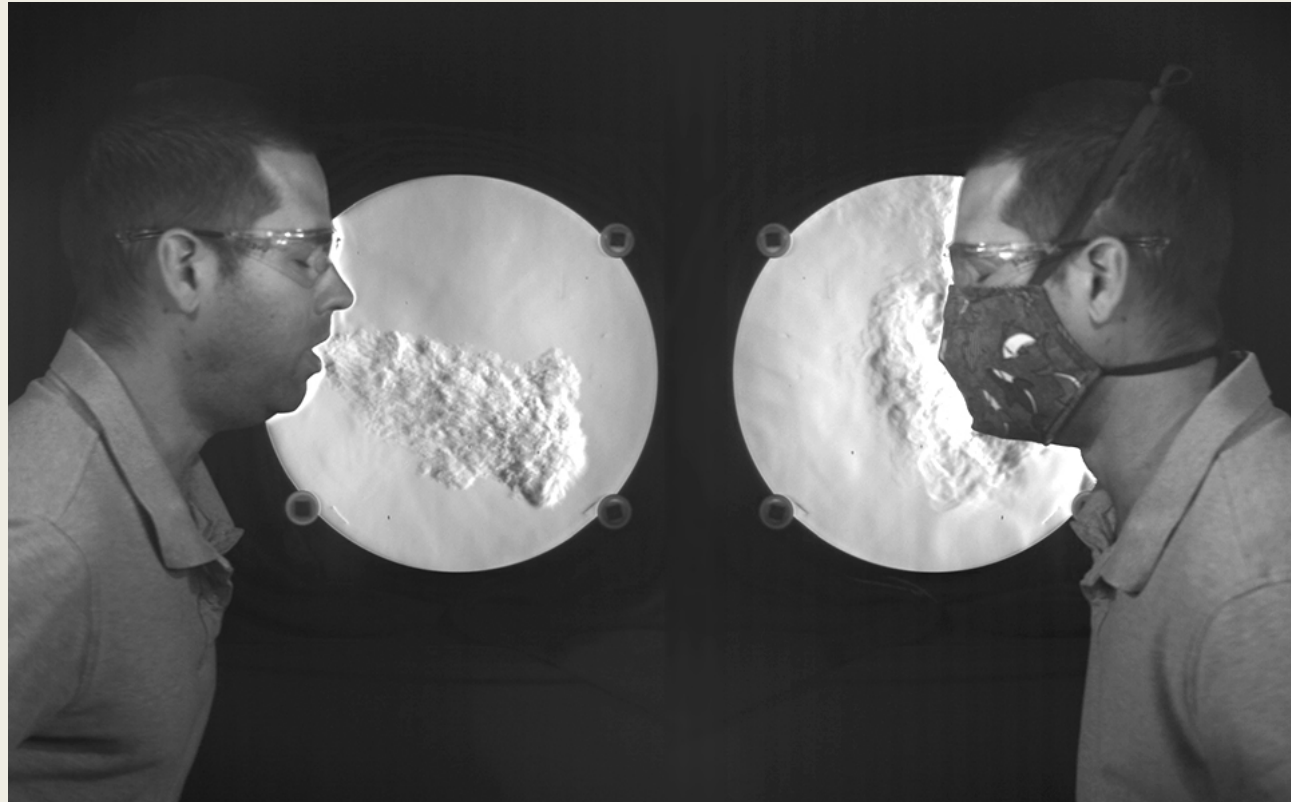
HVAC is only one layer of an effective control strategy

- Source elimination
 - *Testing, contact tracing*
- Substitution – NA
- Engineering controls
 - *HVAC interventions*
- Administrative controls
 - *Behavioral rules and recommendations*
- PPE
 - *Masks, but they can also be source controls*



ASHRAE guidance assumes adherence to recommendations of public health authorities

- Use of masks
- Distancing
- Avoiding large gatherings
- Hygiene



Credit: M. Staymates/N. Hanacek/NIST

<https://www.nist.gov/blogs/taking-measure/my-stay-home-lab-shows-how-face-coverings-can-slow-spread-disease>

Initial guidance driven by perceived risk and possible effectiveness, not \$\$ and operational impacts

- Maximize outdoor air intake of mechanical systems/minimize recirculation
- Disable demand controlled ventilation
- 24/7 system operation at maximum achievable outdoor air flow
- Shut off energy recovery wheels
- Upgrade filters to at least MERV 13
- Open windows, induce ventilation with fans
- Add air cleaners of demonstrated safety and effectiveness, e.g., UVC
- Control humidity to 40 – 60% RH range

What has changed since April/May that would affect guidance

- Science – not much...mainly confirmation of original approach
 - *SARS-CoV-2 penetration of HVAC systems*
 - *Sampling of viable SARS-CoV-2 from air*
 - *More superspreader events associated with low ventilation rate*
 - *No clear evidence of transmission through HVAC systems*
- Risk analysis
 - *Use of Wells-Riley modeling of airborne infection to provide preliminary quantitative estimates of risk*
 - *Related movement toward an “equivalent outdoor air” approach to requirements*
- More consideration of economic and operational factors in prioritizing controls
- + a few key technical insights

Risk analysis with the Wells-Riley model

$$P = \frac{C}{S} = 1 - \exp\left(-\frac{Iqpt}{Q}\right)$$

- Steady-state conditions
- Time-dependent risk
- Quanta determined from data

- P = probability of new infections
- C = new infections
- S = number of susceptibles
- I = number of infectors
- q = quanta generation rate (1/hr)
- p = pulmonary ventilation rate per susceptible (m^3/h)
- t = exposure time (hr)
- Q = flow rate of uncontaminated air (1/hr)

Equivalent clean (outdoor) air flow for other removal factors can be included in Wells-Riley

$$P = 1 - \exp\left[-\frac{ipqt}{Q}\right] = 1 - \exp\left[-\frac{ipqt}{\cancel{V}} / \alpha_{OA}\right] \quad \text{Substitute outdoor air changes, } \alpha_v \text{ for } Q$$

For an air cleaner with CADR = Q_{AC} , $\alpha_{AC} = \frac{Q_{AC}}{\cancel{V}}$

Equivalent ACH = $\alpha_{OA} + \alpha_{AC}$, so

$$P = 1 - \exp\left[-\frac{ipqt}{\cancel{V}} / (\alpha_v + \alpha_{AC})\right]$$

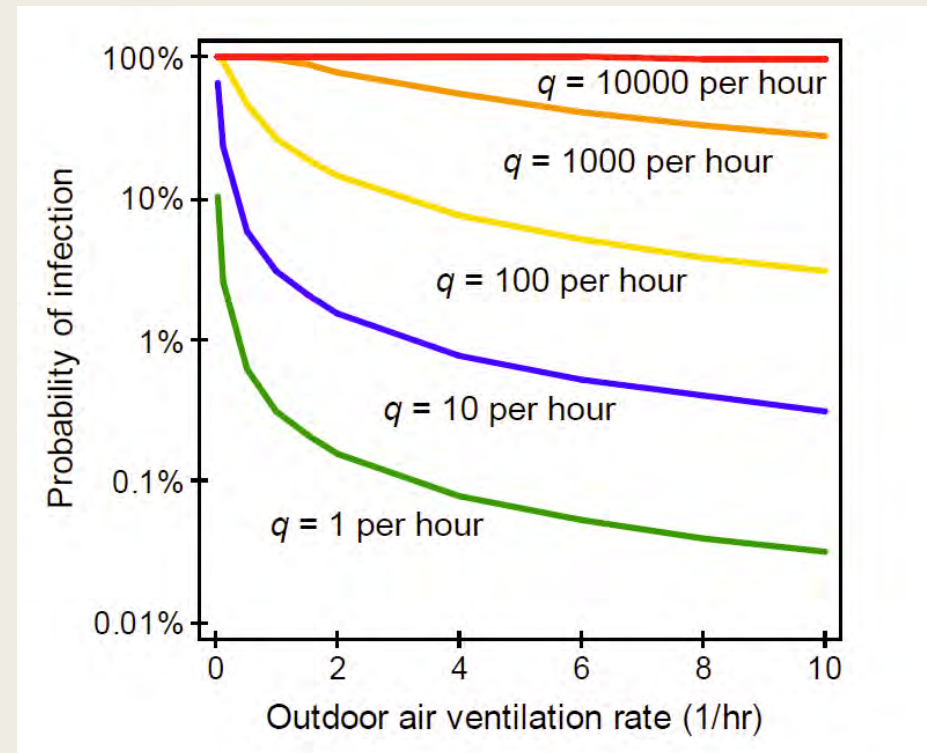
Can include outdoor air, mechanical filtration, air cleaners, deposition, natural decay if quantifiable

Applies contaminant by contaminant

Placement of filter or air cleaner in system matters

Exposure time and air flow are the main independent parameters

- Stephens (2012) HVAC filtration and the Wells-Riley approach to assessing risks of infectious airborne diseases. Final report to NAFA.
- Risk of infection for an average adult susceptible ($p = 0.48 \text{ m}^3/\text{h}$) in a 500 m^2 office for 8 hours with one infected person



Quanta emission rates have been estimated for SARS-CoV-2

		Resting, oral breathing	Heavy activity, oral breathing	Light activity, speaking	Light activity, singing (or speaking loudly)
ER _q	5th percentile	2.4×10^{-2}	1.6×10^{-1}	3.2×10^{-1}	2.1×10^0
	25th percentile	1.2×10^{-1}	8.2×10^{-1}	1.6×10^0	1.0×10^1
	50th percentile	3.7×10^{-1}	2.5×10^0	5.0×10^0	3.2×10^1
	75th percentile	1.1×10^0	7.7×10^0	1.5×10^1	9.8×10^1
	90th percentile	3.1×10^0	2.1×10^1	4.2×10^1	2.7×10^2
	95th percentile	5.7×10^0	3.8×10^1	7.6×10^1	4.9×10^2
	99th percentile	1.7×10^1	1.2×10^2	2.4×10^2	1.5×10^3



Harvard-CU Boulder Portable Air Cleaner Calculator for Schools.v1.2

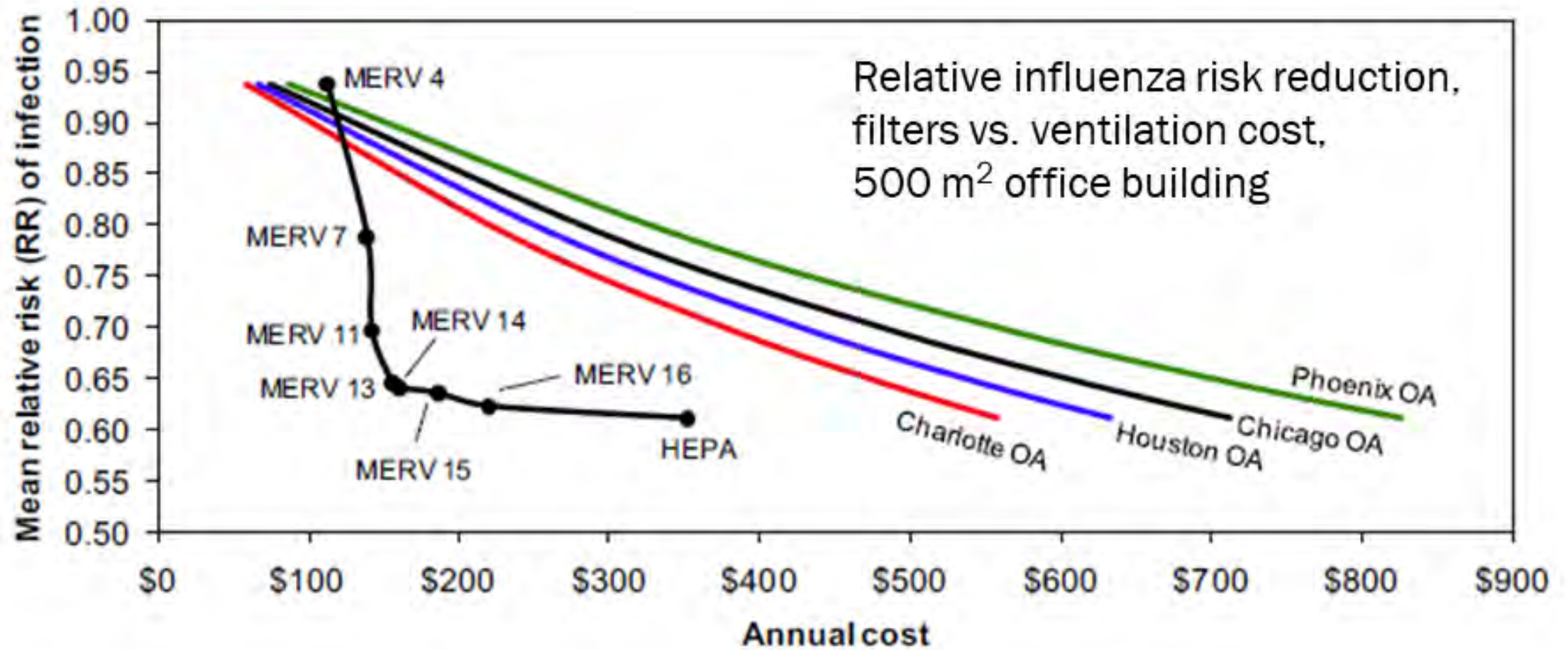
SIMPLE TOOL FOR SCHOOLS FOR SELECTING PORTABLE AIR CLEANER FOR ROOMS (input fields are bright yellow)									
STEP 1 HOW BIG IS THE ROOM?									
Select units of preference	feet								
How big is your room?		500	Input your room size here in square feet						
How tall are your ceilings?		8	Input your room size here in feet						
STEP 2 WHAT IS THE 'CLEAN AIR DELIVERY RATE' OF THE AIR PURIFIER? (you get this from the manufacturer)									
What is the clean air delivery rate of the air purifier?		300	Find the CADR from the manufacturer in units of cubic feet per minute, or cfm; if they report multiple num						
STEP 3 HOW MUCH OUTDOOR AIR VENTILATION DO YOU HAVE?									
How is the ventilation in my school?	Low ventilation	Good ventilation	3 ACH	This is the approximate min					
		Enhanced ventilation	4 ACH	Select this only if your schoo					
		Typical school	1.5 ACH	This is an approximate aver					
		Low ventilation	1 ACH	Select this if your school has					
STEP 4 COMBINING AIR CLEANING AND VENTILATION, IS YOUR ROOM MEETING THE TARGET?									
Air changes from outdoor air ventilation		1							
Air changes from air cleaner		4.5							
Total air changes in the room per hour		5.5							
<div style="display: flex; align-items: center;"> <div style="border: 2px dashed red; border-radius: 50%; padding: 10px; margin: 10px;"> <p>TARGET IS AT LEAST 5 TOTAL AIR CHANGES PER HOUR</p> <table border="1"> <tr> <td style="background-color: #006400; color: white;">Ideal (6 ACH)</td> </tr> <tr> <td style="background-color: #00FF00;">Excellent (5-6 ACH)</td> </tr> <tr> <td style="background-color: #FFD700;">Good (4-5 ACH)</td> </tr> <tr> <td style="background-color: #FFA07A;">Bare minimum (3-4 ACH)</td> </tr> <tr> <td style="background-color: #FF0000;">Low (<3 ACH)</td> </tr> </table> </div> </div>					Ideal (6 ACH)	Excellent (5-6 ACH)	Good (4-5 ACH)	Bare minimum (3-4 ACH)	Low (<3 ACH)
Ideal (6 ACH)									
Excellent (5-6 ACH)									
Good (4-5 ACH)									
Bare minimum (3-4 ACH)									
Low (<3 ACH)									
STEP 5 WHAT SIZE ROOM WILL WORK FOR THIS PORTABLE AIR CLEANER?									
Cubic feet per minute (cfm) of clean air from cleaner		300	This is from the manufacturer (see cell 'c8')						
Cubic feet per minute (cfm) of outdoor air from ventilation		67	This is calculated from air changes per hour and volume of room						
Total cfm of air cleaning and ventilation		367							
Recommended room size for this air cleaner (in square feet)		550	This is the recommended maximum size of the room for this air cleaner to achieve 5 total ACH						

https://docs.google.com/spreadsheets/d/1NEhk1IEdbEi_b3wa6gl_zNs8uBJlSS-86d4b7bW098/edit#gid=1836861232

Energy, economic, and operational considerations

■ Ventilation

- *Increasing it is expensive and energy intensive*
- *There are limits based on environmental control constraints*
- *Increasing outdoor air decreases air recirculated through filters*
- *Theoretical ability to vary outside air varies widely among system types*
- *Not all energy recovery wheels pose a re-entry risk*
- *Need for 24/7 operation is questionable given clearance time (3 air changes → 95% clearance)*
- *There is evidence that enhanced filtration is as effective and lower cost*



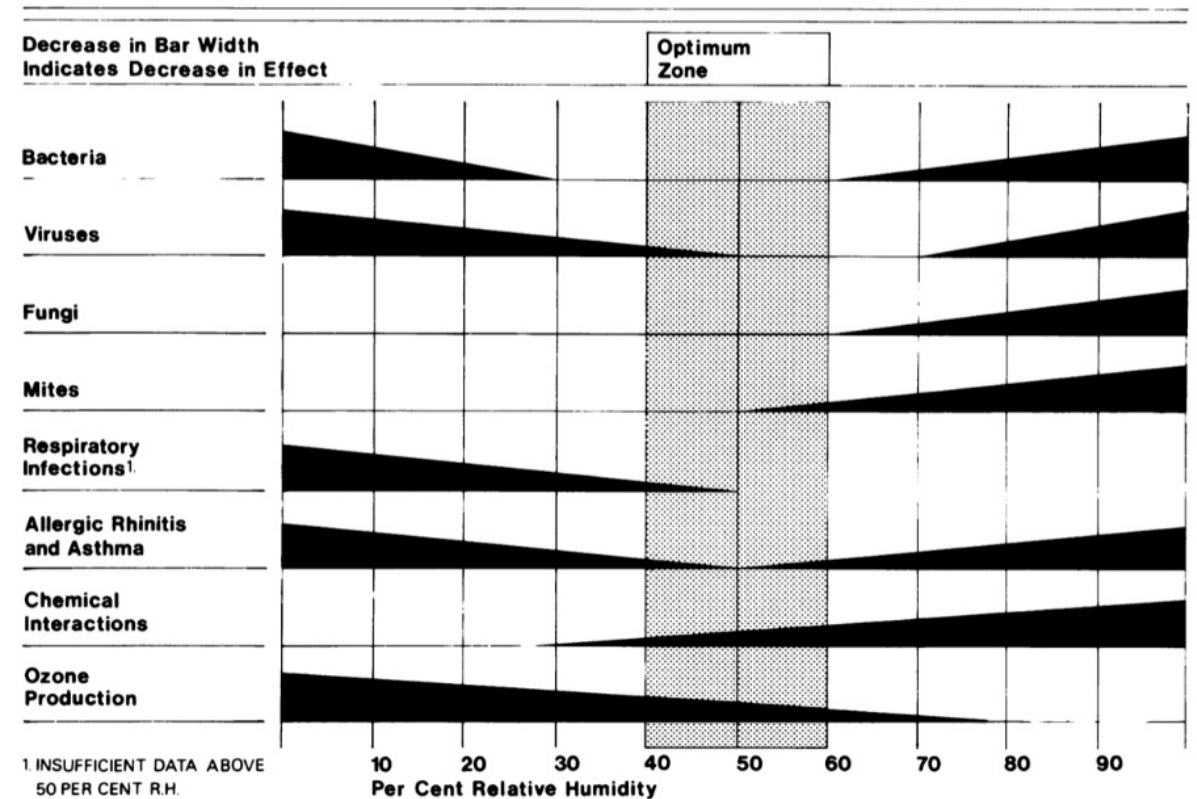
Azimi and Stephens, Building and Environment 70 (2013) 150-160

Azimi and Stephens, Building and Environment 70 (2013) 150-160

Temperature and Humidity Control

- Air temperature and humidity influence infection risk
- Elevated temperature reduces survival
- Several recent studies recommend 40 – 60% RH to minimize infection risk, but pathogen-specific behaviors vary widely
- Relative contribution to Covid-19 risk is not clear and some believe infection patterns demonstrate significance is minor

Arundel AV, Sterling EM et al. *Indirect Health Effects of Relative Humidity in Indoor Environments*, Environmental Health Perspectives Vol 65, 351-61, 1986.



Optimum relative humidity range for minimizing adverse health effects.



Temperature and Humidity

- Possible concerns about humidification and temperature manipulation to control infection risk
 - *Different responses for different pathogens*
 - *Risk of moisture damage/mold growth*
- ASHRAE Covid-19 guidance for existing buildings limits humidity adjustments based on evaluation of system and building limitations
- REHVA Covid-19 guidance – “Humidification and air-conditioning have no practical effect” – based on regional climate and their literature review

Core Recommendations (my paraphrase)

- Public Health Guidance: follow it – masks, distancing, hygiene, etc.
- HVAC System Assessment – verify design intent
- Ventilation, Filtration, Air Cleaning
 - *Required minimum outdoor air (e.g., ASHRAE 62.1)*
 - *Filtration – MERV 13 or equivalent for recirculated air*
 - *Air cleaners – standalone HEPA filters, UV-C or other technologies demonstrated to be effective/safe*
 - *Use equivalent outdoor air approach to exceed baseline outdoor air and filtration requirements (e.g., air change targets)*

Core Recommendations (continued)

- Air distribution – promote mixing while avoiding strong air currents in occupied zone
- Operations
 - *Maintain T and RH set points*
 - *Maintain design maximum outdoor air when occupied (so disable demand control of ventilation)*
 - *Use occupied mode whenever people (e.g. housekeeping staff) are present*
 - *Flush buildings with 3 equivalent air changes pre-occupancy*
 - *Energy recovery wheels – evaluate to determine whether safe to operate*
- At risk populations/high risk activities – evaluate need for additional risk mitigation measures.

Summary

- Making recommendations during the pandemic requires judgment where evidence is lacking
- ASHRAE recommendations, like others, were initially very conservative
- Ongoing reassessment has led to modifications that achieve similar levels of protection with lower cost and energy use impact (next webinar topic!)
- Equivalent outdoor air approach provides flexibility for meeting goals – but hard to quantify
- HVAC protections affect only one of several transmission risk elements and must be combined with other measures known to be effective

Questions?

Bill Bahnfleth
wbahnfleth@psu.edu



PennState
College of Engineering

**ARCHITECTURAL
ENGINEERING**