Pandemic: This Winter and Beyond

Oct 28, 2020

SOM

Current Research

Winter is Coming

Our Built Environment

ASHRAE POSITION

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.

WHO's POSITION – JULY 9th, 2020

Transmission of SARS-CoV-2: implications for infection prevention precautions

Scientific brief

09 July 2020

World Health Organization

This document is an update to the scientific brief published on 29 March 2020 entitled "Modes of transmission of virus causing COVID-19: implications for infection prevention and control (IPC) precaution recommendations" and includes new scientific evidence available on transmission of SARS-CoV-2, the virus that causes COVID-19.

Overview

This scientific brief provides an overview of the modes of transmission of SARS-CoV-2, what is known about when infected people transmit the virus, and the implications for infection prevention and control precautions within and outside health facilities. This scientific brief is not a systematic review. Rather, it reflects the consolidation of rapid reviews of publications in peer-reviewed journals and of non-peer-reviewed manuscripts on pre-print servers, undertaken by WHO and partners. Preprint findings should be interpreted with caution in the absence of peer review. This brief is also informed by several discussions via teleconferences with the WHO Health Emergencies Programme ad hoc Experts Advisory Panel for IPC Preparedness, Readiness and Response to COVID-19, the WHO ad hoc COVID-19 IPC Guidance Development Group (COVID-19 IPC GDG), and by review of external experts with relevant technical backgrounds.

The overarching aim of the global Strategic Preparedness and Response Plan for COVID-19(1) is to control COVID-19 by suppressing transmission of the virus and preventing associated illness and death. Current evidence suggests that SARS-CoV-2, the virus that causes COVID-19, is predominantly spread from person-to-person. Understanding how, when and in what types of settings SARS-CoV-2 spreads is critical to develop effective public health and infection prevention and control measures to break chains of transmission.

Modes of transmission

This section briefly describes possible modes of transmission for SARS-CoV-2, including contact, droplet, airborne, fomite, fecal-oral, bloodborne, mother-to-child, and animal-to-human transmission. Infection with SARS-CoV-2 primarily causes respiratory illness ranging from mild disease to severe disease and death, and some people infected with the virus never develop symptoms.

Contact and droplet transmission

Transmission of SARS-CoV-2 can occur through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings.(2-10) Respiratory droplets are >5-10 µm in diameter whereas droplets ≤5µm in diameter are referred to as droplet nuclei or aerosols.(11) Respiratory droplet transmission can occur when a person is in close contact (within 1 metre) with an infected person who has respiratory symptoms (e.g. coughing or sneezing) or who is talking or singing; in these circumstances, respiratory droplets that include virus can reach the mouth, nose or eyes of a susceptible person and can result in infection. Indirect contact transmission involving contact of a susceptible host with a contaminated object or surface (fomite transmission) may also be possible (see below).

Airborne transmission

Airborne transmission is defined as the spread of an infectious agent caused by the dissemination of droplet nuclei (aerosols) that remain infectious when suspended in air over long distances and time.(11) Airborne transmission of SARS-CoV-2 can occur during medical procedures that generate aerosols ("aerosol generating procedures").(12) WHO, together with the scientific community, has been actively discussing and evaluating whether SARS-CoV-2 may also spread through aerosols in the absence of aerosol generating procedures, particularly in indoor settings with poor ventilation.

The physics of exhaled air and flow physics have generated hypotheses about possible mechanisms of SARS-CoV-2 transmission through aerosols.(13-16) These theories suggest that 1) a number of respiratory droplets generate microscopic aerosols (<5 µm) by

https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

750 PROFESSIONALS, 51 NATIONS, 1 PETITION

Apply building best practices to save lives

AIA

ASHRAE

uia

INTERNATIONAL WELL BUILDING INSTITUTE™

WORLD GREEN BUILDING COUNCIL

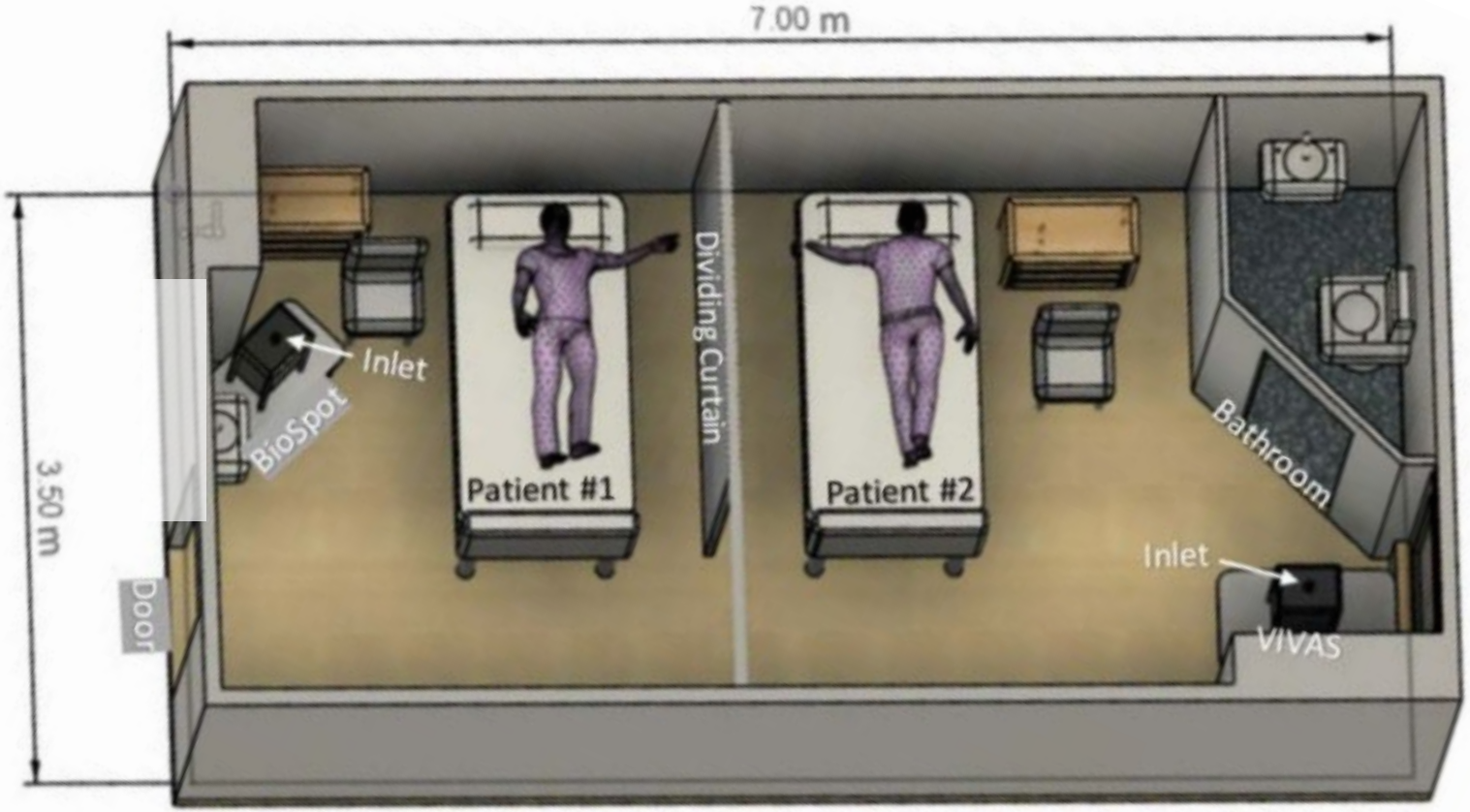
IFI International Federation of Interior Architects/Designers

*"…Today's update acknowledges the existence of some published reports showing limited, uncommon circumstances where people with COVID-19 infected others who were **more than 6 feet away or shortly after the COVID-19-positive person left an area**…."*

CDC, Oct 5th, 2020

https://www.cdc.gov/media/releases/2020/s1005-how-spread-covd.html

ACTIVE VIRUS FOUND 4.8 M (15.7’) AWAY FROM SUBJECT



Viable SARS-CoV-2 in the air of a hospital room with COVID-19 patients 2 John A. Lednicky, PhD1,2*, Michael Lauzardo, MD2,3, Z. Hugh Fan, PhD4,5, Antarpreet Jutla, PhD,6 3 Trevor B. Tilly, PhD,6 Mayank Gangwar6 , Moiz Usmani6 , Sripriya Nannu Shankar6 , Karim Mohamed5 4 , Arantza Eiguren-Fernandez, PhD7 , Caroline J. Stephenson1,2, Md. Mahbubul Alam1,2 5 , Maha A. Elbadry, PhD1,2, Julia C. Loeb1,2, Kuttinchantran Subramaniam, PhD2,8, Thomas B. Waltzek, PhD2,8 6 , Kartikeya Cherabuddi, MD,3, J. Glenn Morris, Jr., MD2,3, and Chang-Yu Wu, PhD

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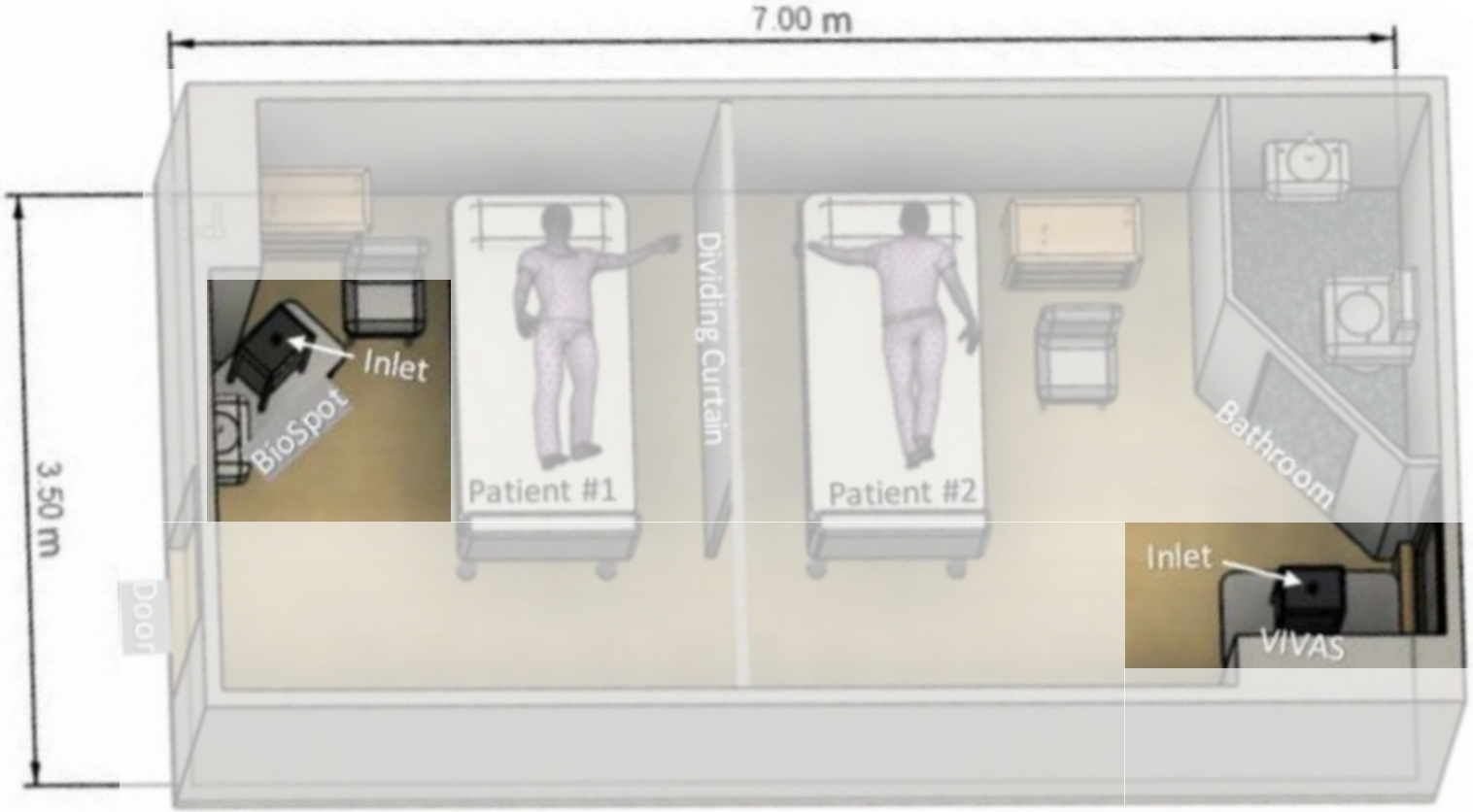

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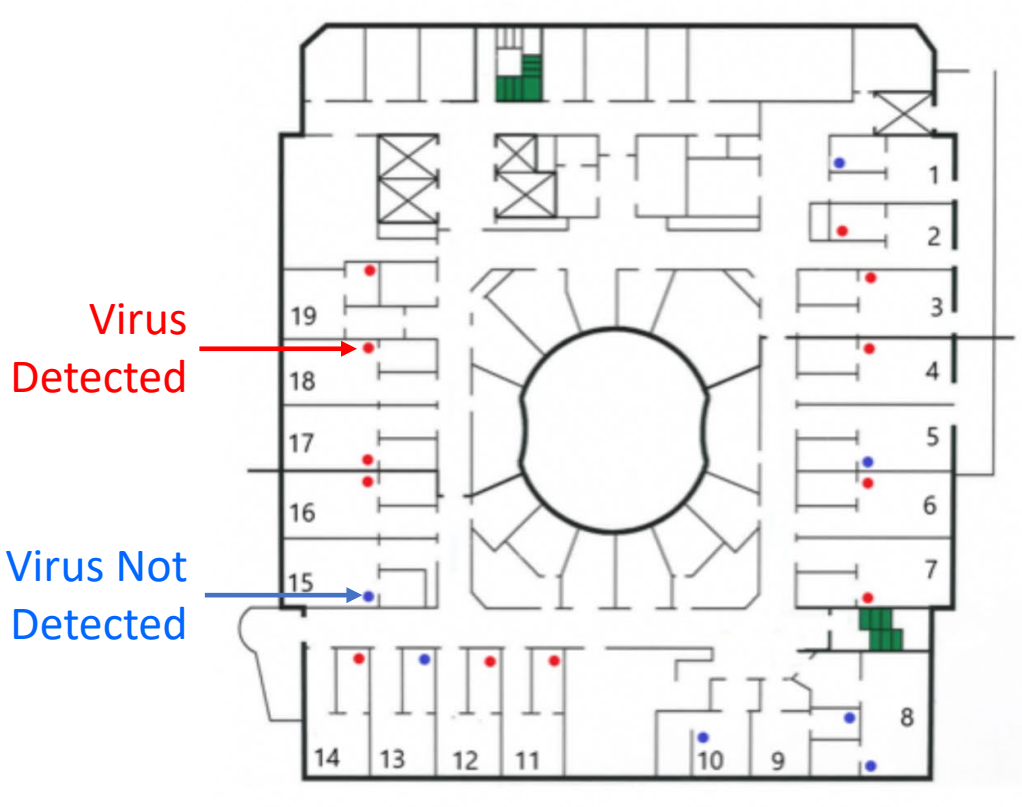
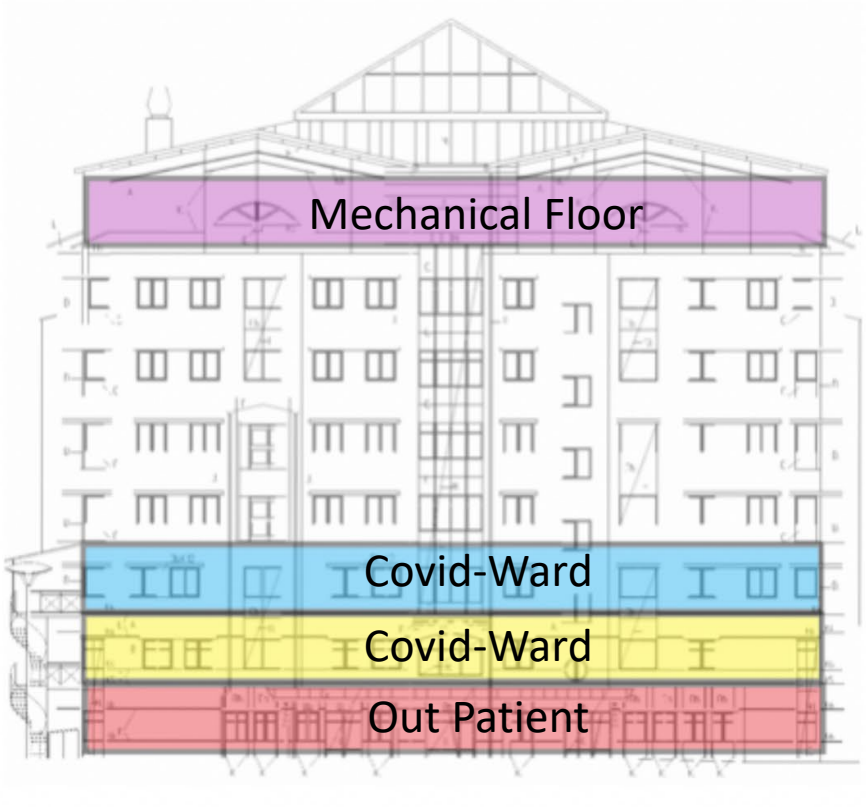
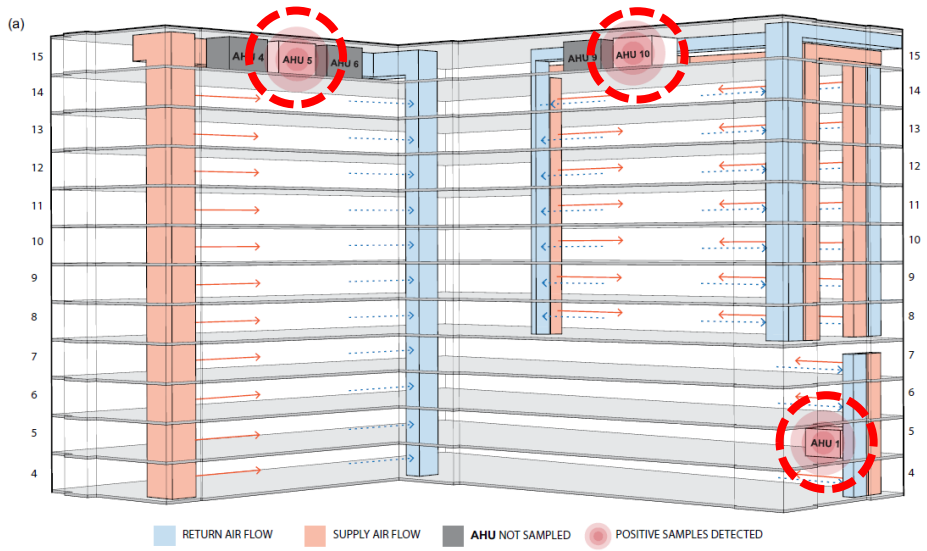
VIRUS FOUND IN CEILING VENT AND **56 M** INTO THE DUCTWORK

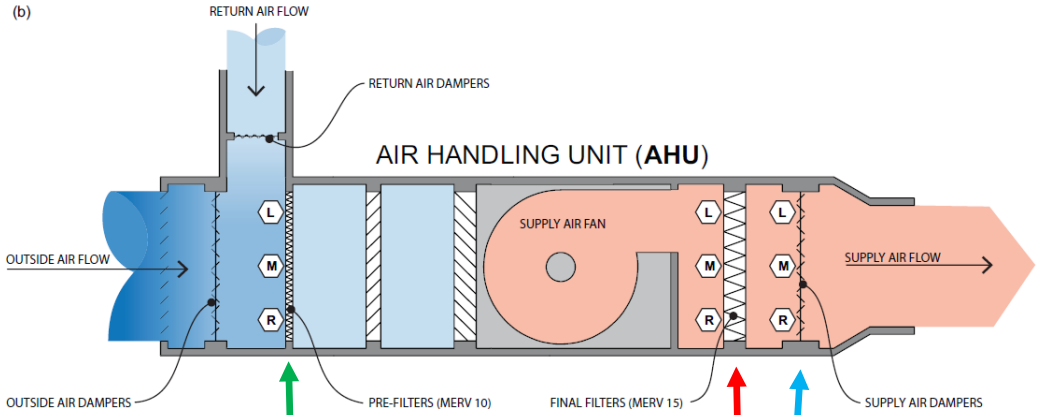




Long-distance airborne dispersal of SARS-CoV-2 in COVID-19 wards
Karolina Nissen Uppsala University
Janina Krambrich Uppsala University
Dario Akaberi Uppsala University
Tove Hoffman Uppsala University
Jiaxin Ling Uppsala University
Åke Lundkvist Uppsala University
Erik Salaneck (erik.salaneck@medsci.uu.se) Uppsala University

VIRUS FOUND IN AHU





	Pre-Filters		Final Filters		Supply Air Dampers	
	Total Number (n)	*Number Positive (%)*	*Total Number (n)*	*Number Positive (%)*	*Total Number (n)*	*Number Positive (%)*
	20	*7 (35)*	*12*	*2 (16.67)*	*24*	*5 (20.8)*
Cumulative Gene Copies (x̄)	*354.8 (34.2)*		*103.2 (86.2)*		*342.5 (77.7)*	

Standard 52.2 Minimum Efficiency Reporting Value (MERV)	Composite Average Particle Size Efficiency, % in Size Range, µm			Average Arrestance, %
	Range 1 (0.3-1.0)	Range 2 (1.0-3.0)	Range 3 (3.0-10.0)	
15	$85 \le E_1$	$90 \le E_2$	95 ≤ E3	n/a

Identification of SARS-CoV-2 RNA in Healthcare Heating, Ventilation, and Air Conditioning Units
Patrick F. Horve, Leslie Dietz, Mark Fretz, David A. Constant, Andrew Wilkes, John M. Townes, Robert G. Martindale, William B. Messer, Kevin G. Van Den, Wymelenberg

DUTCH NURSING HOME

"…Never before has spread of the virus via air circulation been so plausible. RIVM has revised the ventilation directive…"

"…17 of the 21 residents in the De Tweemaster nursing home ward became infected...The virus was subsequently found in high values on the mesh of the air-conditioning unit and in the filters of four ventilation boxes..."

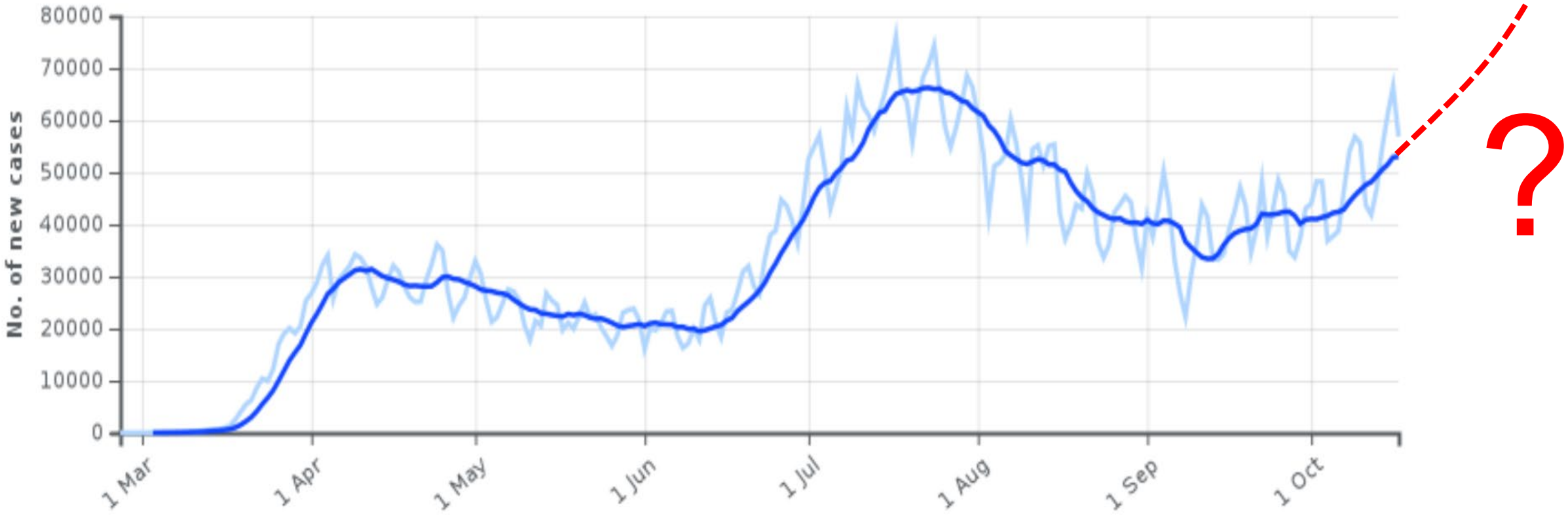
https://www.volkskrant.nl/nieuws-achtergrond/vertrouwelijk-rivm-rapport-ventilatiesysteem-verspreidde-virus-in-verpleeghuis~bd49436/

Current Research

Winter is Coming

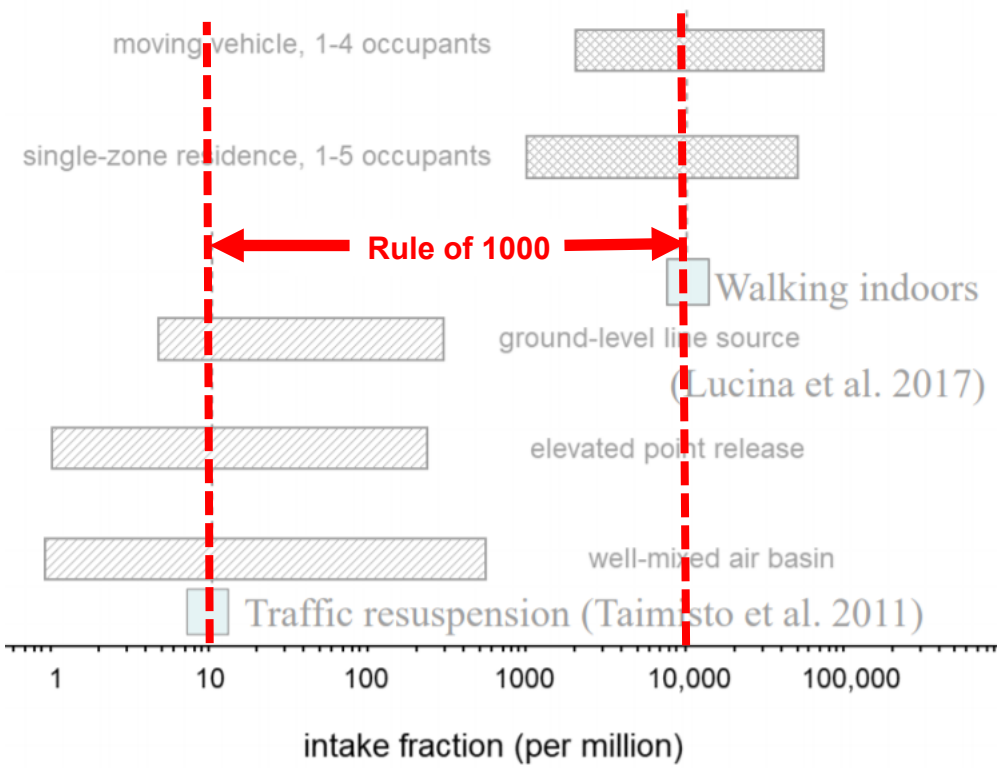
Our Built Environment

US NEW COVID CASES, 7 DAYS MOVING AVERAGE



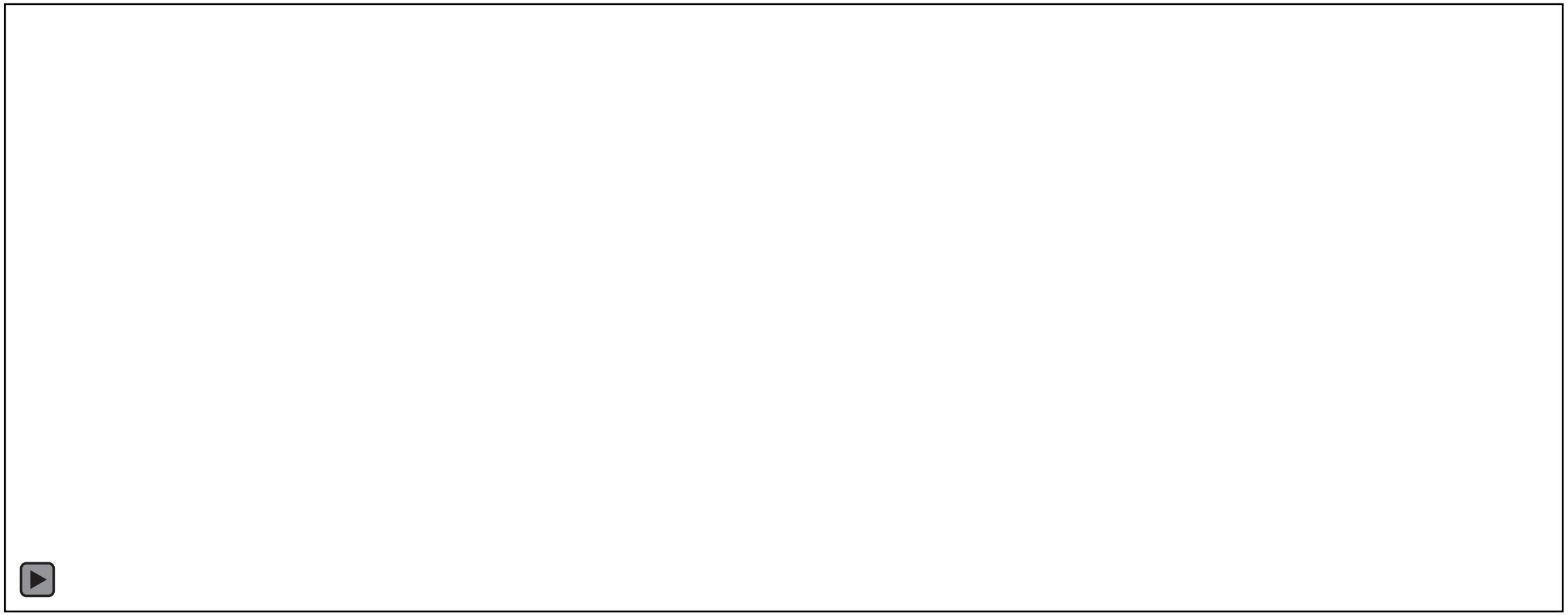
https://en.wikipedia.org/wiki/COVID-19_pandemic_in_the_United_States

RULE OF “1000”:
A POLLUTANT RELEASED INDOOR IS 1000 TIMES MORE LIKELY TO BE INHALED



SOURCE: Lai, Thatcher, Nazaroff, 2000

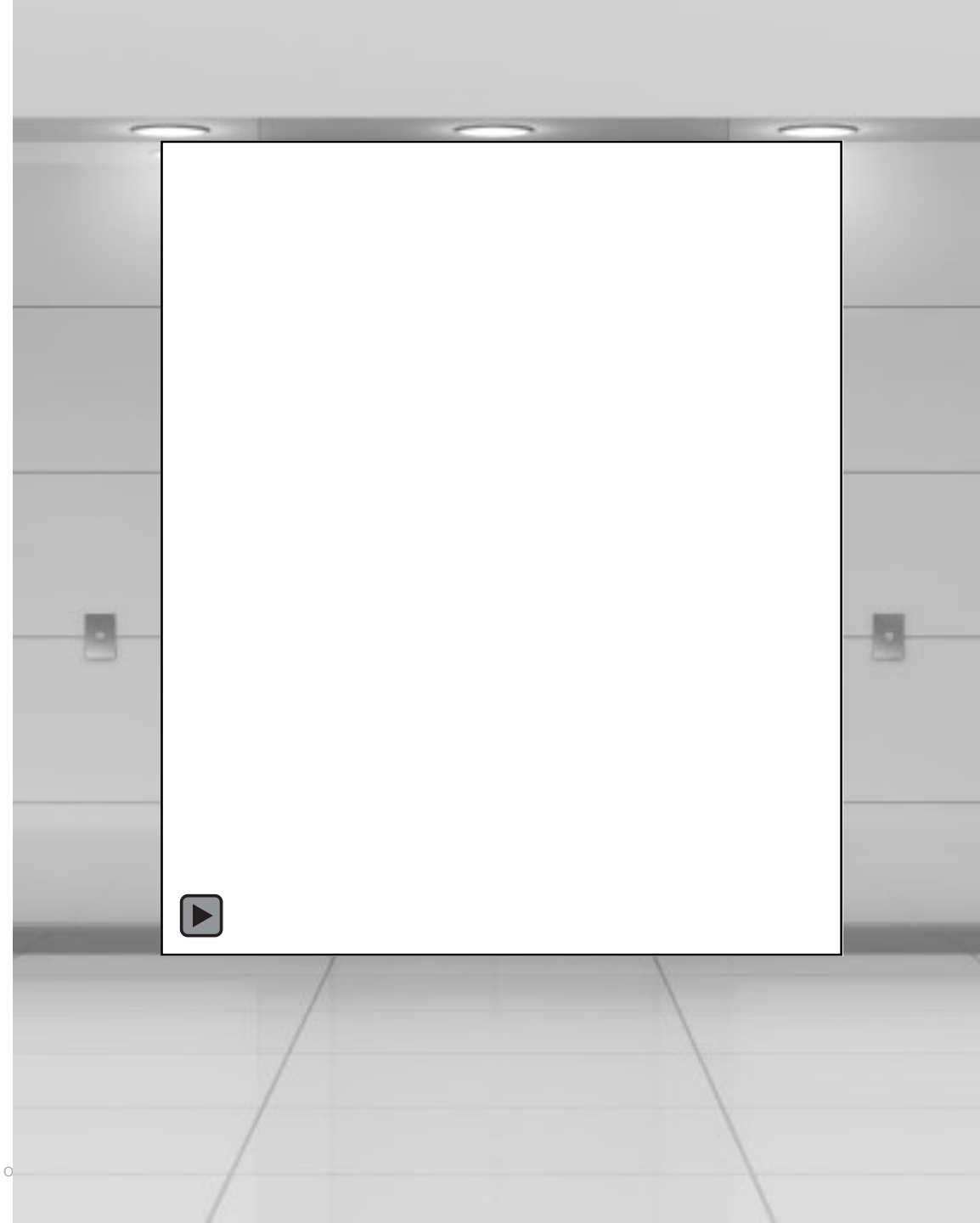
SUN VS. NO SUN



https://www.dhs.gov/science-and-technology/sars-airborne-calculator

OFFICE IN CHICAGO WINTER - ELEVATOR

- 70 F
- 25% RH
- 219 FT3
- 350 CFM fan
- Infected person speaking (9.4 Quanta/hour)
- Risk of 2 minutes ride
- 1 person out of 4 infected



https://www.burnhamnationwide.com/final-review-blog/ada-building-requirements-for-elevators

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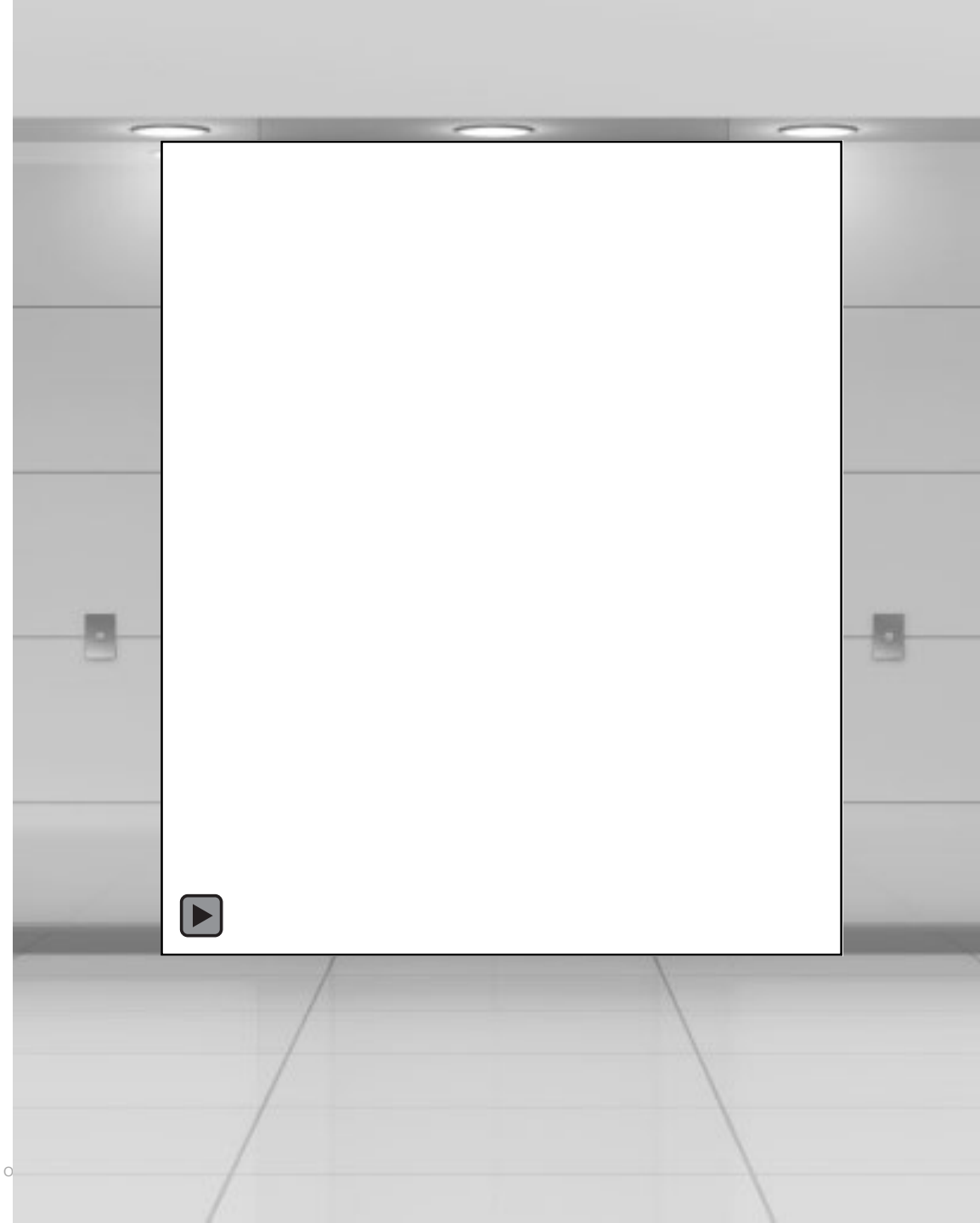

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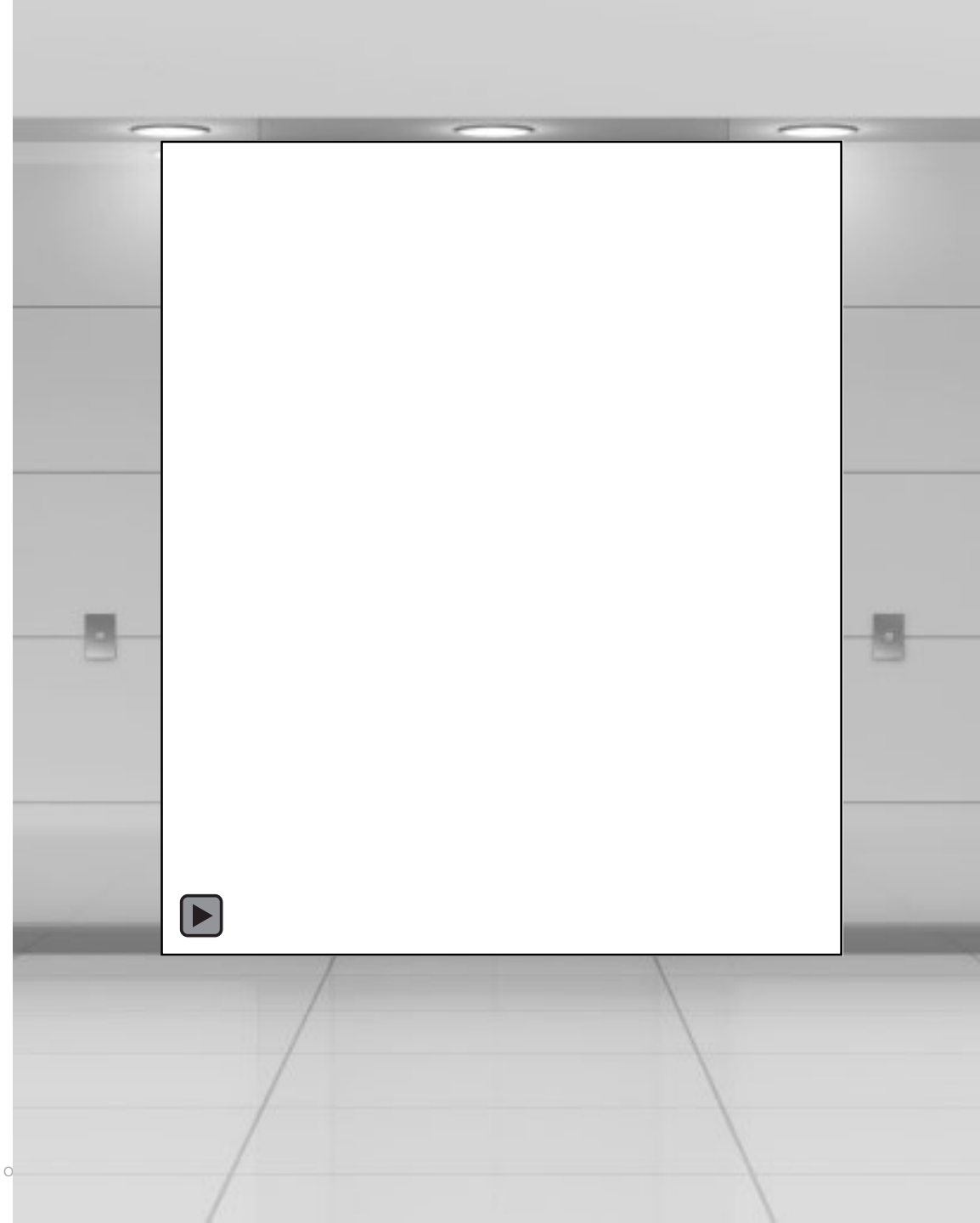
- 0.02% no mask, exhaust on
- 0.005% with Mask, exhaust on



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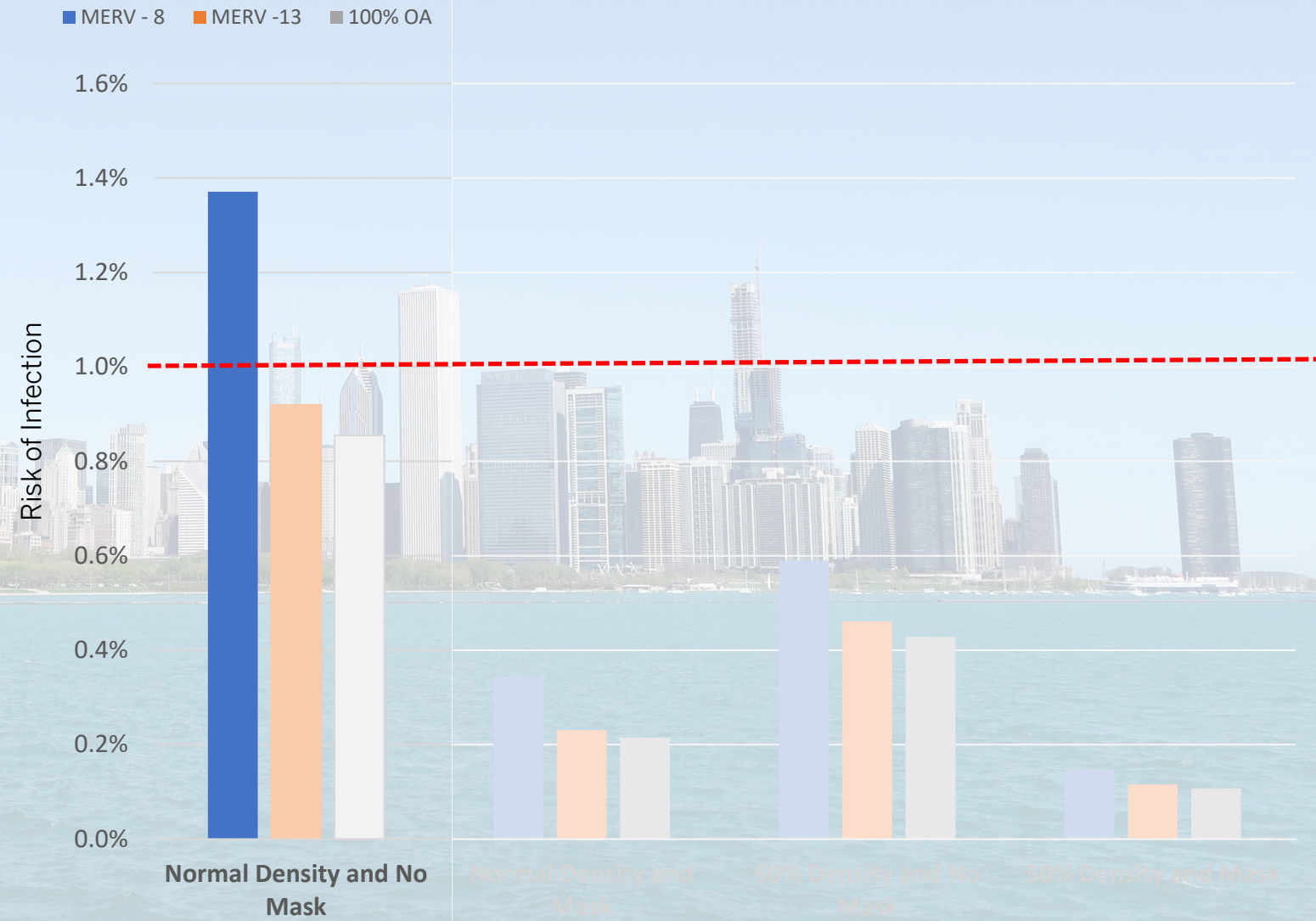
OFFICE IN CHICAGO WINTER

- 70 F
- 25% RH
- 150 sf/person
- Infected person speaking (9.4 Quanta/hour)
- Risk of 8 hours
- Prevailing rate – 3.0 % of population
- VAV system – 2.9 air changes/per hour

1+% risk, no mask



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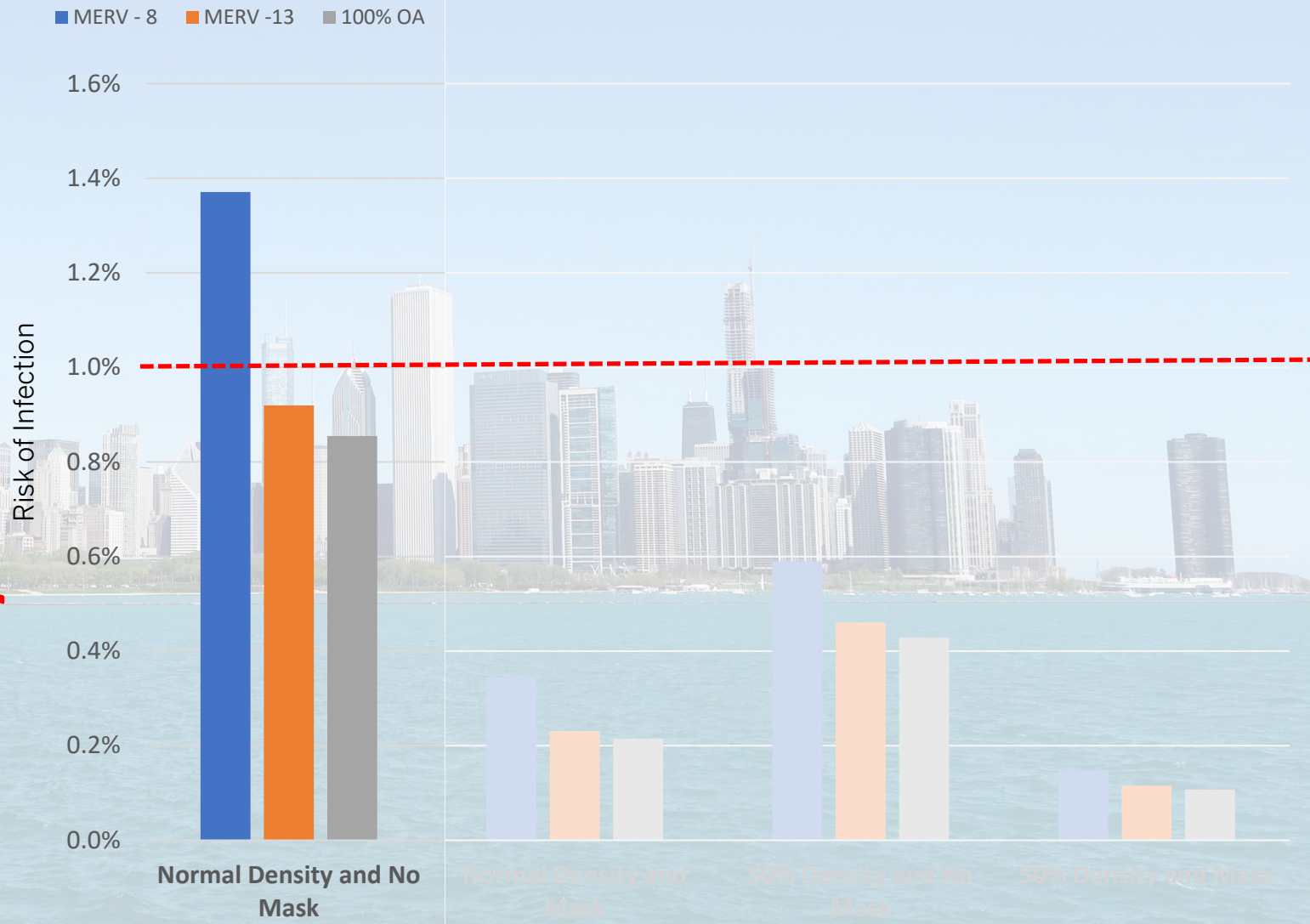
- 1% risk with no mask

100 outside air

≈ MERV-13 filter



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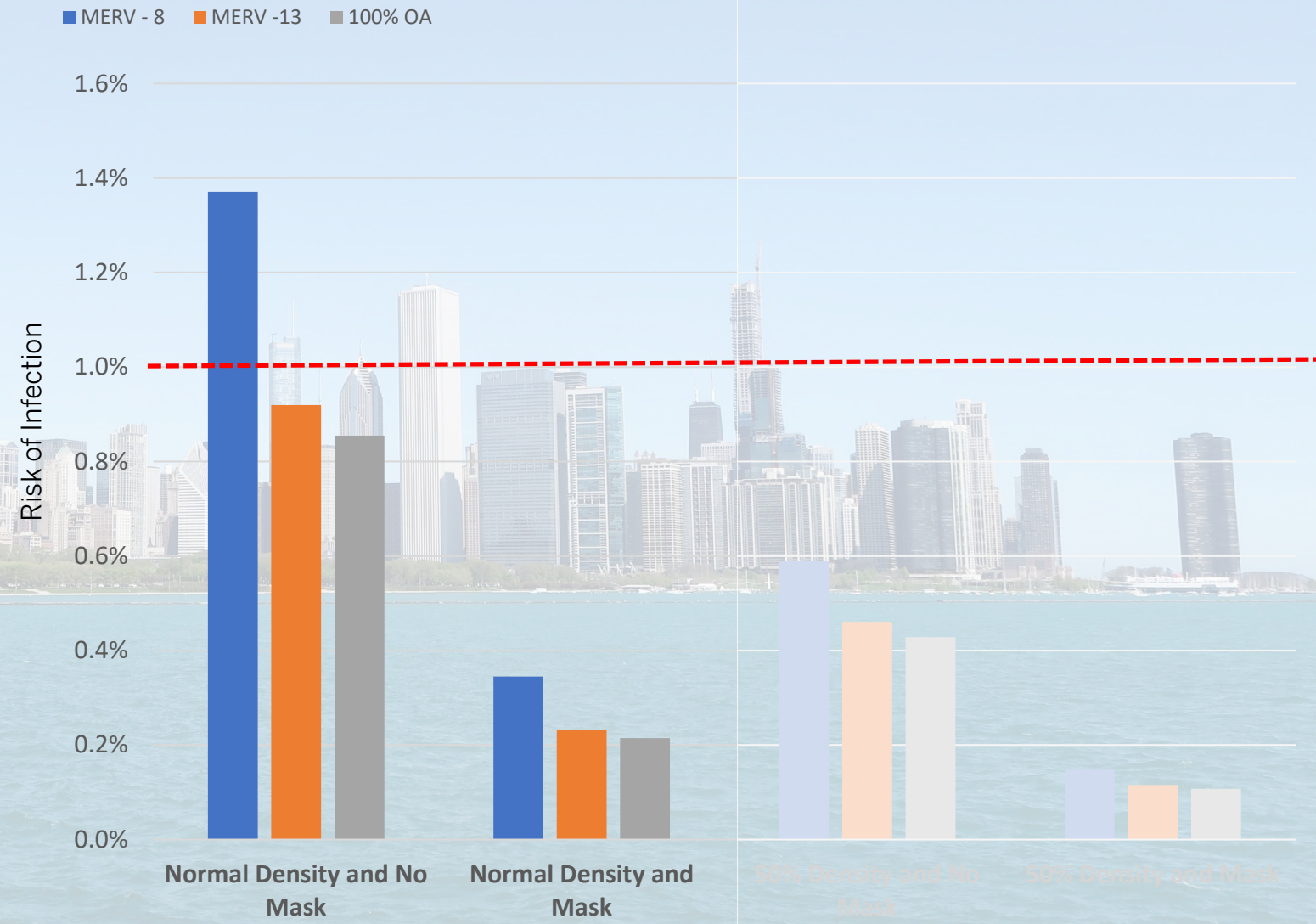
- 1% risk with no mask
- 100 outside air ≈ MERV-13 filter

With Masks, 0.2%



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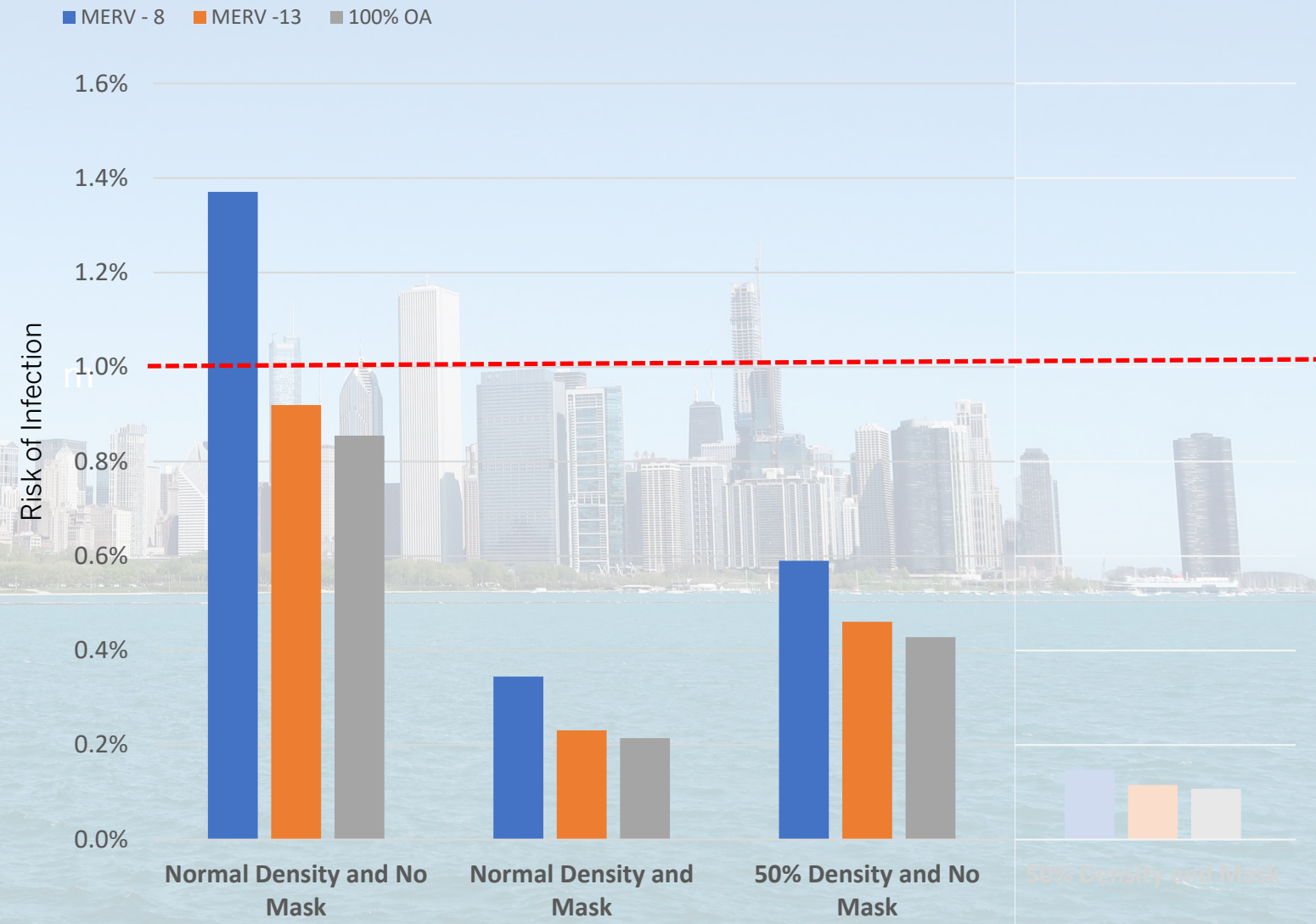
- 1% risk with no mask
- 100 outside air ≈ MERV-13 filter
- With masks, 0.2%

50% density reduction, 50% risk reduction



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- Risk of 8 hours
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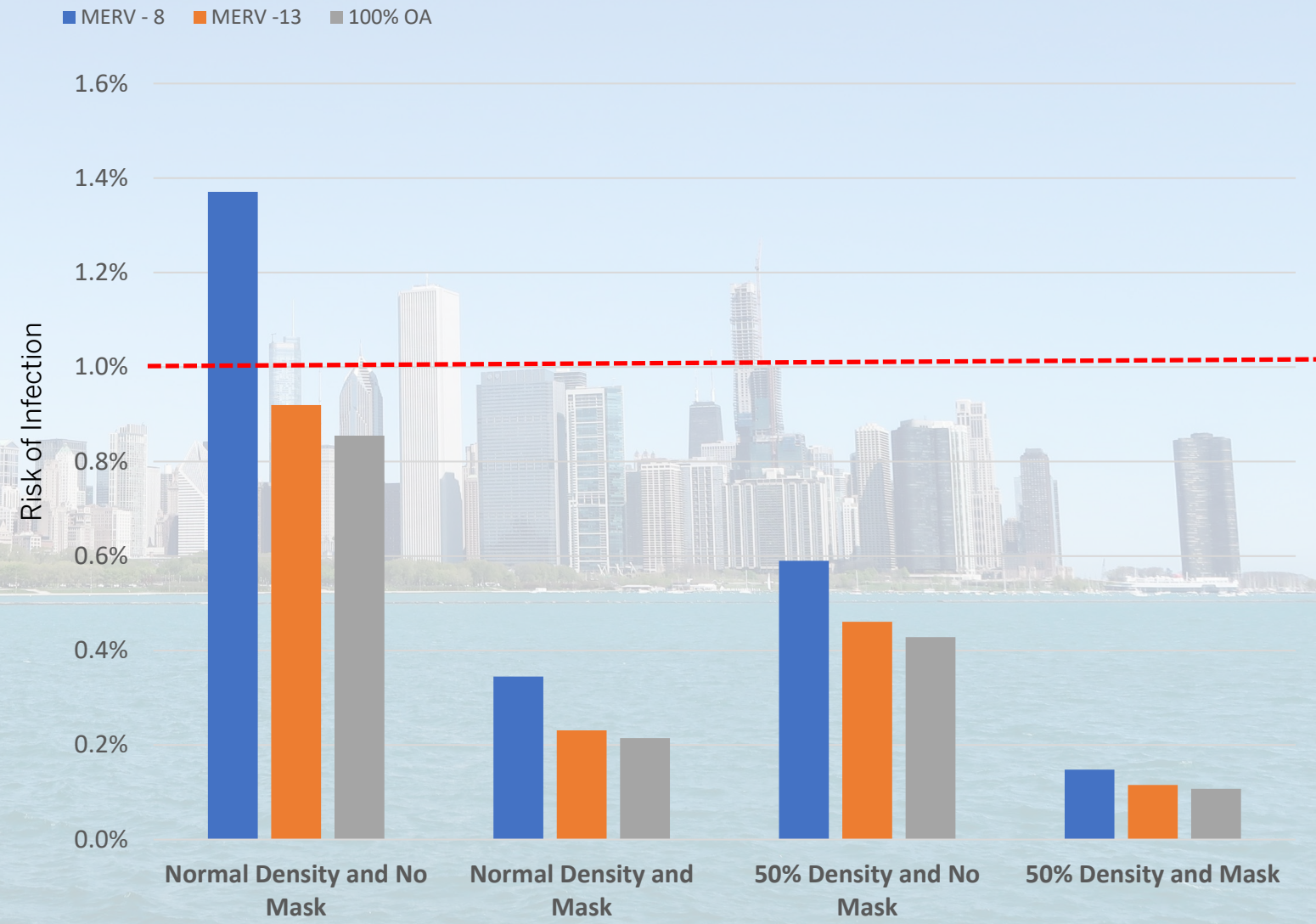
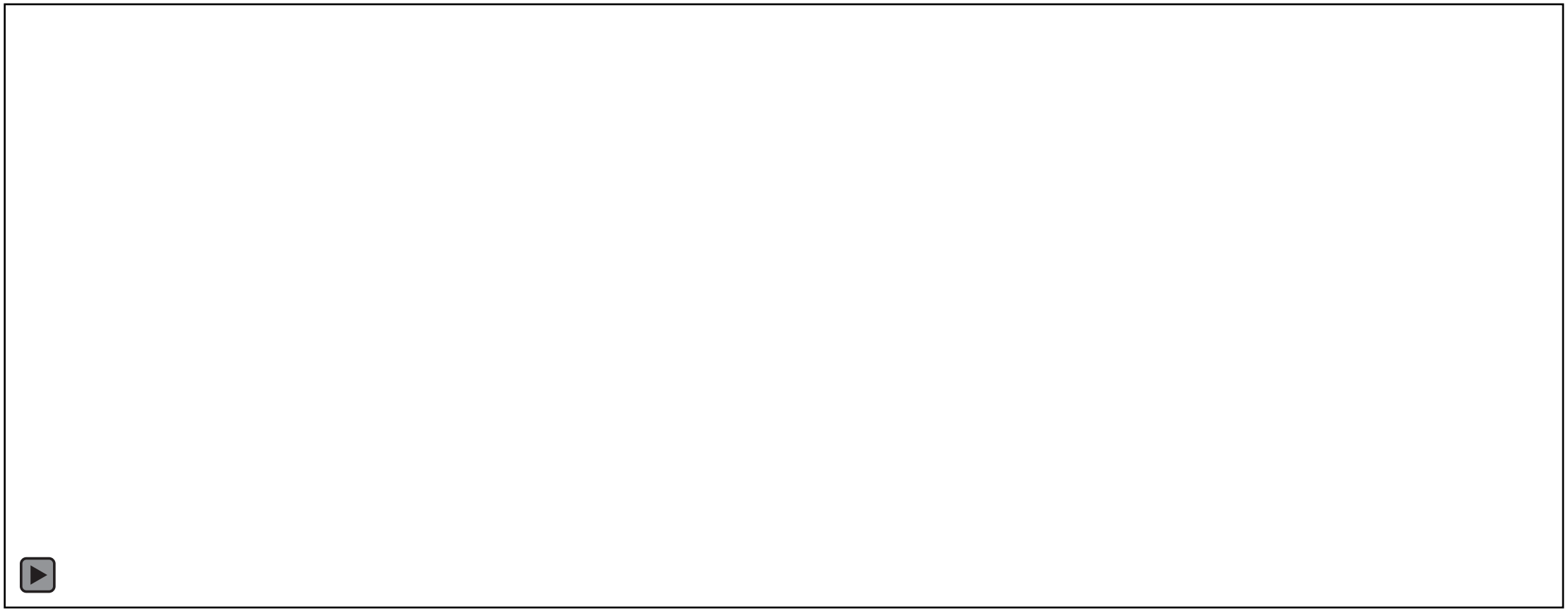
- VAV system – 2.9 air changes/per hour

- 1% risk with no mask
- 100 outside air ≈ MERV-13 filter
- 50% mask reduced risk by 25%
- 50% density reduction, 50 risk reduction

50% density with mask, risk below 0.1%



SARS-COV2 AIRBORNE DECAY CALCULATOR



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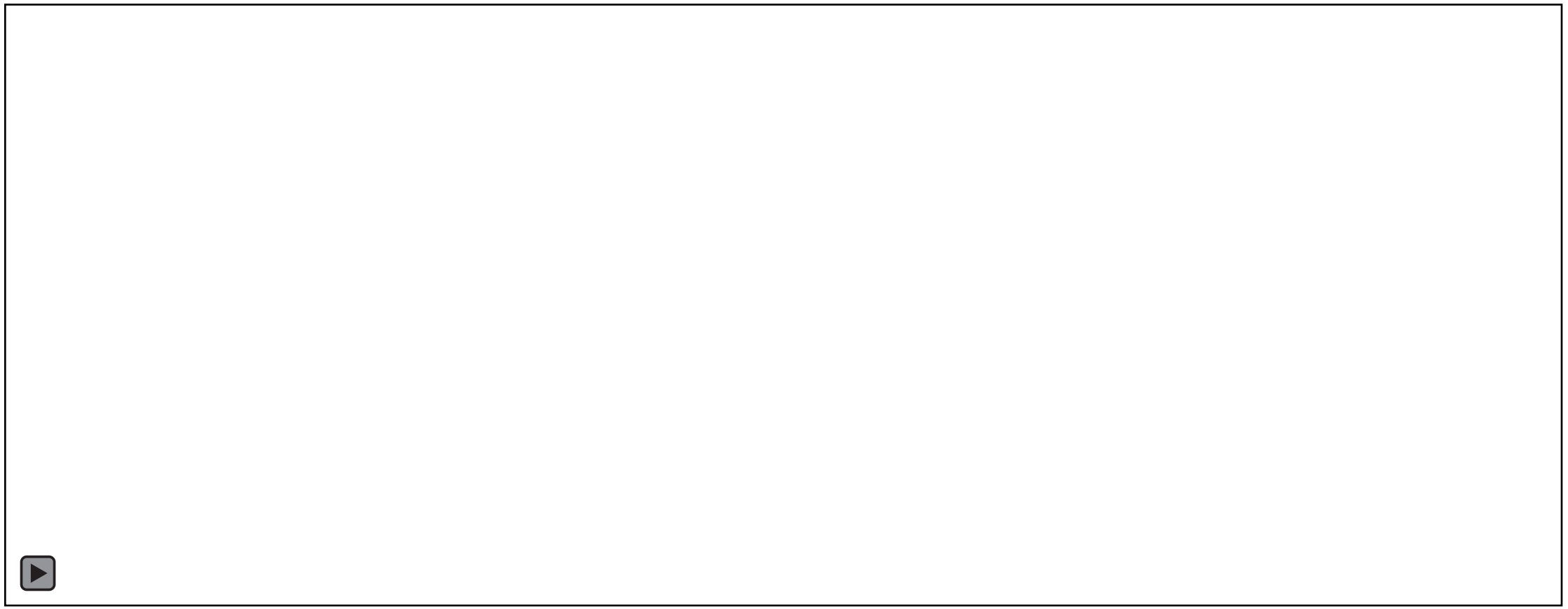

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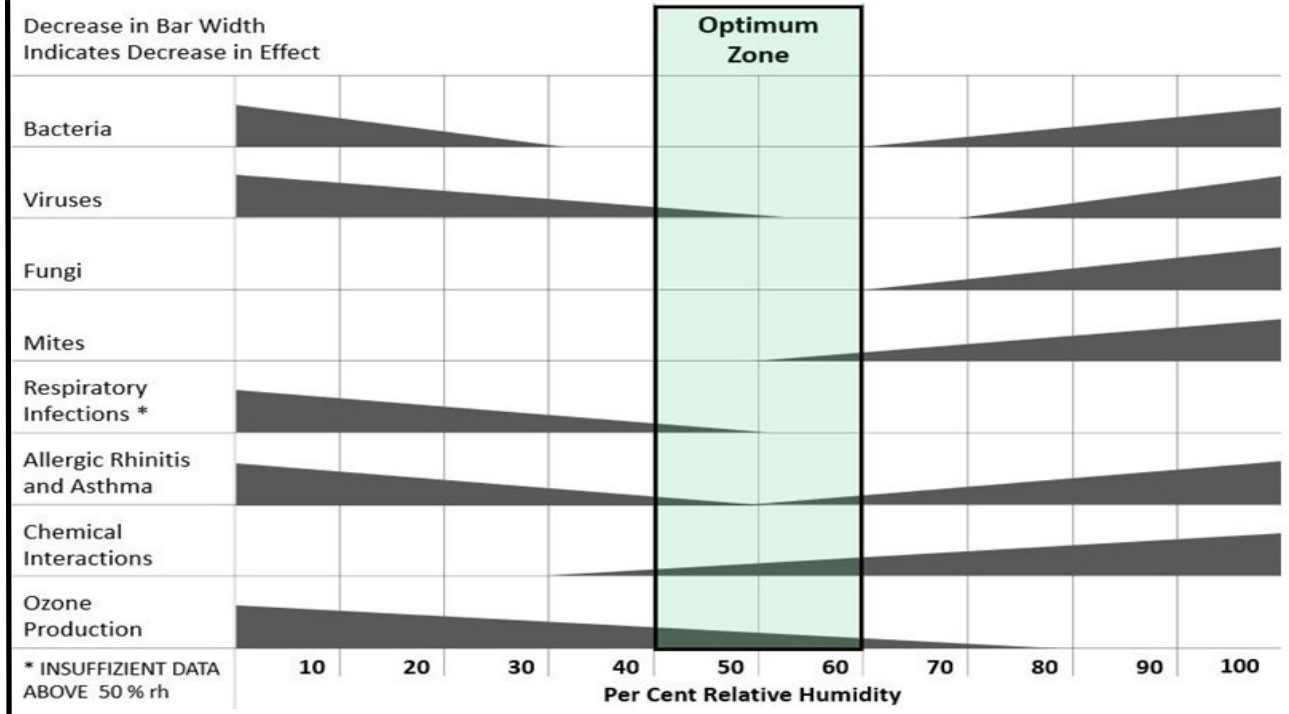
ENVIRONMENT

Relative Humidity 40-60%



Indirect Health Effects of Relative Humidity Indoor Environment Arundel AV, Sterling EM et al.

ENVIRONMENT

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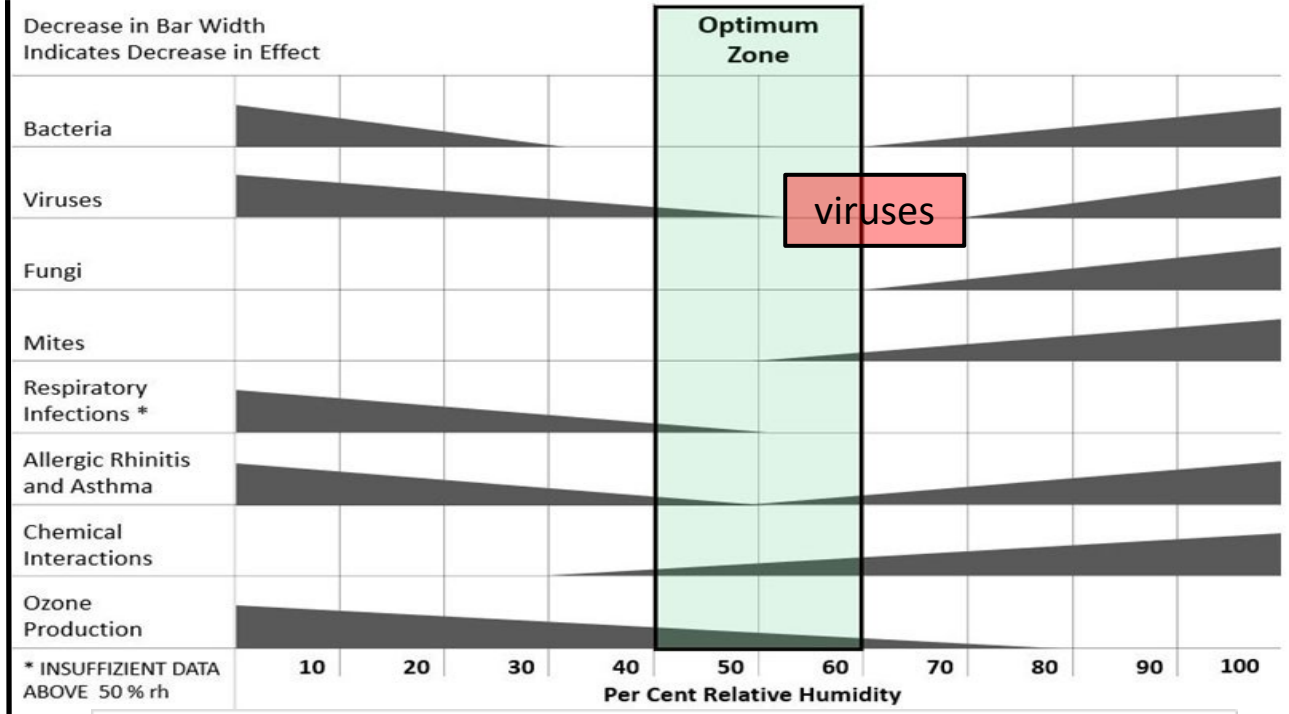
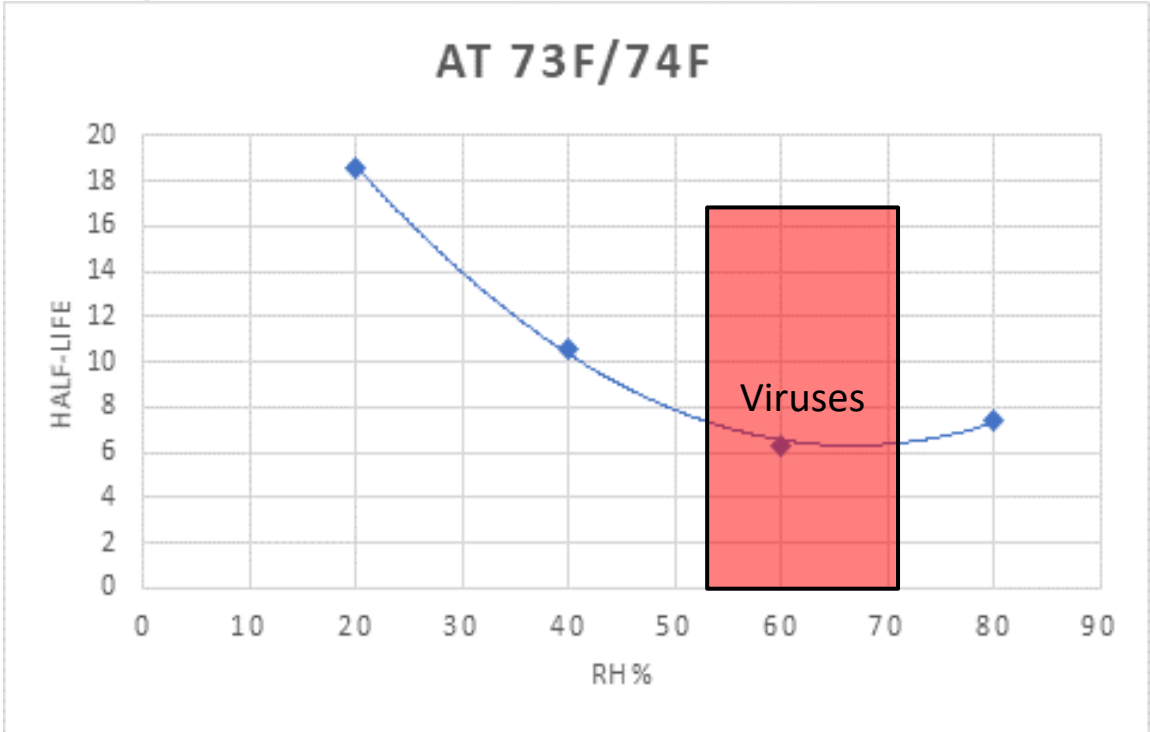




Indirect Health Effects of Relative Humidity Indoor Environment Arundel AV, Sterling EM et al.

HUMIDIFIER

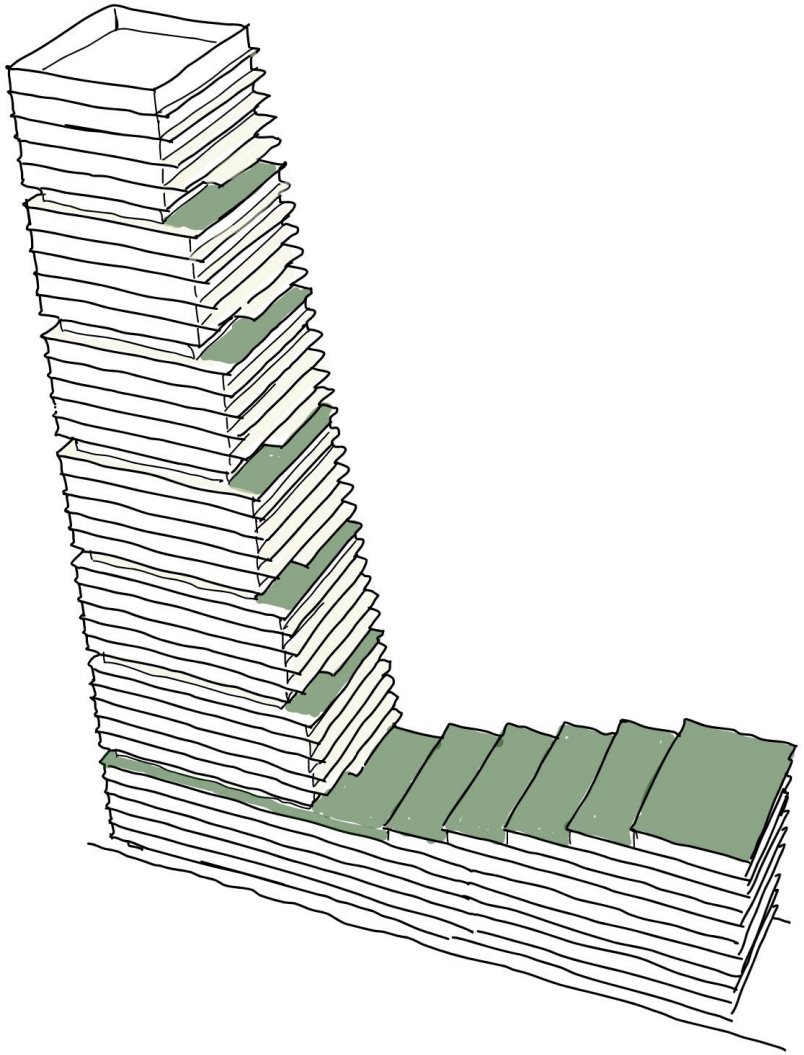
https://www.walmart.com/ip/230ml-Mini-Portable-Cool-Mist-Cup-Humidifier-USB-Ultrasonic-Air-Humidifier-Purifier-Office-Desk-Bedroom-Home-Babies-Kids-Car-7-Colors-LED-Night-Light/549868696

Current Research

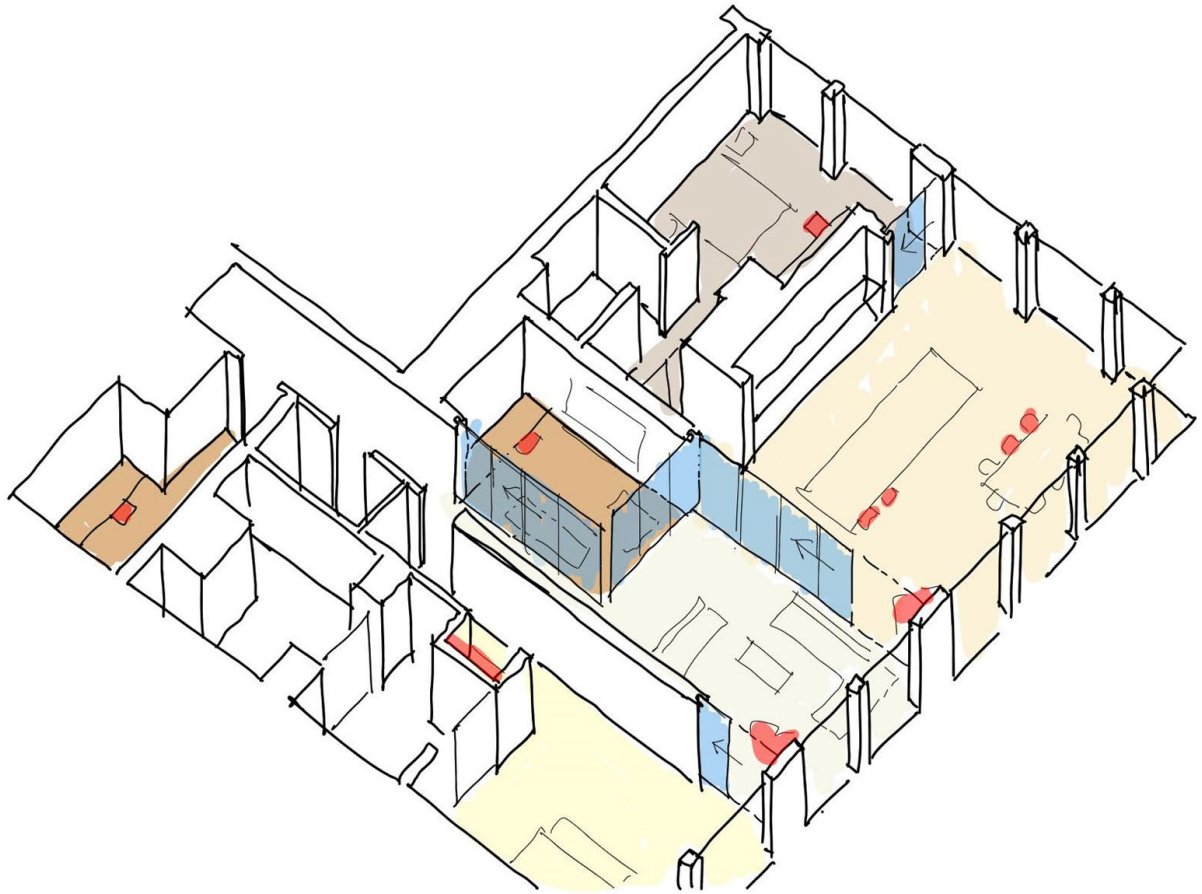
Winter is Coming

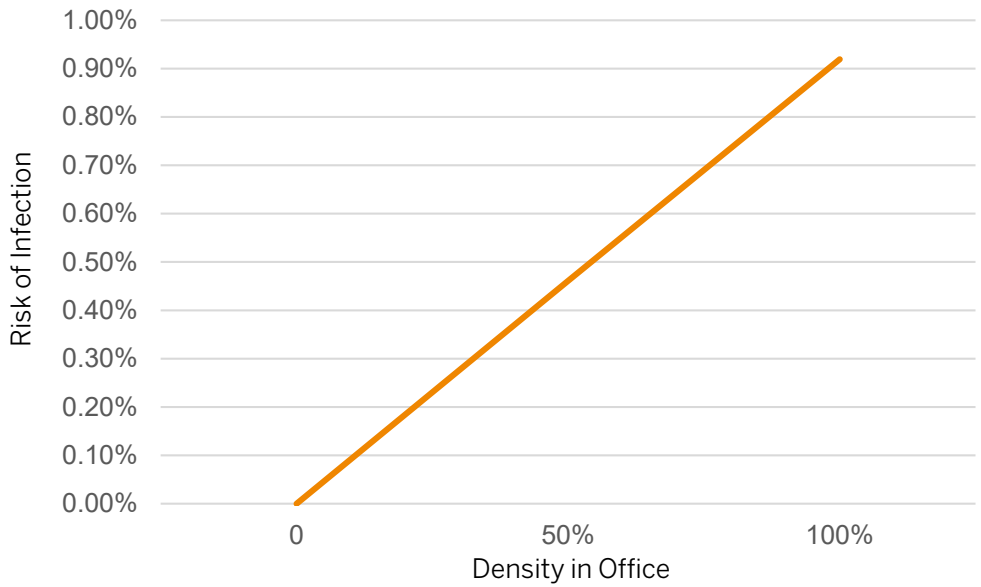
Our Built Environment

1. THE GREEN SPACES

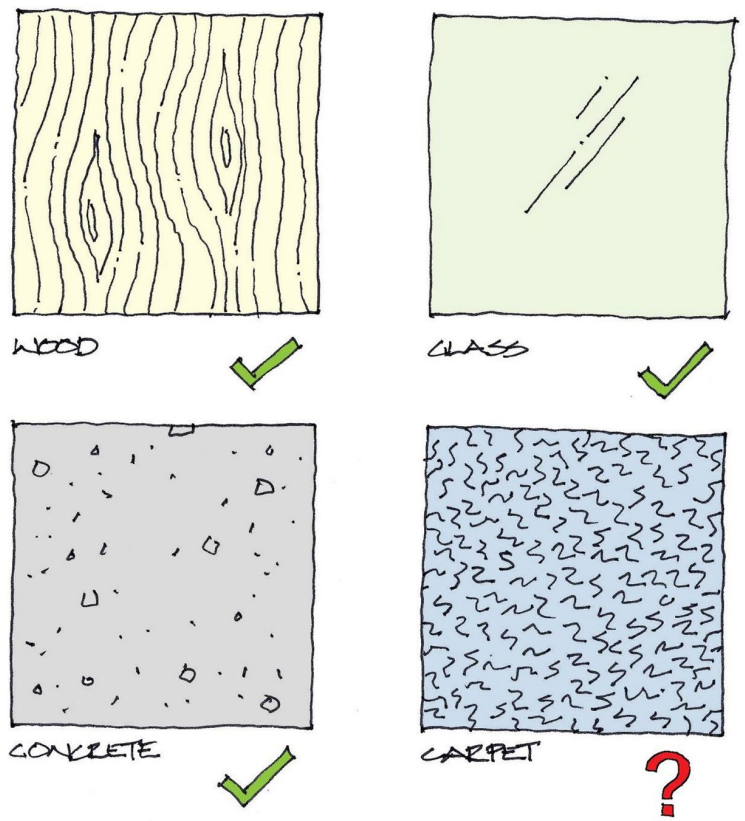


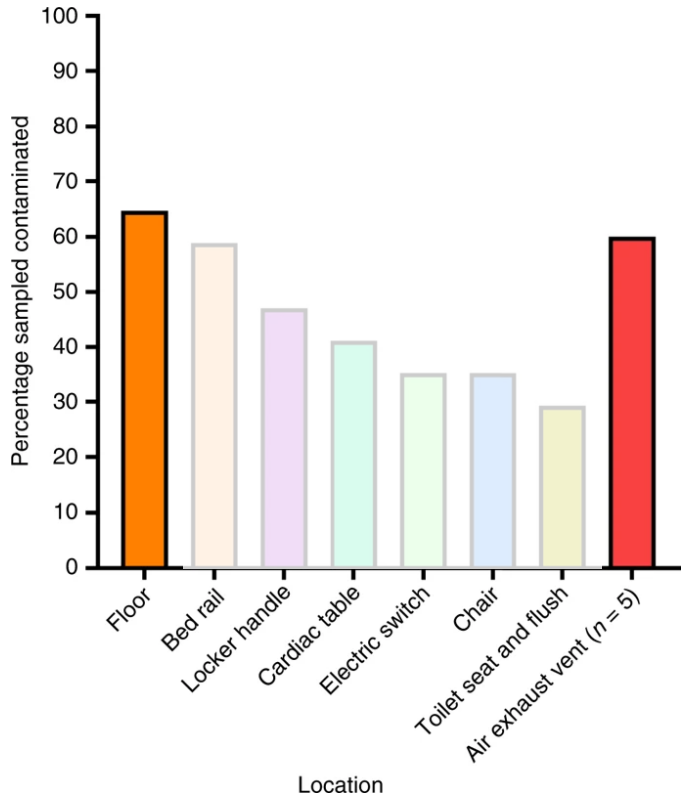
2. THE FLEXIBLE SPACES





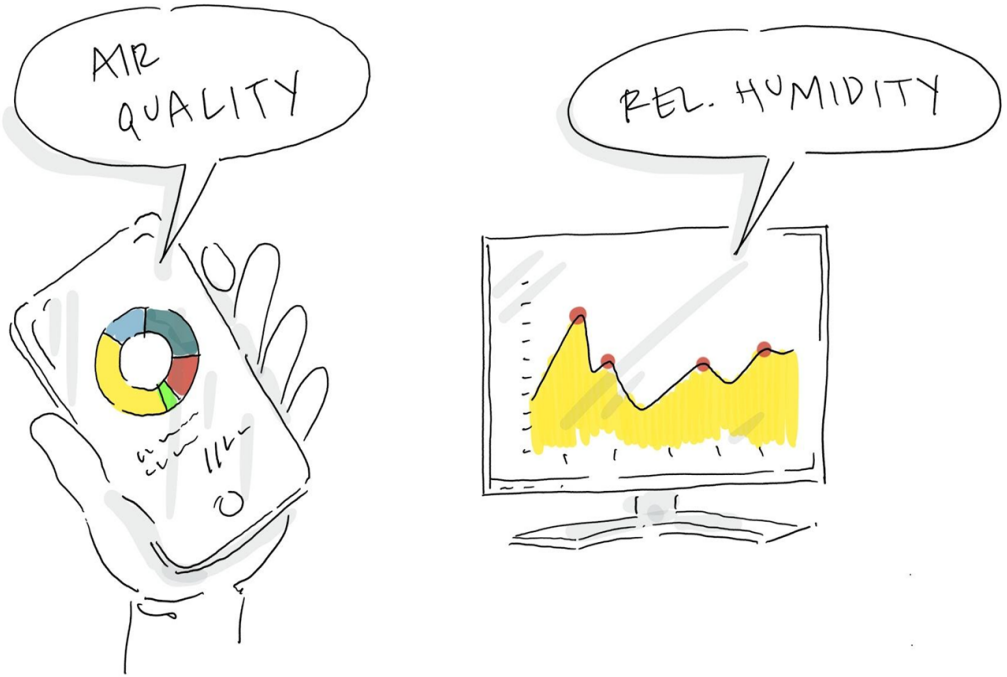
3. THE MATERIAL SPACES

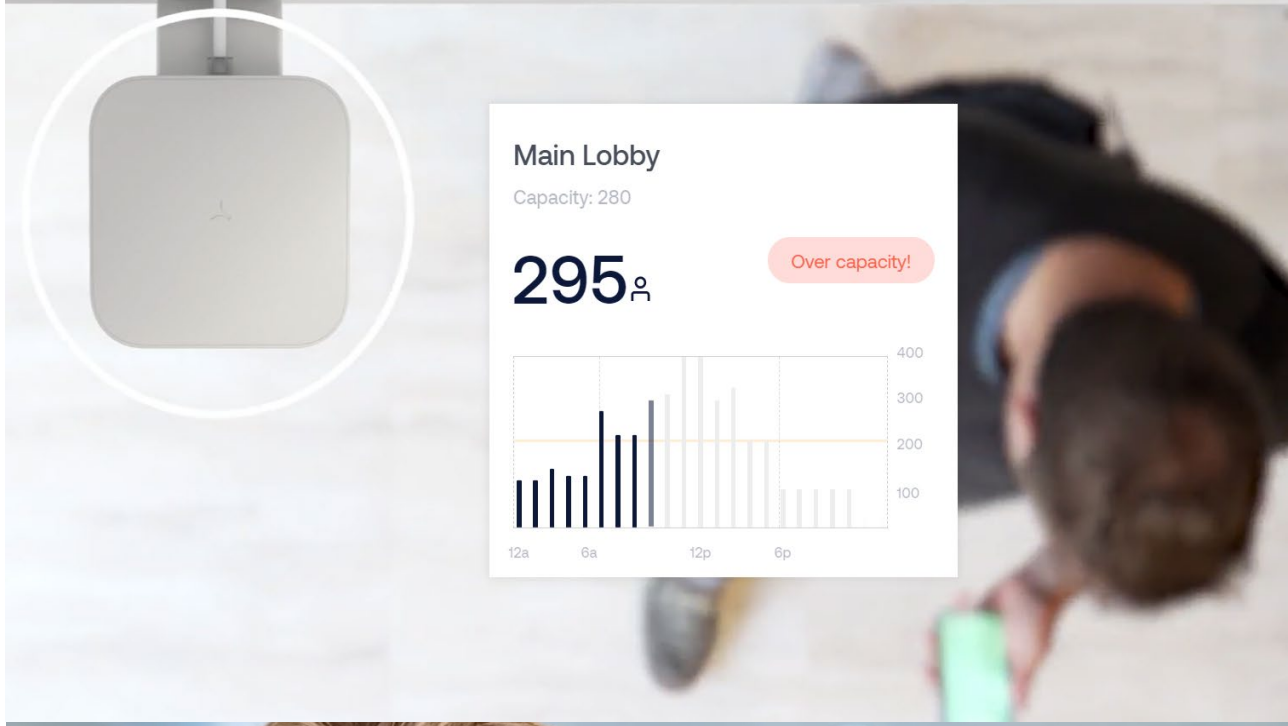


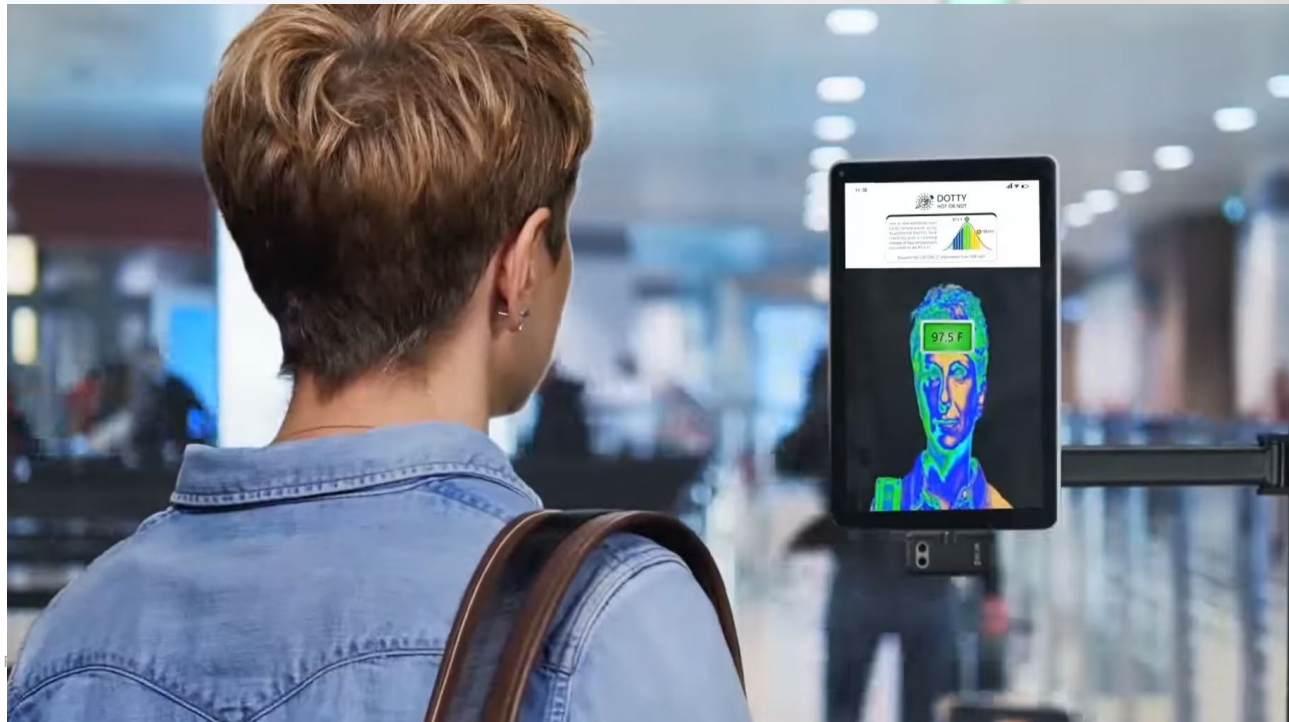


Po Ying Chia Kristen Kelli Coleman for the Singapore 2019 Novel Coronavirus Outbreak Research Team

4. THE MEASURED SPACES





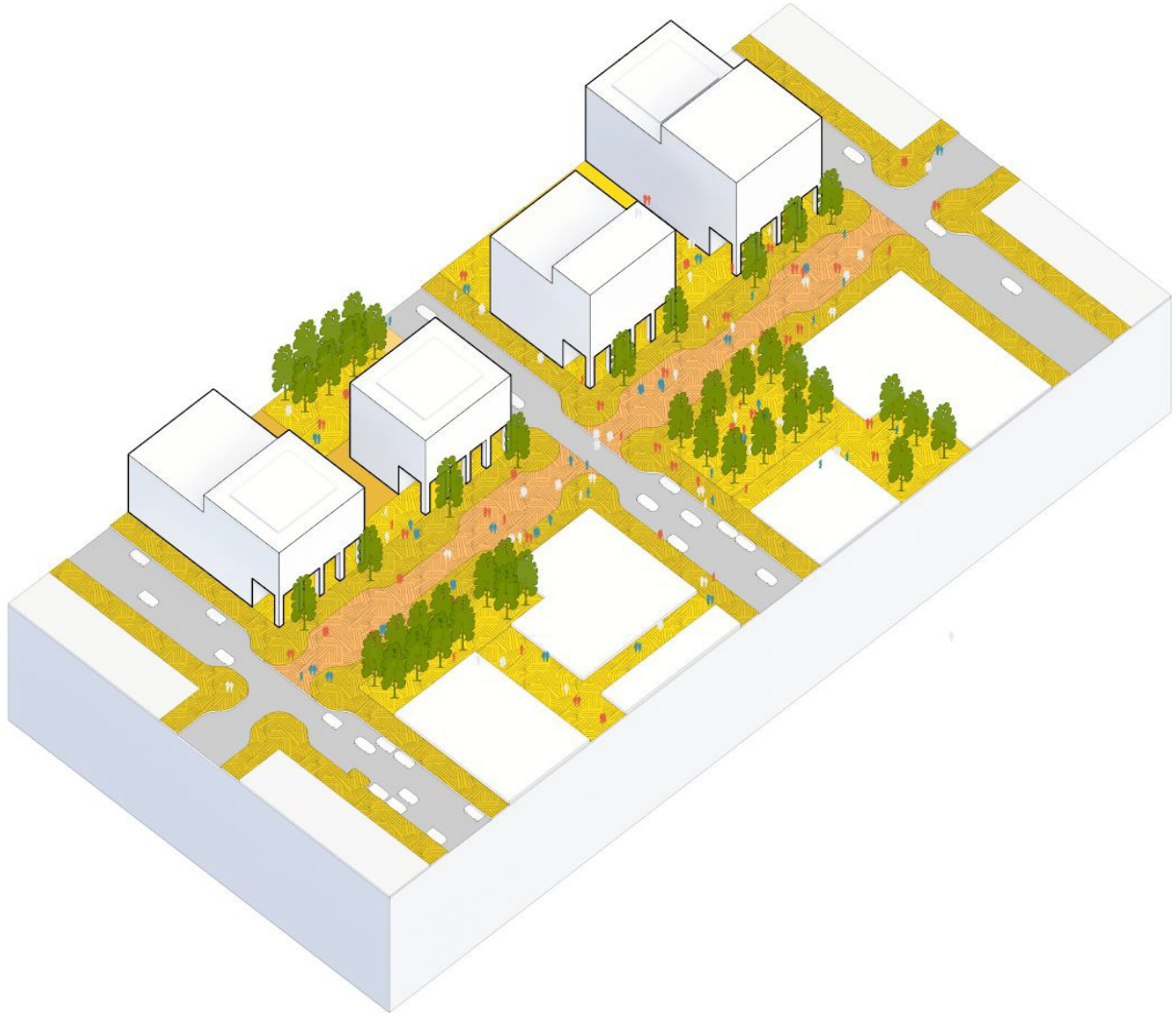


5. THE FILTERED SPACES

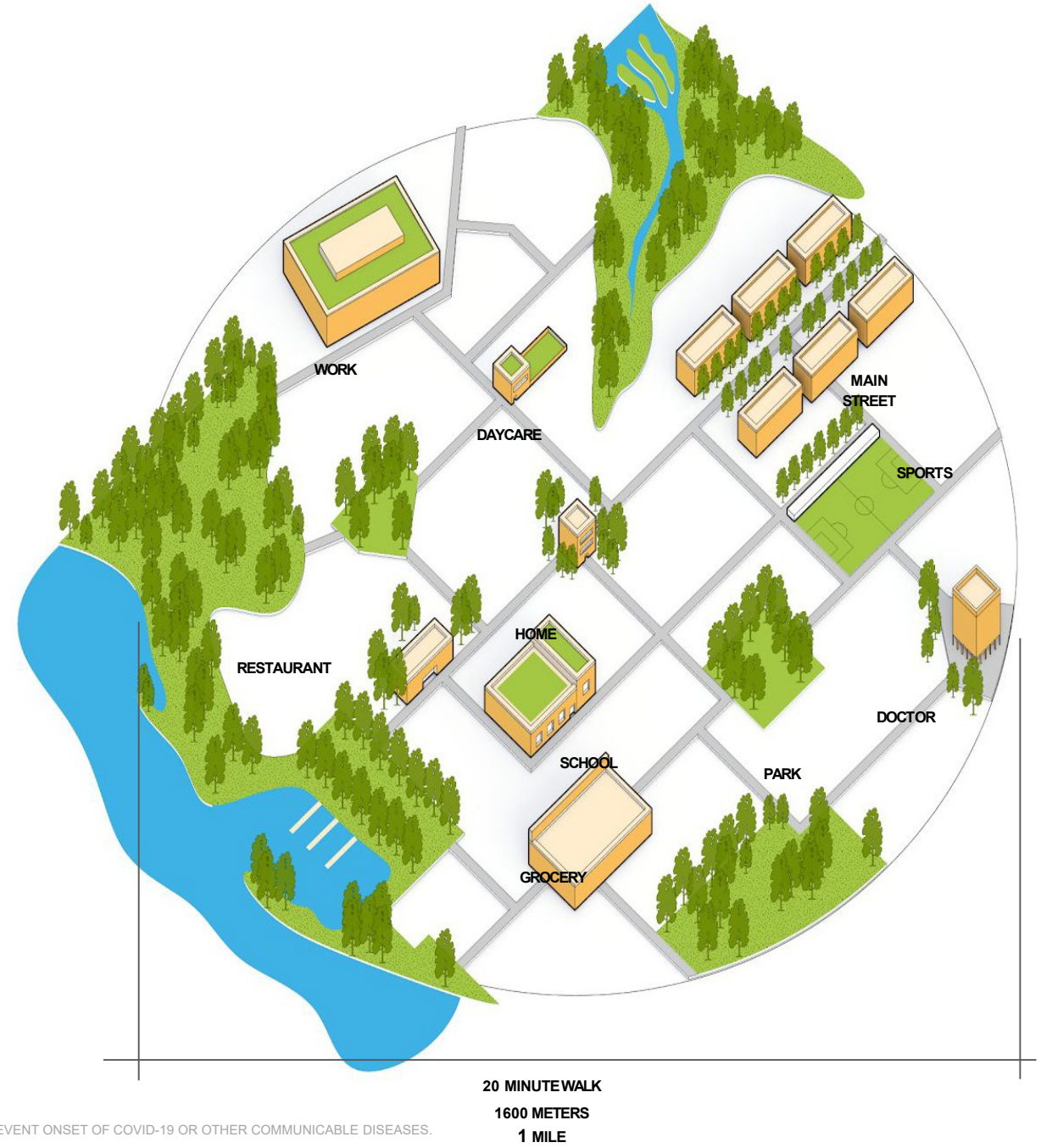
Standard 52.2 Minimum Efficiency Reporting Value (MERV)	Composite Average Particle Size Efficiency, % In Size Range, µm			Average Arrestance, %
	Range 1 (0.3-1.0)	Range 2 (1.0-3.0)	Range 3 (3.0-10.0)	
1	n/a	n/a	E3 < 20	$A_{avg} < 65$
2	n/a	n/a	E3 < 20	$65 \le A_{avg} < 70$
3	n/a	n/a	E3 < 20	$70 \le A_{avg} < 75$
4	n/a	n/a	E3 < 20	$75 \le A_{avg}$
5	n/a	n/a	20 ≤ E3	n/a
6	n/a	n/a	35 ≤ E3	n/a
7	n/a	n/a	50 ≤ E3	n/a
8	n/a	$20 \le E_2$	70 ≤ E3	n/a
9	n/a	$35 \le E_2$	75 ≤ E3	n/a
10	n/a	$50 \le E_2$	80 ≤ E3	n/a
11	$20 \le E_1$	$65 \le E_2$	85 ≤ E3	n/a
12	$35 \le E_1$	$80 \le E_2$	90 ≤ E3	n/a
13	$50 \le E_1$	$85 \le E_2$	90 ≤ E3	n/a
14	$75 \le E_1$	$90 \le E_2$	95 ≤ E3	n/a
15	$85 \le E_1$	$90 \le E_2$	95 ≤ E3	n/a
16	$95 \le E_1$	$95 \le E_2$	95 ≤ E3	n/a

https://www.secondnature.com/blog/staying-healthy/what-merv-rating-should-I-use

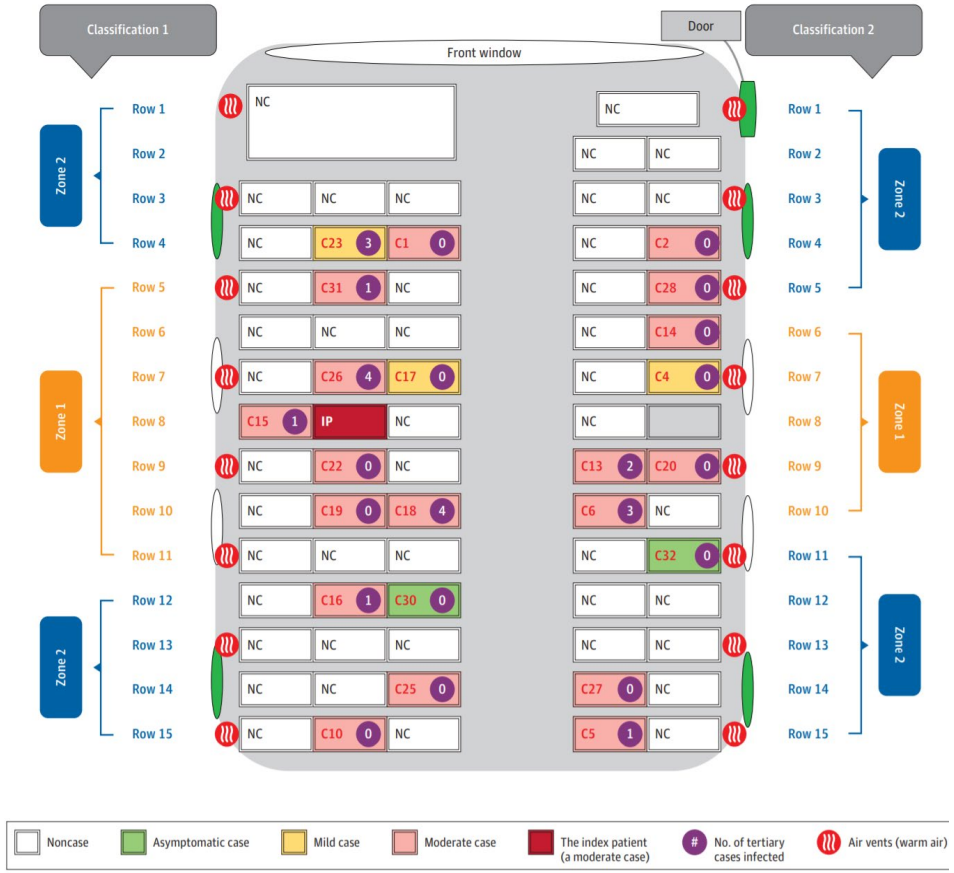
6. THE PEDESTRIAN CITY



7. THE 15 MINUTES CELLULAR CITY

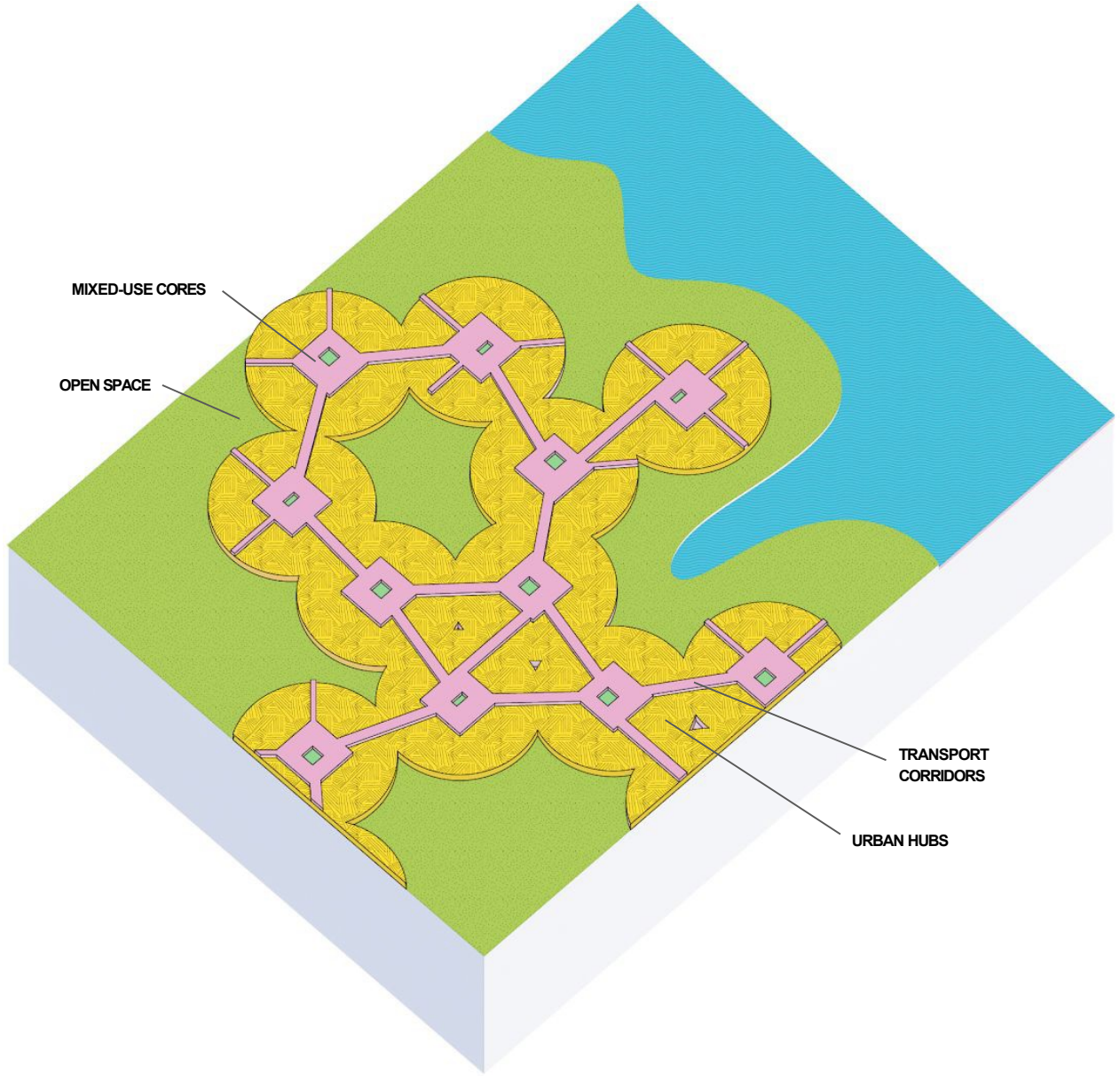


LAST MILE TRANSPORTATION



Community Outbreak Investigation of SARS-CoV-2 Transmission Among Bus Riders in Eastern China Ye Shen, PhD; Changwei Li, PhD; Hongjun Dong, MD; Zhen Wang, MD; Leonardo Martinez, PhD; Zhou Sun, MD; Andreas Handel, PhD; Zhiping Chen, MD; Enfu Chen, MD; Mark H. Ebell, MD, MS; Fan Wang, MA; Bo Yi, MD; Haibin Wang, MD; Xiaoxiao Wang, MD; Aihong Wang, MD; Bingbing Chen, MD; Yanling Qi, PhD; Lirong Liang, MD, PhD; Yang Li, PhD; Feng Ling, MD; Junfang Chen, MD; Guozhang Xu, MD

8. THE NETWORK CITY



Pandemic: This Winter and Beyond:

Oct 23, 2020

SOM

Winter Is Coming
HVAC Strategies during COVID-19:
Inpatient Medical HVAC

Kim Shinn, TLC Engineering Solutions

COVID-19 Guidance

ASHRAE - https://www.ashrae.org/technical-resources/resources

ASHE Website for more information – Public Access
https://www.ashe.org/COVID19resources

The current ASHRAE Standard 170 pressure relationships, air change rates and filtration efficiencies have proven to have served us well and there is little evidence that going beyond those requirements yields cost-justified improvements in COVID-19 viral transmission mitigation. There is probably no safer place in the US built environment than a code compliant, well-operated and -maintained hospital.

Now, if we could just reduce the number of infectious people in those buildings…


STANDARD

ANSI/ASHRAE/ASHE Standard 170-2017
(Supersedes ANSI/ASHRAE/ASHE Standard 170-2013)
Includes ANSI/ASHRAE/ASHE addenda listed in Appendix C

Ventilation of Health Care Facilities

See Appendix C for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the ASHE Board of Directors, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Senior Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

ISSN 1041-2336

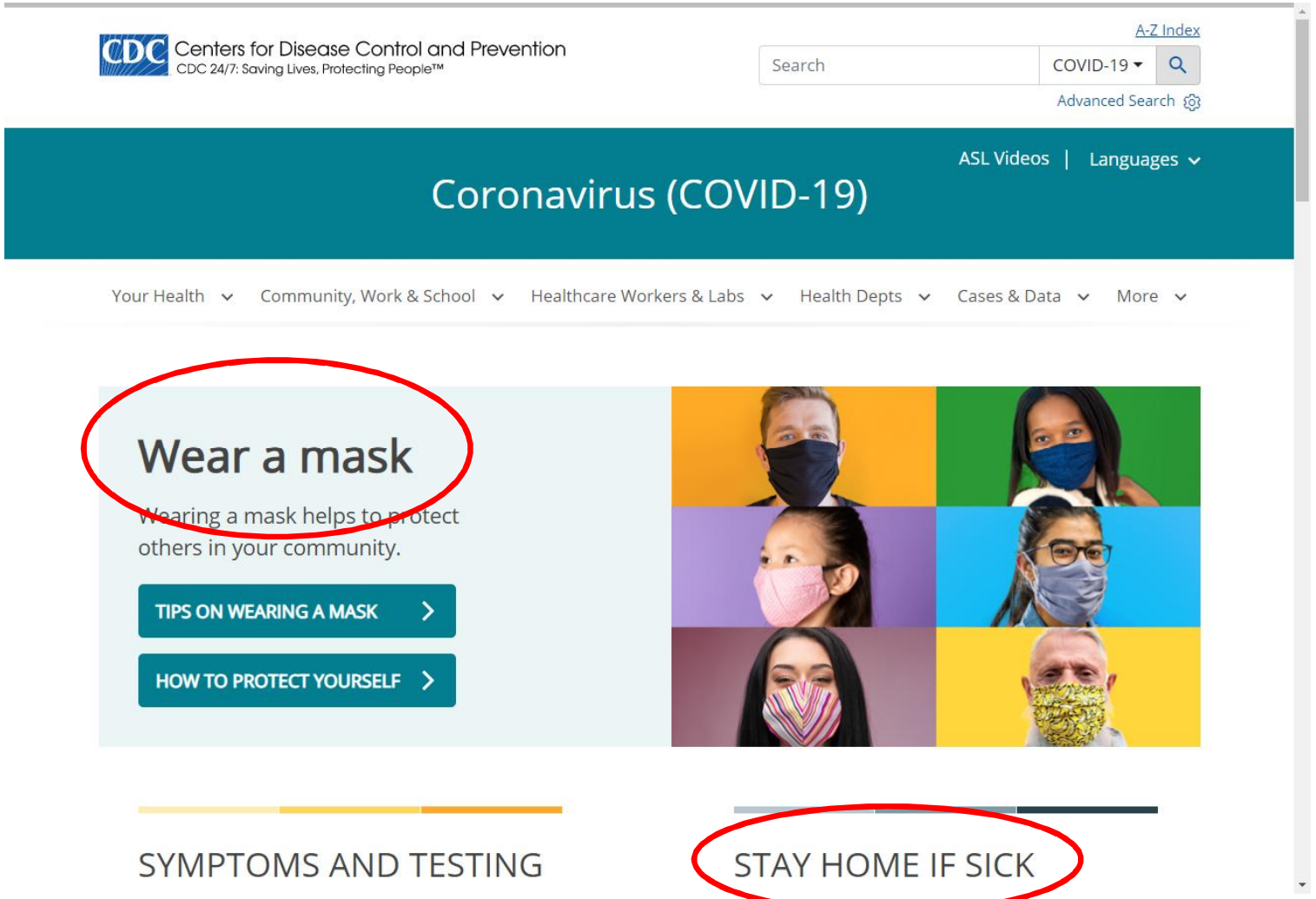
ASHRAE

ASHE
American Society for Healthcare Engineering
A personal membership group of the American Hospital Association

Approved American National Standard
ANSI
www.ansi.org

Current CDC Guidance

https://www.cdc.gov/coronavirus/2019-ncov/index.html



Current CDC Guidance

https://www.cdc.gov/coronavirus/2019-ncov/hcp/us-healthcare-facilities.html

Current CDC Guidance

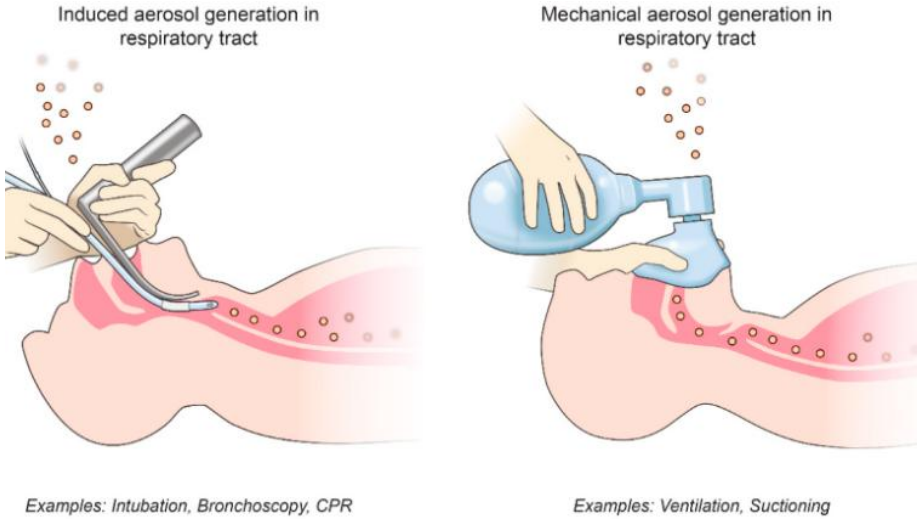
https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html

- Place patients in a single-person room with the door closed. The patient should have a dedicated bathroom. To the extent possible, the patient should stay there for the length of stay – minimize room transfers.
- Airborne Infection Isolation Rooms (AIIRs) should be reserved for patients who will be undergoing aerosol generating procedures.
- As a measure to limit exposure and conserve PPE, facilities could consider designating entire units within the facility, with dedicated personnel, to care for patients with suspected or confirmed SARS-CoV-2 infection.

A little more on AIIRs

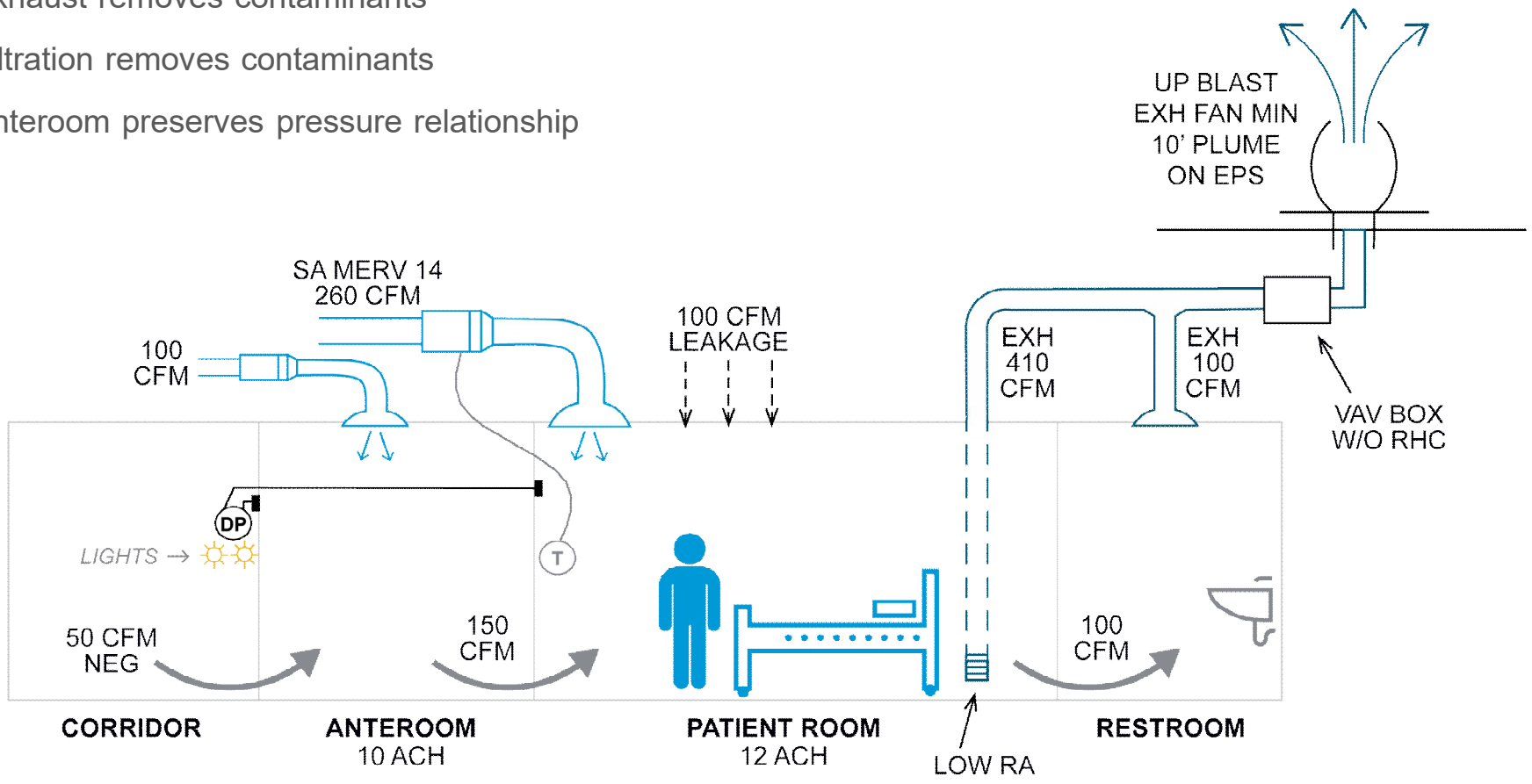
Airborne Infectious Isolation Room

- Minimum 12 Air Changes / Hour
- Negative Relative Pressure (Clean to Less Clean)
- All Air Exhausted Directly to Outdoors
- Anteroom strongly recommended



Airborne Infectious Isolation Room

- Air changes dilute contaminant level
- Exhaust removes contaminants
- Filtration removes contaminants
- Anteroom preserves pressure relationship



True AIIRs

A word about Air Changes

Ventilate the room and terminal clean before re-use

Follow CDC air change clearance rates

Dilution is the Solution to Pollution!

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *		
ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6+	46	69
8	35	52
10+	28	41
12+	23	35
15+	18	28
20	14	21
50	6	8

Establish solutions beyond A.I.I. rooms as needed

- Negative relative pressure helps contain contaminants, *but only while the door is closed, which is the reason for an anteroom*
- Do not depend on a single door to maintain a pressure relationship
  - Corridors outside both AIIRs and negative pressure segregation rooms contain virus particles.
  - Healthcare personnel should maintain PPE whenever they are in a unit housing COVID or suspected-COVID patients
- Negative pressure *does not equal* 100% exhaust

PPE for HCPs

COVID-19 Personal Protective Equipment (PPE) for Healthcare Personnel

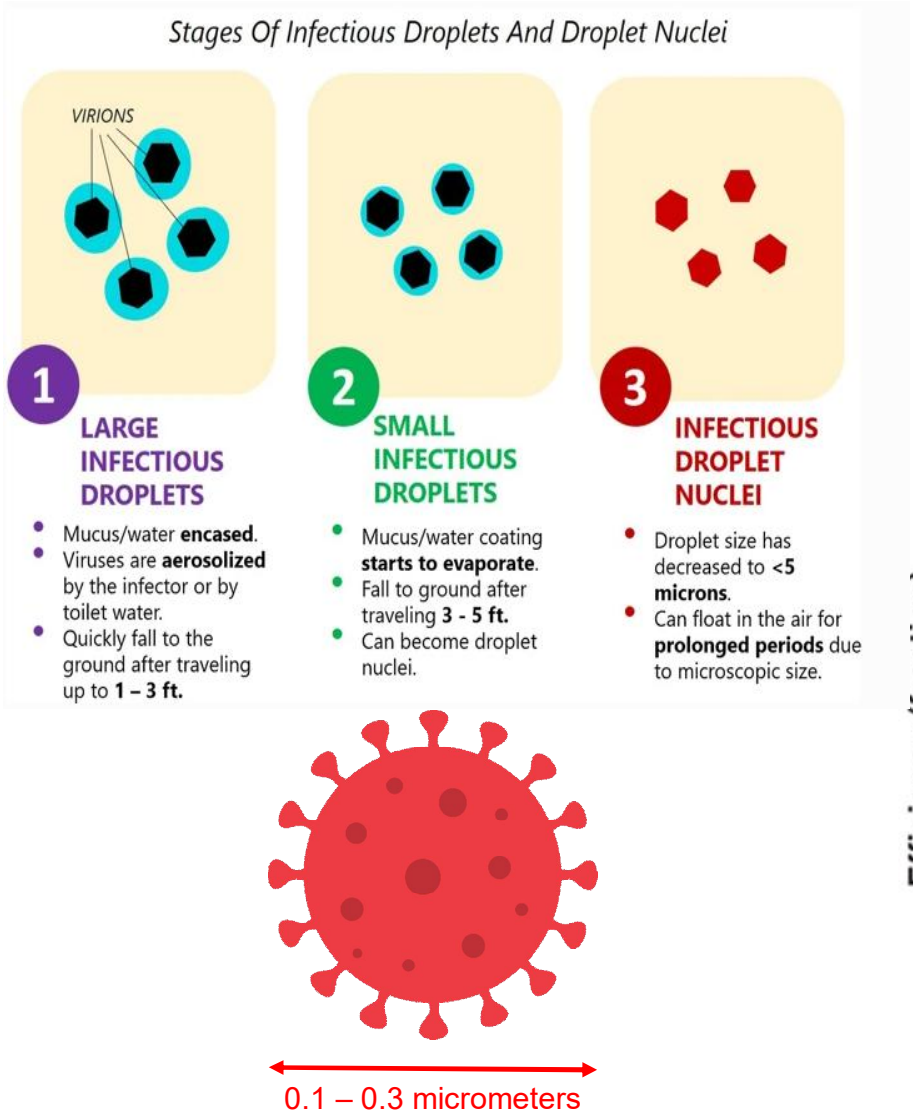
Preferred PPE – Use N95 or Higher Respirator

Acceptable Alternative PPE – Use Facemask

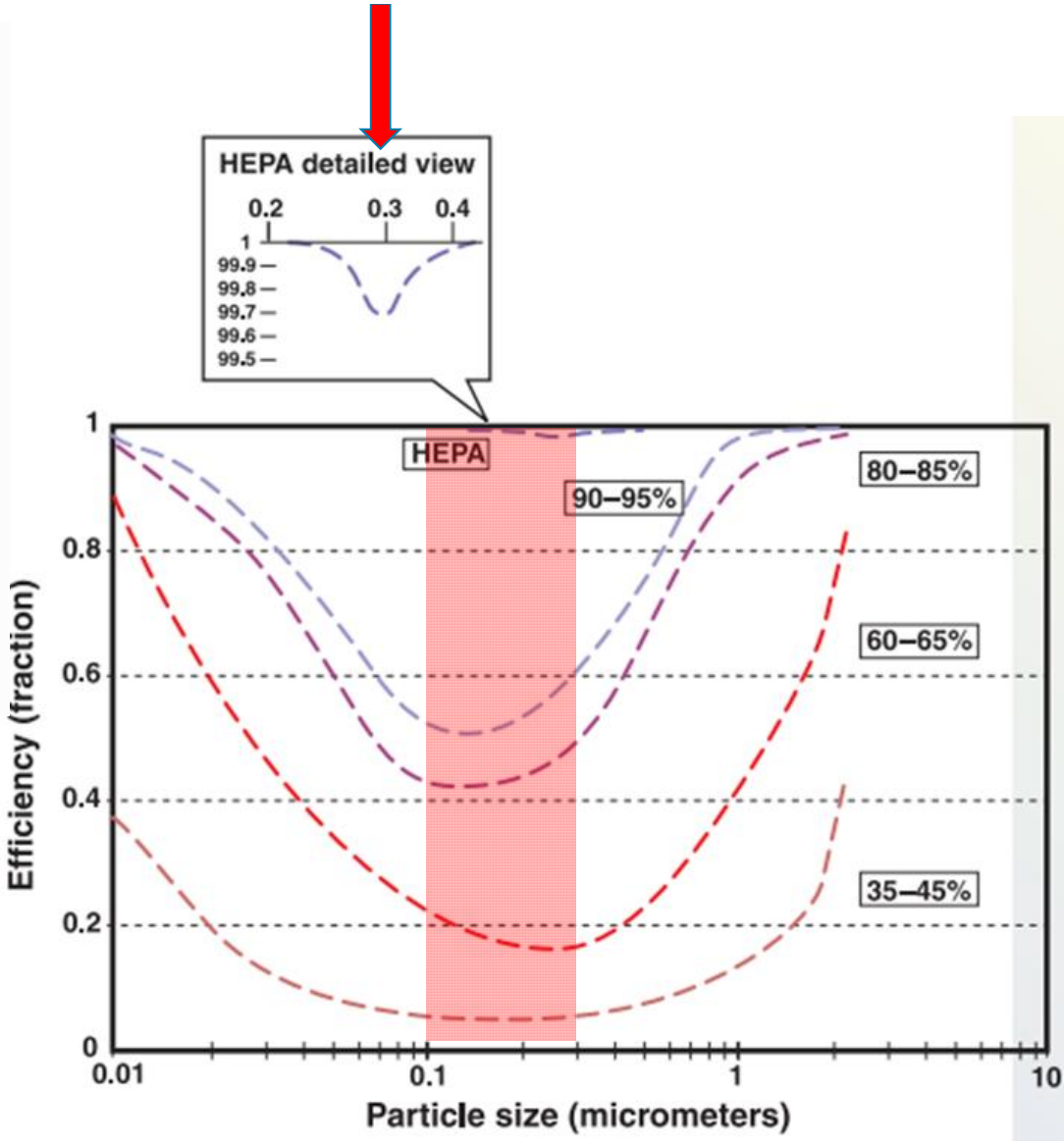
CDC

cdc.gov/COVID19

Basics - HEPA



0.1 – 0.3 micrometers

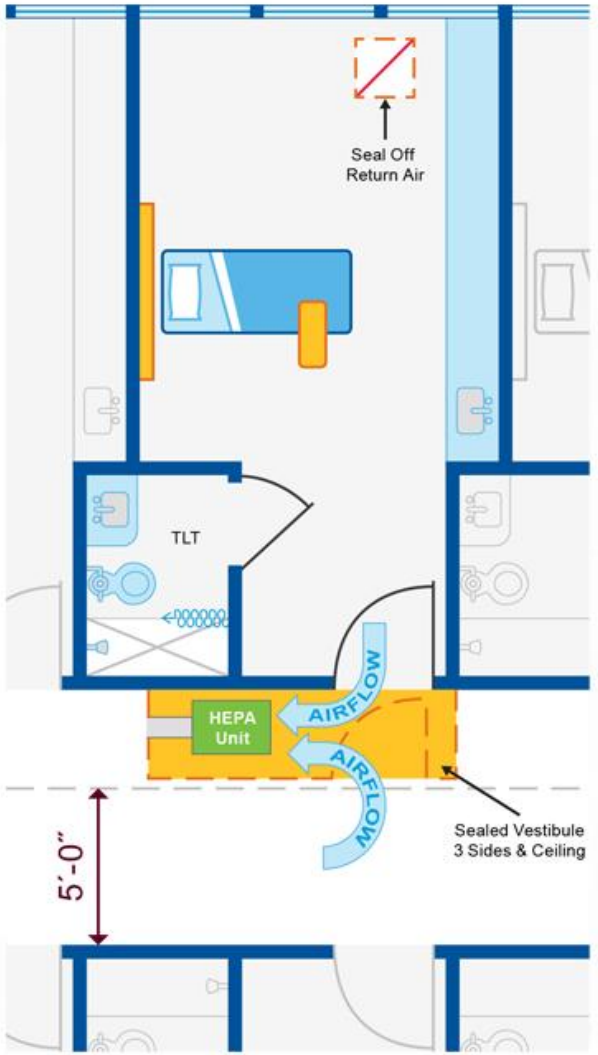


Small Scale Surge

HEPA to Hallway

- Single exam or patient room
- Create “sealed” vestibule to patient room
  - Vestibule should be a minimum 3'-0" x 6'-0"
  - Need minimum 5’-0” egress clearance in the corridor
- Seal off return air grill in patient room
- Place HEPA fan filter unit in hallway ceiling
- Keep door to vestibule closed but door to patient room open
- Verify negative pressure prior to placing room in service and monitor negative pressure while in service
- Limit patient transport and patient transfers
- Terminal cleaning after ACH removes potentially infections particles

https://www.ashe.org/negative-pressure-rooms

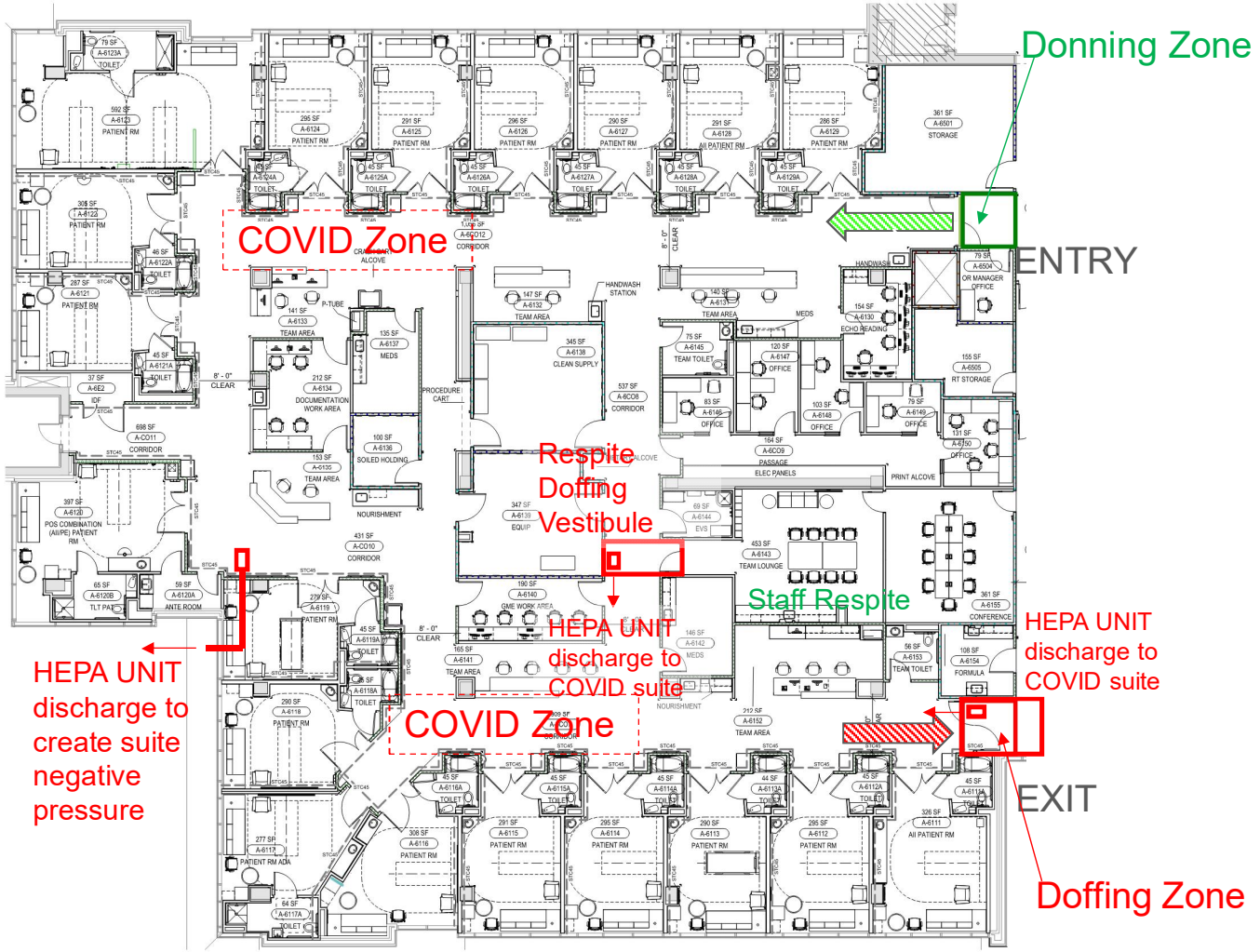


Hot / Cold Zones

The benefits of designating COVID patient suites includes the ability to establish the suite as a negative relative pressure zone to adjoining suites.

Use a HEPA fan filter unit to establish negative relative pressure in the suite. Consider using at least two units for redundancy purposes.

This arrangement avoids the need for HEPA units in each patient room and the necessary HVAC air re-balance and correspondent make-up air issues.



And now a brief word on ACS

- Alternate Care Sites (ACS)
  - Parking Garages
  - Tents
  - Convention Centers

- What about “putting patients in single occupant rooms with the door closed” did you ***not*** understand?
- The hotels and dormitories in town are pretty much empty, and they would love the business:
  - Already have plumbing, HVAC and power
  - Probably won’t fall down in a windstorm

What I tell people who ask about Gizmos

- The practical reality is that NOTHING we do to an HVAC system is going to make it safe to share an indoor space with people who aren't wearing masks.
- MORE practical reality: If everyone in an indoor space wear their masks, properly applied and operating ASHRAE 62 ventilation and filtration will make the risk of infection pretty effing low.
- The most effective gizmo in this pandemic would be summary justice for anyone not wearing a mask in an indoor space. We kill enough of those dumb ♌♋♦♦♋❒♎♦ and the risk of infection will drop to ***zero***.

Valar Morghulis

BranchPattern

OCTOBER 2020

Building Systems & IEQ Informed by COVID-19

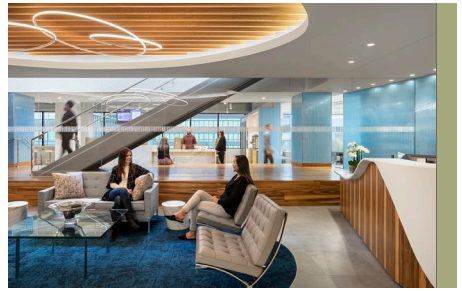
Pete Jefferson, PE

Timeline

SEP 2018

Built First Calculator for Flu Risk

Created a rudimentary model of viral transmission to analyze benefit of underfloor air distribution vs. overhead systems



FEB 2020

Formed Internal COVID-19 Task Force

Led by Marcel Harmon, PhD – focused on studying existing relevant research, monitoring new research, and developing building science tools

APR 2020

Began Modeling Viral Risk in Buildings

Work included K-12 Schools, Universities, Workplace, and Aviation Projects representing over 100,000 daily occupants

v1.0

JUN 2020

Released Flu Infection Risk Estimator (FIRE) Web Tool

Focused on Influenza A as proxy for SARS-CoV-2. Used to assess Probability of Infection in indoor spaces.

OCT 2020

Released FIRE v2.0 – Changed from Flu to "Facility"

Tool significantly improved to model for SARS-CoV-2, as well as adding additional strategies such as UVGI and masks.

v2.0

Continuing: Modeling Building Systems for Energy + Health

Using FIRE in concert with energy models to develop holistic strategies to achieving building energy and health outcomes.

Demographics + Room Information

# of people under 18: 10

Activity level for under 18: Resting

# of people 18 or older: 40

Activity level for 18 and older: Light

Weighted average salary: $ 0

Room height (ft): 14

Room area (ft^2): 2300

UVGI Mounting Height (ft): 0

# of rooms: 1

DEMOGRAPHICS + ROOM INFORMATION

BETTER BUILT ENVIRONMENTS

Viral Parameters

Virus type:

SARS-CoV-2

Removal time (t_{rem}):

0.250

Exposure time per day (t_{E1}):

1.00

Exposure time per viral season (t_{exp2}):

5%

Sick days lost per infection:

17

# of infected people:

2

Expiratory means:

Speaking

Level of virus shedding:

Low

% under 18 vaccinated:

0%

% 18 and over vaccinated:

0%

VIRAL PARAMETERS

BETTER BUILT ENVIRONMENTS

Baseline + Design Conditions

Baseline RH:

20%

Baseline outdoor air (cfm/space):

0

Baseline recirculated air (cfm/space):

0

Baseline filter type:

MERV 4

Baseline UVGI upper room average irradiance (μW/cm2):

0

Baseline # of portable air cleaning units:

0

Baseline portable air cleaning unit CADR:

0

Baseline mask wearing:

No mask

Baseline % infected wearing mask:

100%

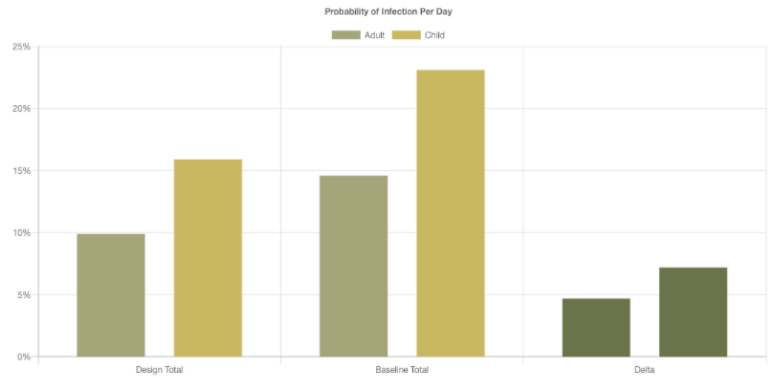
Baseline % non-infected wearing mask:

100%

BASELINE + DESIGN CONDITIONS

BETTER BUILT ENVIRONMENTS

Adult Probability of Infection	
Design $P_{infection\text{-}settling}$ Per Day	100%
Design $P_{infection\text{-}ventilation}$ Per Day	9.9%
Design $P_{infection\text{-}filtration}$ Per Day	N/A
Design $P_{infection\text{-}RHinactivation}$ Per Day	N/A
Design $P_{infection\text{-}UVGinactivation}$ Per Day	N/A
Design $P_{infection\text{-}PAC}$ Per Day	N/A
Design $P_{infection\text{-}mask}$ Per Day	N/A
Design $P_{infection\text{-}total}$ Per Day	9.9%
Baseline $P_{infection\text{-}total}$ Per Day	14.6%
Estimated Decrease in $P_{infection\text{-}total}$ Per Day Compared to Baseline	4.7%
Design $P_{infection\text{-}total}$ Per Viral Season	22%
Baseline $P_{infection\text{-}total}$ Per Viral Season	31.5%
Estimated Decrease in $P_{infection\text{-}total}$ Per Year Compared to Baseline	9.5%



PROBABILITY OF INFECTION

BETTER BUILT ENVIRONMENTS

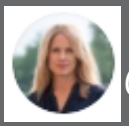

THE GOOD

INDUSTRY RESPONDING WITH FREE RESOURCES

- Harvard Chan School of Public Health
  - https://covid-19.forhealth.org
- ASHRAE Epidemic Task Force
  - https://www.ashrae.org/technical-resources/resources
- AIA COVID Resources for Architects
  - https://www.aia.org/pages/6280670-covid-19-resources-for-architects
- BranchPattern Facility Infection Risk Estimator
  - https://branchpattern.com/research/facility-infection-risk-estimator-v2-0/

Suggested Follows


@linseymarr


@ShellyMBoulder


@CorsIAQ


@jljcolorado


@j_g_allen


@MarcelHarmon1

BranchPattern

COVID-19: America hasn't used this little energy in 16 years

COVID-19 has seen the closure of public spaces, businesses and factories all across America.

Image: REUTERS/Shannon Stapleton

Link

PEOPLE CARE ABOUT INDOOR AIR QUALITY NOW

How to Keep the Coronavirus at Bay Indoors

Tips for dodging the virus as Americans retreat from colder weather: Open the windows, buy an air filter — and forget the UV lights.

The New York Times

The Air We Breathe

And what else you need to know today.

By David Leonhardt

Sept. 15, 2020

Opinions

Yes, airborne transmission is happening. The CDC needs to set the record straight.

The headquarters of the Centers for Disease Control and Prevention in Atlanta. (Elijah Nouvelage/Bloomberg News)

Opinion by **Joseph G. Allen** and **Linsey C. Marr**

Climate and Environment

No matter what the CDC says, here's why many scientists think the coronavirus is airborne

"To the general public, 'airborne' can evoke fear and panic. People think of the movie 'Contagion,' which is like 'Jaws' but for infectious diseases."

LONG OVERDUE BUILDING ASSESSMENTS AND RETRO-CX BEING DONE

BETTER BUILT ENVIRONMENTS


THE BAD

Occupied building. The outside air dampers are shut despite the BAS system showing them open.

RAMPANT VENTILATION PROBLEMS

BETTER BUILT ENVIRONMENTS

AT LEAST HE GOT A WINDOW…

BETTER BUILT ENVIRONMENTS

National Laboratory studied 162 classrooms across 28 elementary schools in California and found that the average CO_2 concentration was above 1,500 ppm.[8] (In one district the average was closer to 2,500 ppm.) California is not an aberration. In Texas, one in five schools tested had peak CO_2 concentrations above 3,000 ppm.[9] These are just two examples of dozens of studies showing similar findings. Taken together, the full body of scientific evidence paints a problematic picture—up to 90 percent of schools in the United States are not meeting the *minimum* ventilation standards.

From the Book: *Healthy Buildings*
Joseph Allen, Director Healthy Buildings Program
Harvard T.H. Chan School of Public Health

”CROWDED AND POORLY VENTILATED” OFTEN MEANS SCHOOLS

MULTIPLE STUDIES REPORTED 70-90% OF SCHOOLS ARE UNDERVENTILATED

Elementary School: CO2 Levels During School Hours on 10/7/2020

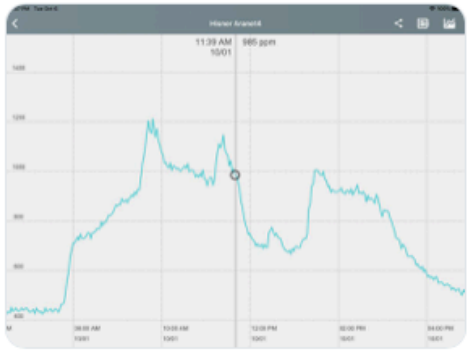
Recommended: 600-800 ppm
ASHRAE 62.1 Std: ~1,100 ppm max
Actual: 1,023 avg / 1,273 peak

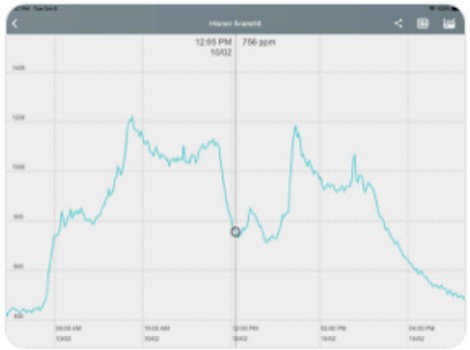
Ryan

Follow @LongDesertTrain 429 followers

11 Oct, 7 tweets, 6 min read

Pictured throughout thread are CO2 readings from my classroom Aranet4 CO2 meter. I have two 90-min classes (8:00-9:30, 9:40-11:10) & one 25-min homework/reading period (11:20-11:45) before lunch/prep from 11:50-1:15 & one 95-min class after (1:25-3:00). #covidco2 1/7





Maximum readings:

10-1: ~1200
10-2: ~1200
10-5: ~1200
10-6: 1447
10-7: 1345
10-8: 1446
10-9: 1448

Like ~80% of the rooms in my school, mine has no windows, but I'm lucky to have two doors, one opening to the hallway and one to our science lab. #covidco2 2/7

SCIENCE TEACHERS DON'T MISS A CHANCE TO EXPERIMENT

BETTER BUILT ENVIRONMENTS

NOT JUST LIMITED TO SCHOOLS…

OFFICES ~ 40-50% UNDERVENTILATED[1]
HIGHER ED
PLACES OF WORSHIP
GYMS[2]
CIVIC & GOVERNMENT[3]
SENIOR/ASSISTED LIVING

1. Two NIST studies of 114 office buildings.
2. Based on my own observations of every Crossfit “Box.” Trust your nose.
3. This includes an unnamed Senator’s office, which had no outside air.

LOTS OF THE SOLUTIONS *CAN* REQUIRE MORE ENERGY AND $$$

INCREASED OUTSIDE AIR
DISABLED ENERGY RECOVERY
BETTER FILTERS
HUMIDIFICATION
UVGI
PORTABLE AIR CLEANERS


THE UGLY

Image: Los Angeles Times

CHEMICALS + POORLY VENTILATED SPACES… WHAT COULD GO WRONG?

(GBA EVENT ON THIS SUBJECT NOV. 5TH!)

BETTER BUILT ENVIRONMENTS

(He’s wearing a lab coat, so you can believe it)

MANIPULATING SCIENCE FOR SALES

(ASK FOR THE ACTUAL RESEARCH)

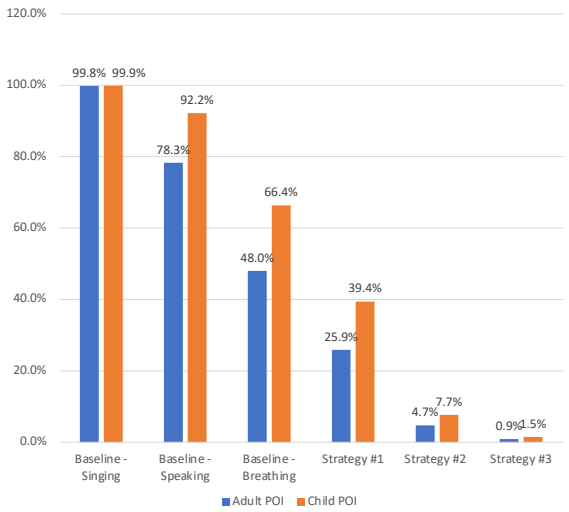

MOVING FORWARD

Calculating the risk: An online tool translates space stats into COVID risk

ANYA LITVAK
Pittsburgh Post-Gazette
alitvak@post-gazette.com

OCT 12, 2020 | 6:15 AM

Sanctuary Analysis: Probability of Infection (POI)



WE HAVE A LOT OF EXISTING BUILDINGS TO DEAL WITH

Assess
Retro-Commission
Continuous Commissioning

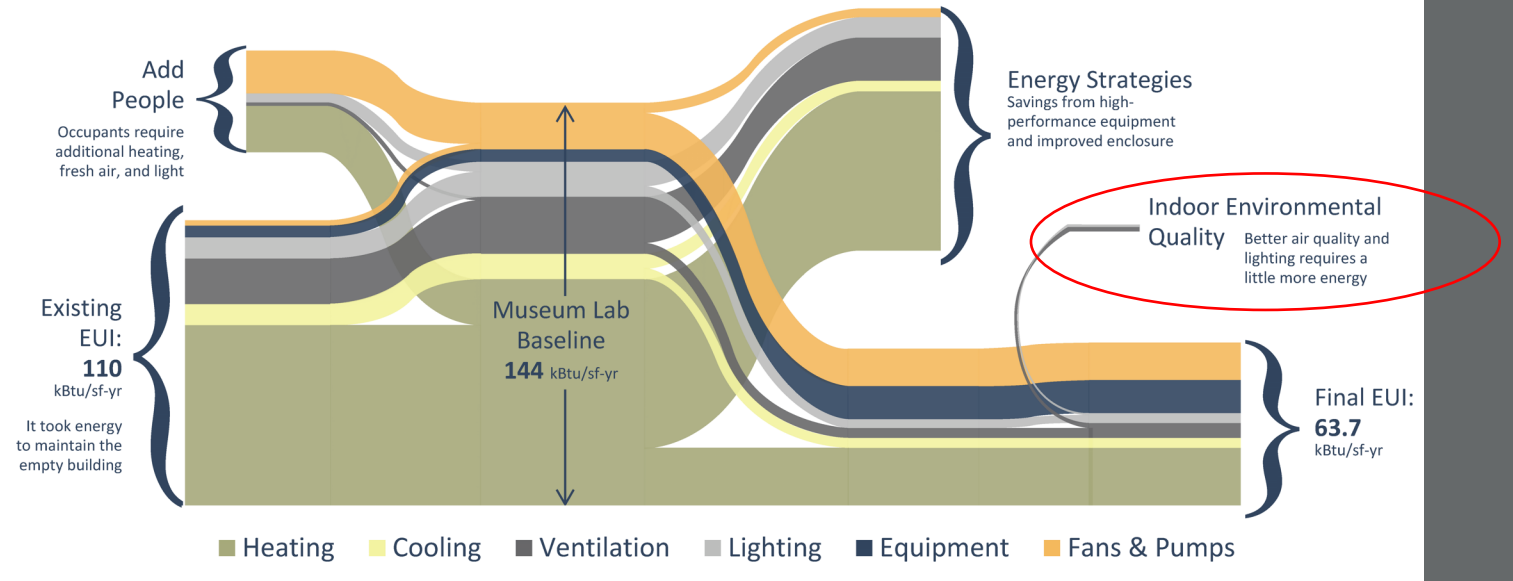
Make a plan based on science - not sales

Erie PK-8 – Net-Zero Ready (25 kBtu/sf/yr)
Cuningham Group Architects

GET OUTSIDE AIR RATES RIGHT

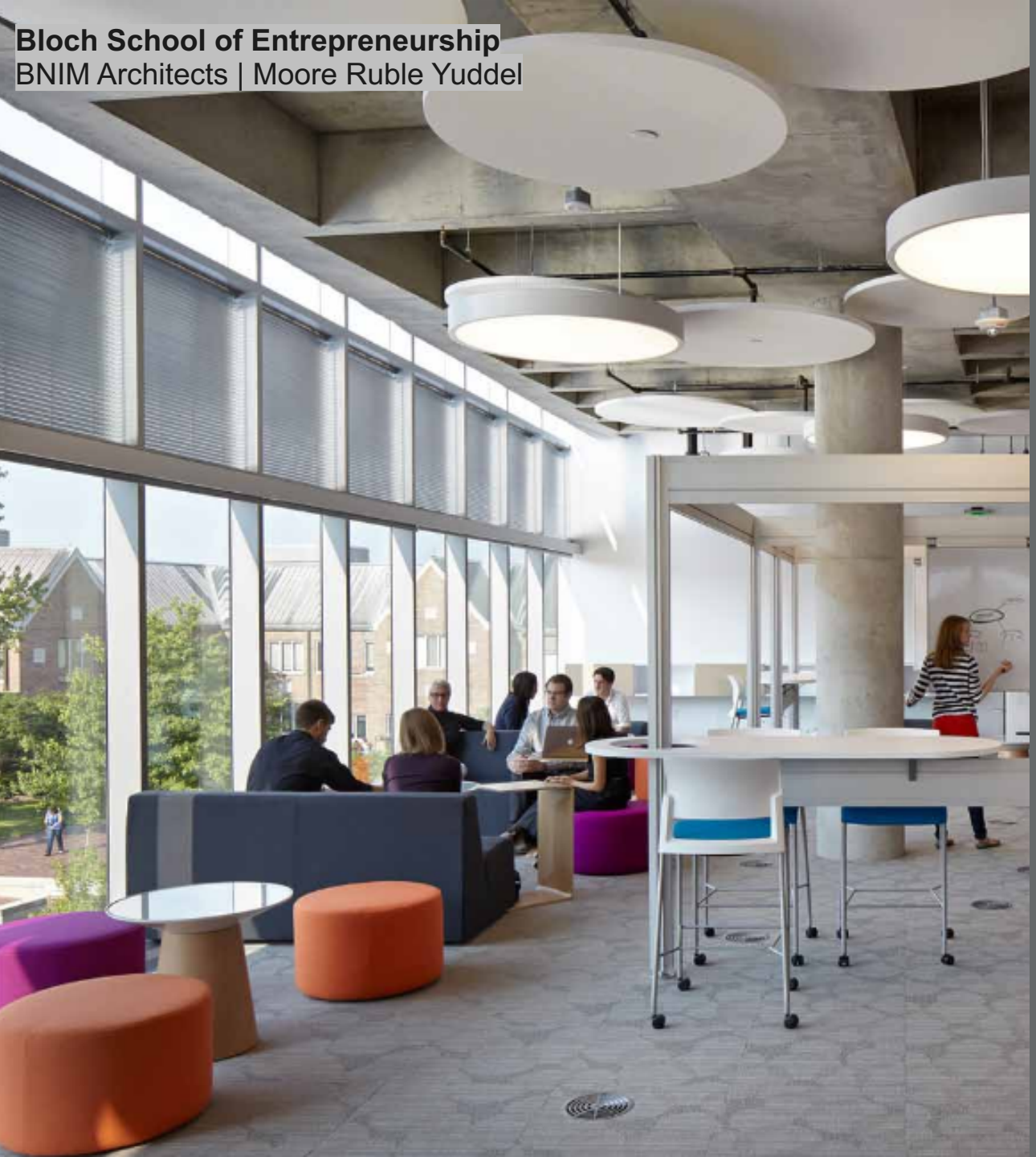
ASHRAE STD 62.1 + 30%
600-800 ppm CO2
Operable Windows*

***Outside air quality matters too**
Red light: Close windows
Green light: Open windows



DEDICATED OUTSIDE AIR WITH ENERGY RECOVERY

How we get better air quality for less energy than traditional systems



Bloch School of Entrepreneurship
BNIM Architects | Moore Ruble Yuddel

DISPLACEMENT VENTILATION (NEW BUILDINGS)

Reduced mixing of air within the space = lower transmission of viruses

Increases “ventilation effectiveness”
Means less outside air to achieve the same CO_2 levels as overhead

Saves energy

Erie PK-8 – Net-Zero Ready (25 kBtu/sf/yr)
Cuningham Group Architects

DISPLACEMENT VENTILATION (NEW BUILDINGS)

Reduced mixing of air within the space = lower transmission of viruses

Increases “ventilation effectiveness” Means less outside air to achieve the same CO2 levels as overhead

Saves energy

FactSet World Headquarters
Perkins Eastman Architects

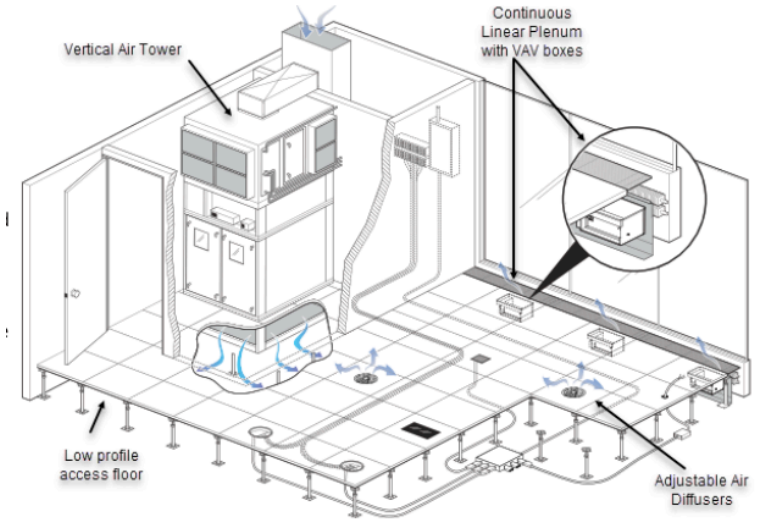


Image: Global IFS Solutions

DISPLACEMENT VENTILATION (EXISTING BUILDINGS)

Existing overhead systems can be modified to become Underfloor Air Distribution (UFAD) or displacement ventilation systems

Improved energy, thermal comfort, and reduced viral transmission

State Historical Society of Missouri
Gould Evans Architects

HUMIDIFICATION

40-60% RH good for inactivating viruses… but we're playing with fire (technically water)

Don't throw it into an existing building casually

Requires a great envelope, really careful detailing, and robust controls and maintenance

Plays nicely with PassiveHouse

Image: Kaiterra

AIR QUALITY MONITORING

Increased use of tools for continuously monitoring indoor air quality[1]

Allows us to diagnose system issues that go years without being noticed – which is how we got here in the first place

1. **If we don't do it, our occupants will. Basic units can be found for less than $100 on Amazon.**

1421 Blake
Lake | Flato Architects

BranchPattern

Pete Jefferson

412.727.8388

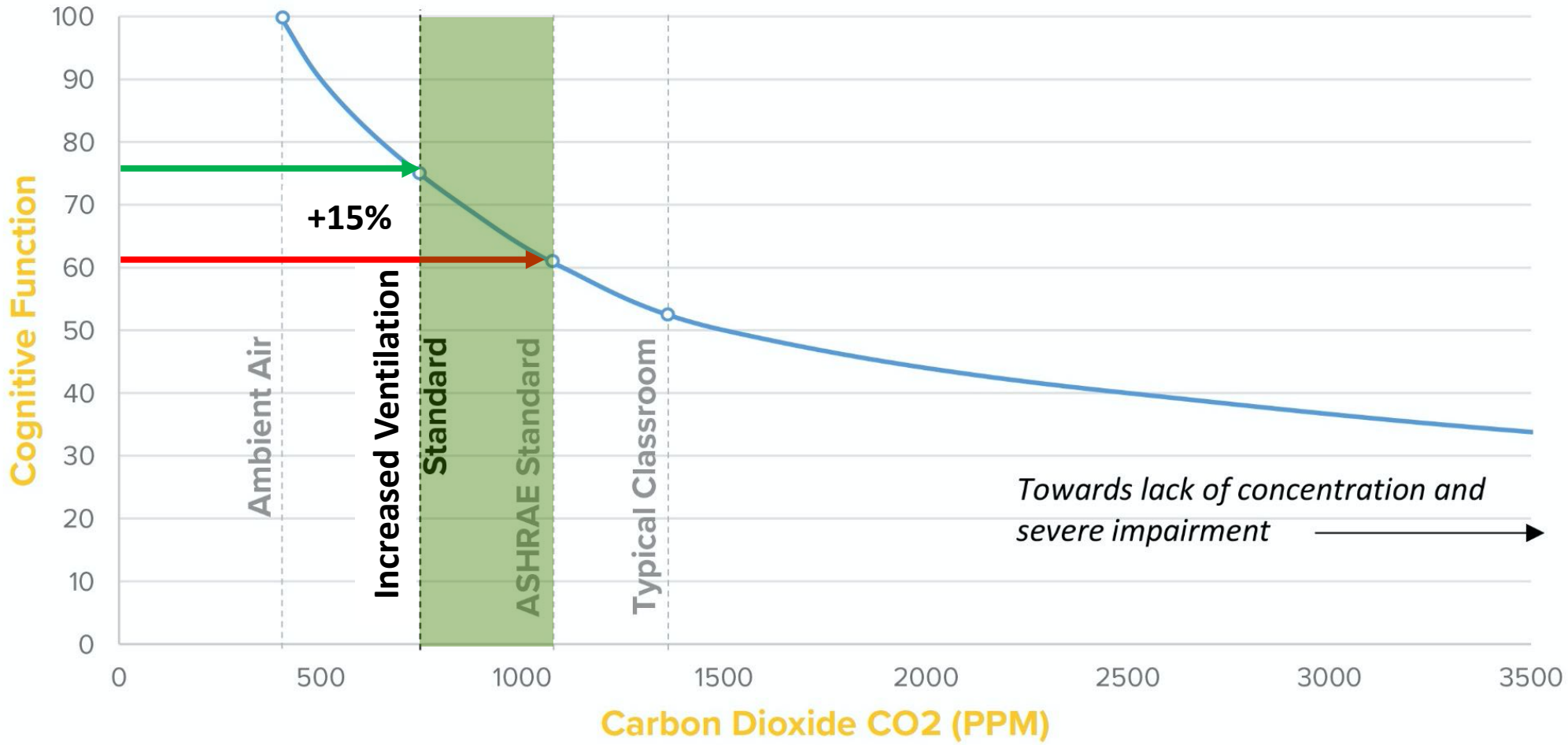
pete.j@branchpattern.com

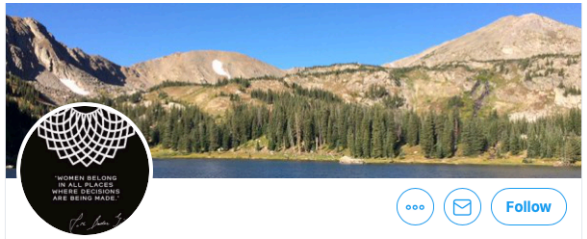
BETTER BUILT ENVIRONMENTS®

LAGNIAPPE

(A little something extra)

AIR QUALITY AND COGNITIVE FUNCTION





Alex Huffman
@HuffmanLabDU

#aerosol #bioaerosol research, chemistry, @DUsciencemath, @UofDenver; detection methods, health & environ effects; learning to be an advocate for others.

University of Denver · sites.google.com/site/huffmanla...
Joined July 2014

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@paddycollins @paddyocollins · Aug 19

Alex, have you done studies of Bi-Polar Ionization? Our schools are considering installing this system.

3 · 1

Alex Huffman
@HuffmanLabDU

Replying to @paddyocollins

Short answer: avoid the ionization. Better just to improve ventilation & filtration itself (MERV in HVAC system; add HEPA filtration units in-room). These are more efficient than other seemingly fancy system, and ionization can cause unintended air chemistry = health problems.

12:20 PM · Aug 19, 2020 · Twitter Web App

Jose-Luis Jimenez
@jljcolorado

1/ Air cleaners: the good, the dubious, and the ugly

With pandemic & major contribution of aerosol spread, many ppl wanting "air cleaning devices" to reduce / remove virus. Unfortunately many types, aggressive & misleading marketing of unproven & potentially dangerous cleaners

11:29 AM · Aug 7, 2020 · Twitter Web App

240 Retweets **65** Quote Tweets **505** Likes

Jose-Luis Jimenez @jljcolorado · Aug 7

22/ Comments?
- Happy to update this, if peer-reviewed evidence addressing all oxidation products is provided. Not seen any so far.
- Expect dismissal from manufacturers (again). But please provide evidence.
- Comments? Anything I missed?
@ShellyMBoulder @CorsIAQ @IAQinGWN

12 · 5 · 34

Dr. Richard Corsi
@CorsIAQ

Replying to @amigadehelado and @scientific_fire

6 ft between tables is woefully inadequate where masks not worn.

Bi-polar ionization is being heavily marketed but IMO has not been rigorously & independently tested w/ results published in a peer-reviewed journal. Some can also emit a lot of ozone. See ashrae.org/technical-reso...

RESEARCHER THOUGHTS ON BI-POLAR IONIZATION

BETTER BUILT ENVIRONMENTS

Bipolar Ionization/Corona Discharge / Needlepoint Ionization and Other Ion or Reactive Oxygen Air Cleaners

- Air cleaners using reactive ions and/or reactive oxygen species (ROS) have become prevalent during the COVID-19 pandemic. New devices that are not mentioned elsewhere in this guidance likely fall into this category.
- Technologies utilize various methods to create reactive ions in air that react with airborne contaminants, including viruses. The design of the systems can be modified to create mixtures of reactive oxygen species (ROS), ozone, hydroxyl radicals and superoxide anions.
- Systems are reported to range from ineffective to very effective in reducing airborne particulates and acute health symptoms.
- Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered.
- Systems may emit ozone, some at high levels. Manufacturers are likely to have ozone generation test data.

For more information, see the ASHRAE Position Document on Filtration and Air Cleaning and CDC Response to ASHRAE ETF on Bipolar Ionization

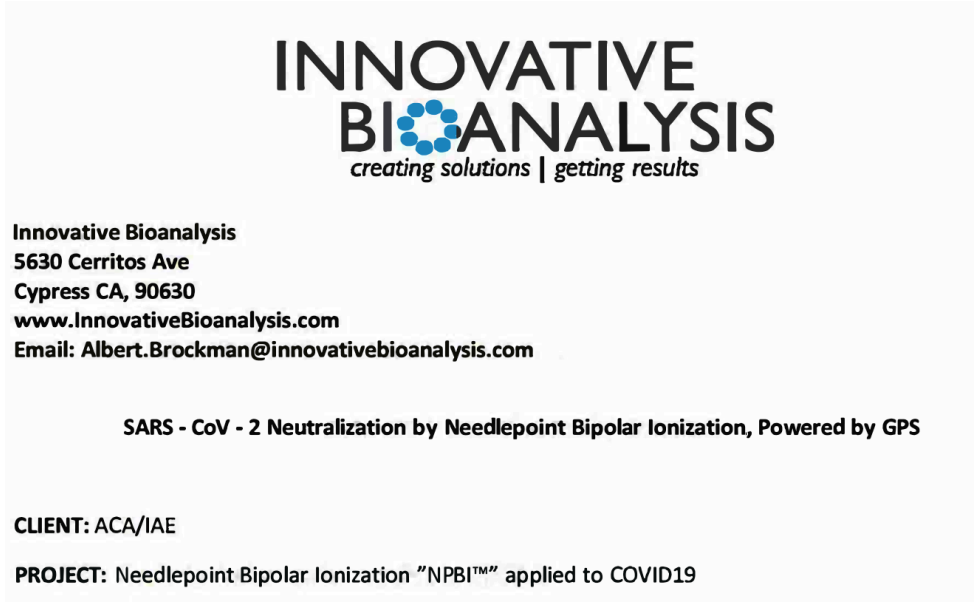
CDC Position on Bipolar Ionization

ASHRAE does not currently have a Society position on bipolar ionization. However, the ASHRAE ETF did reach out to CDC for their position on the technology. The following is the response from CDC in its entirety:

Thank you for your question. Although this was pointed out in the earlier CDC responses, it is important for me to re-emphasize that CDC does not provide recommendations for, or against, any manufacturer or manufacturer's product. While bi-polar ionization has been around for decades, the technology has matured and many of the earlier potential safety concerns are reportedly now resolved. If you are considering the acquisition of bi-polar ionization equipment, you will want to be sure that the equipment meets UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners) which is intended to validate that no harmful levels of ozone are produced. Relative to many other air cleaning or disinfection technologies, needlepoint bi-polar ionization has a less-documented track record in regards to cleaning/disinfecting large and fast volumes of moving air within heating, ventilation, and air conditioning (HVAC) systems. This is not to imply that the technology doesn't work as advertised, only that in the absence of an established body of evidence reflecting proven efficacy under as-used conditions, the technology is still considered by many to be an "emerging technology". As with all emerging technologies, consumers are encouraged to exercise caution and to do their homework. Consumers should research the technology, attempting to match any specific claims against the consumer's intended use. Consumers should request efficacy performance data that quantitively demonstrates a clear protective benefit under conditions consistent with those for which the consumer is intending to apply the technology. Preferably, the documented performance data under as-used conditions should be available from multiple sources, some of which should be independent, third party sources.

CDC & ASHRAE THOUGHTS ON BI-POLAR IONIZATION

BETTER BUILT ENVIRONMENTS



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SARS - CoV - 2 Neutralization by Needlepoint Bipolar Ionization, Powered by GPS

CLIENT: ACA/IAE

PROJECT: Needlepoint Bipolar Ionization "NPBI™" applied to COVID19

"Initial testing has demonstrated the ionizers ability to neutralize the pathogen, namely SARS-CoV-2, on a static surface. Further studies required for reproducing testing as well as variation in environment and environmental factors."

Interpretation: When they say it "kills 99% of the virus in 30 minutes", it was the virus in a petri dish in a box flooded with ions. Most people probably believed it was addressing the airborne virus.

MY THOUGHTS ABOUT BI-POLAR IONIZATION

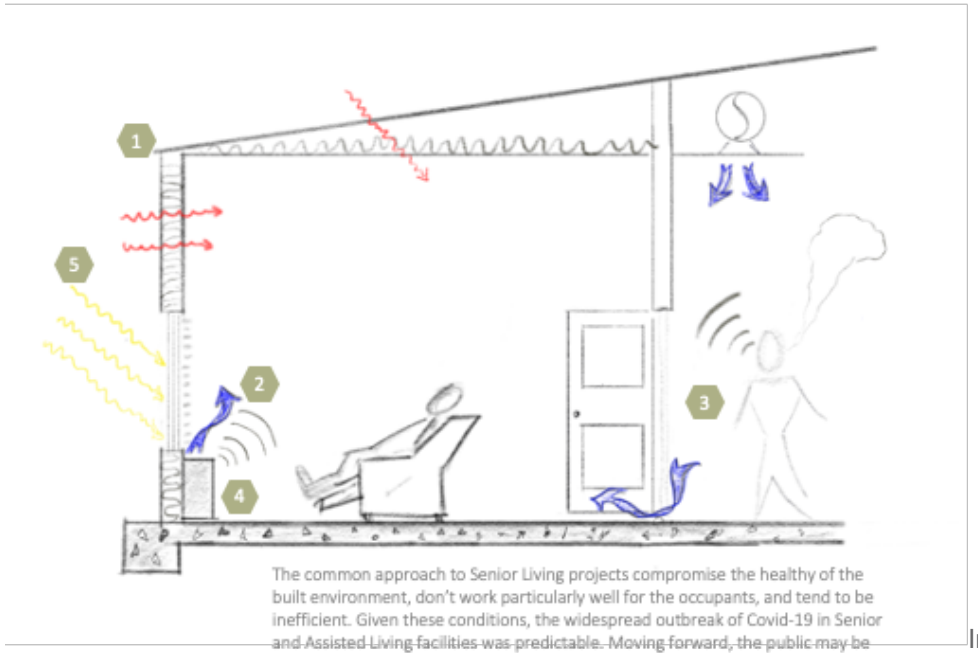
- Why is the research cited so hard to obtain?
- Lack long-term healthy studies to address:
  - Breathing ionized air long term
  - What ions do to healthy lung tissue
- Potential ozone generation in lower quality units
- CO2 a byproduct that's casually dismissed by manufacturers, or worse, justified by misapplied research
- It's easier than getting ventilation right, hence it's popular
- Does it work? Maybe. But there's a lot we don't know compared to primary strategies

CORONAVIRUS

Worker became ‘super spreader’ of coronavirus at Joliet nursing home where 26 people died, officials say, and it shows need for more testing

Understanding the Problem: Conventional Senior Living Design

Conventional Senior Living projects leave much to be desired in the way of building healthy, high-performing spaces. Having reviewed existing facilities, here are some of the ways in which these spaces create energy and indoor environmental quality issues:



1. Minimal code-compliant envelopes lead to excessive heat loss/gain and air leakage. This can result in moisture/mold issues, higher energy use, and requires heavier use of the HVAC system.
2. The most common HVAC system type is a Packaged Terminal A/C (PTAC) Unit. While economical, these units are loud and generally provide poor thermal comfort. Coupled with a mediocre envelope, they run frequently, creating a noisy, drafty space.
3. Code-required ventilation air is often delivered by pressurizing the corridor and undercutting doors. This introduces a path for noise and pathogens to enter a residence from adjacent spaces.
4. PTAC units don’t have any meaningful filters and recirculate indoor air. Pathogens and particulate matter can build up in the space over time, particularly during winter months.
5. Daylight is often an afterthought with no real intention for how to control glare. As a result, interior shades are necessary, creating a dark space that’s disconnected from the outdoors.

The common approach to Senior Living projects compromise the healthy of the built environment, don’t work particularly well for the occupants, and tend to be inefficient. Given these conditions, the widespread outbreak of Covid-19 in Senior and Assisted Living facilities was predictable. Moving forward, the public may be more concerned about how these types of spaces protect the residents’ health and well-being.

Image: BranchPattern

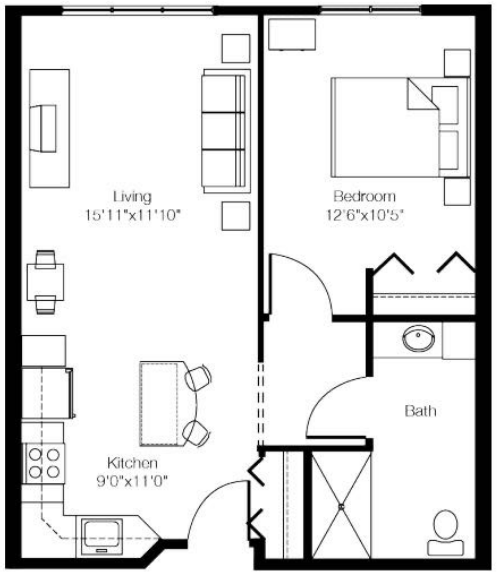
MODELING A SENIOR HOUSING DISASTER:
SYMPHONY OF JOLIET (IL)

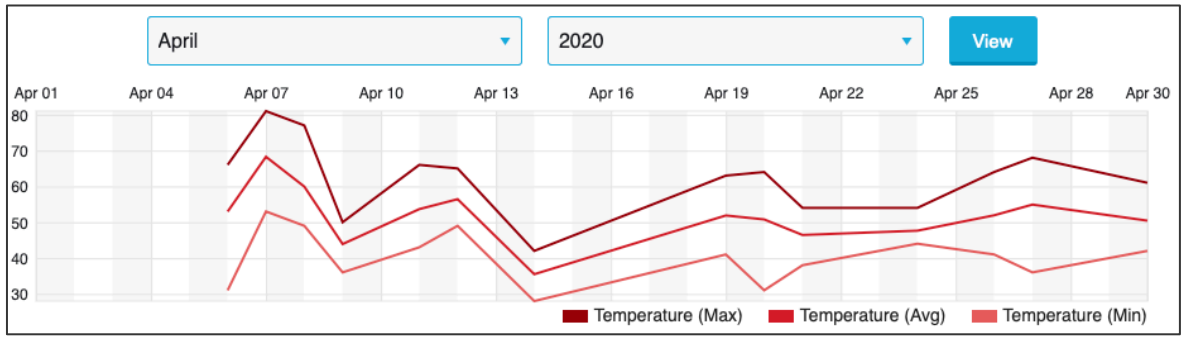
Infected maintenance worker visited 40 rooms to assemble dining furniture

Worker described “physical exertion” of assembling tables

Resulted in 26 deaths

Senior living projects recipe for disaster, not just because of resident risk





Probability of Infection: 81.2%

MODELING A SENIOR HOUSING DISASTER:
SYMPHONY OF JOLIET (IL)

Assumptions:

- 264 SF, 8.5’ ceiling
- Worker in space 42 min (0.7 hr)
- Moderate activity level
- Medium viral shedding
- Speaking to resident
- 20% RH
- 20 CFM OA (leakage)
- 50 CFM Recirculated (probably generous)
- MERV 7 Filter
- No masks

Temps were mostly too cool to open windows, meaning units were heating. But it wasn’t cold enough to create much load, so even recirculation air was probably minimal.

MODELING A SENIOR HOUSING DISASTER:
SYMPHONY OF JOLIET (IL)

Facility Infection Risk Estimator v2.0
Probability of Infection

Baseline: 81.2%

Easy Changes:
Both Wear a Mask: 68.1%
+Portable HEPA filter ($200): 20.6%

Better Systems:
50 CFM OA, 75 CFM RA, MERV 13: 46.1%
+Masks: 37.3%
+Add Portable HEPA filter: 16.4%

If (1) resident per room, reduced infected from 32 people to 7.

Adult Probability of Infection	
Design $P_{infection\text{-}settling}$ Per Day	100%
Design $P_{infection\text{-}ventilation}$ Per Day	76.3%
Design $P_{infection\text{-}filtration}$ Per Day	66.8%
Design $P_{infection\text{-}RHinactivation}$ Per Day	N/A
Design $P_{infection\text{-}UVGlinactivation}$ Per Day	N/A
Design $P_{infection\text{-}PAC}$ Per Day	30.2%
Design $P_{infection\text{-}mask}$ Per Day	100%
Design $P_{infection\text{-}total}$ Per Day	16.4%
Baseline $P_{infection\text{-}total}$ Per Day	79.1%
Estimated Decrease in $P_{infection\text{-}total}$ Per Day Compared to Baseline	62.7%
Design $P_{infection\text{-}total}$ Per Viral Season	0%
Baseline $P_{infection\text{-}total}$ Per Viral Season	0%
Estimated Decrease in $P_{infection\text{-}total}$ Per Year Compared to Baseline	0%

https://branchpattern.com/research/facility-infection-risk-estimator-v2-0/