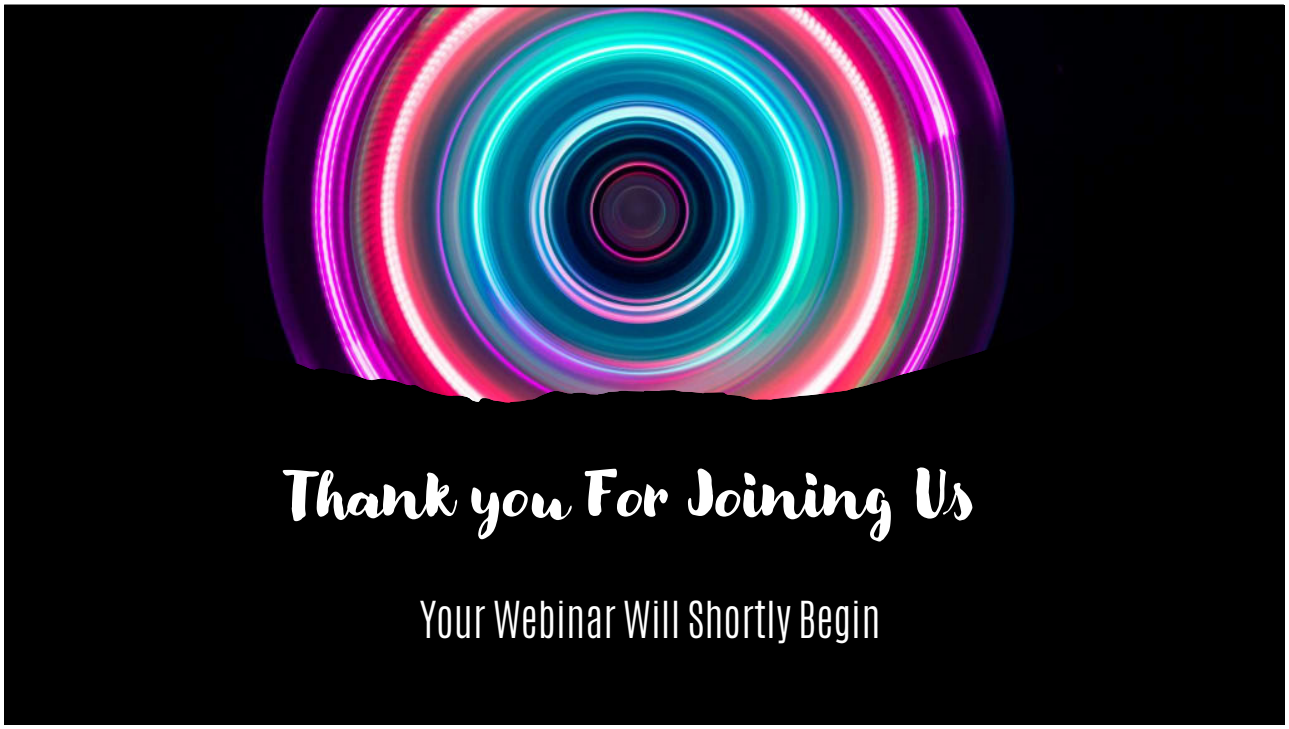

Thank you For Joining Us
Your Webinar Will Shortly Begin

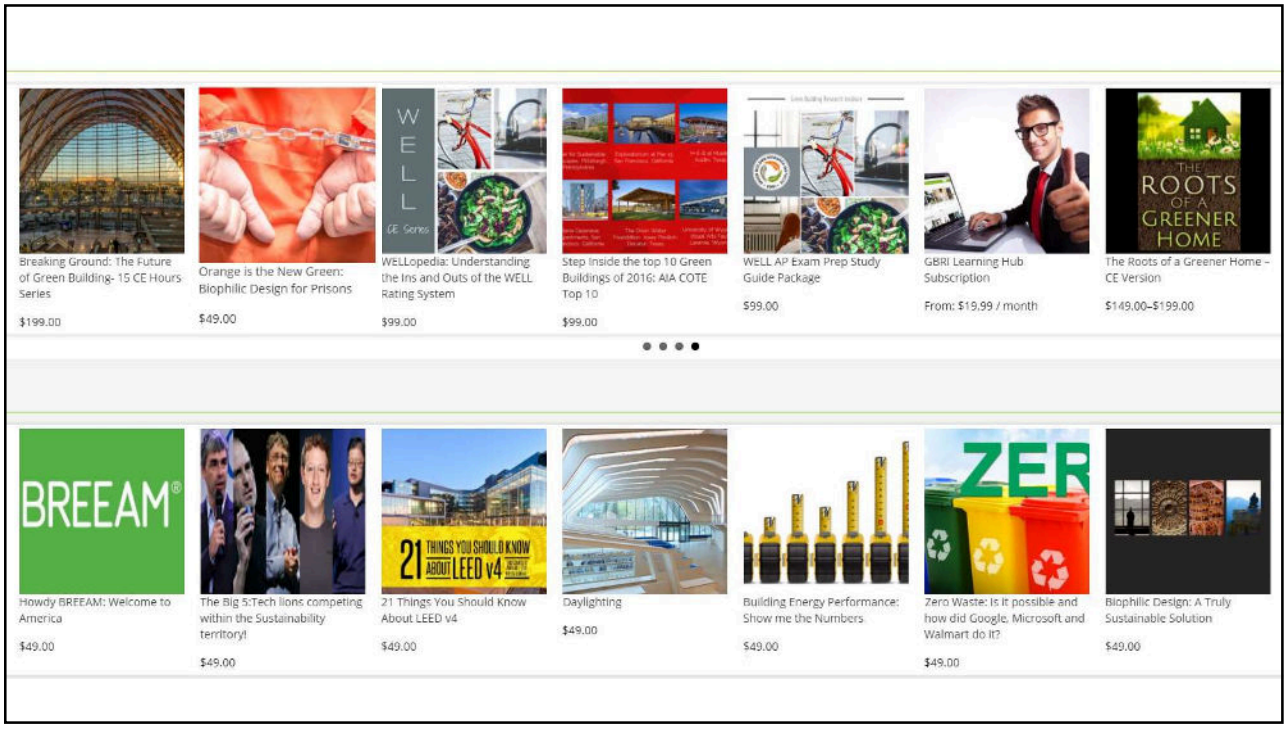
1


Thank you
For Joining Us
Your Webinar Will Shortly Begin

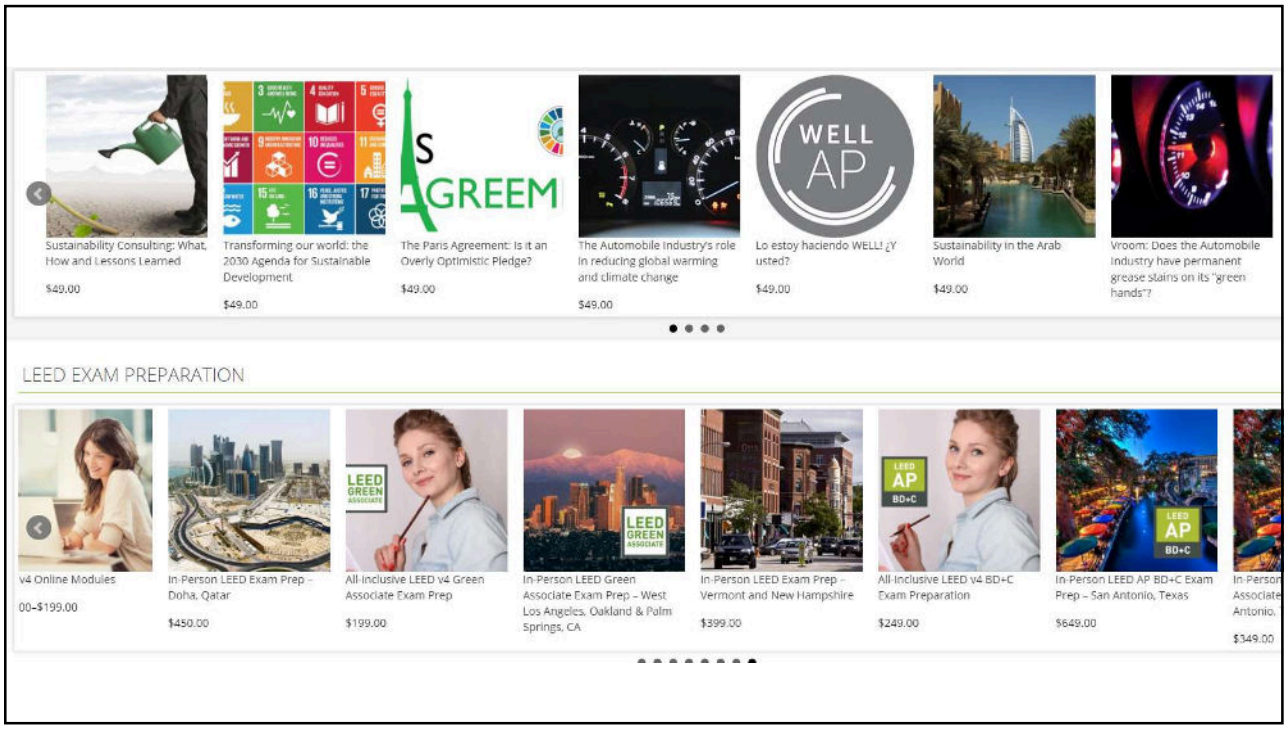
2

SUSTAINABILITY | EDUCATION | EMPOWERMENT

3



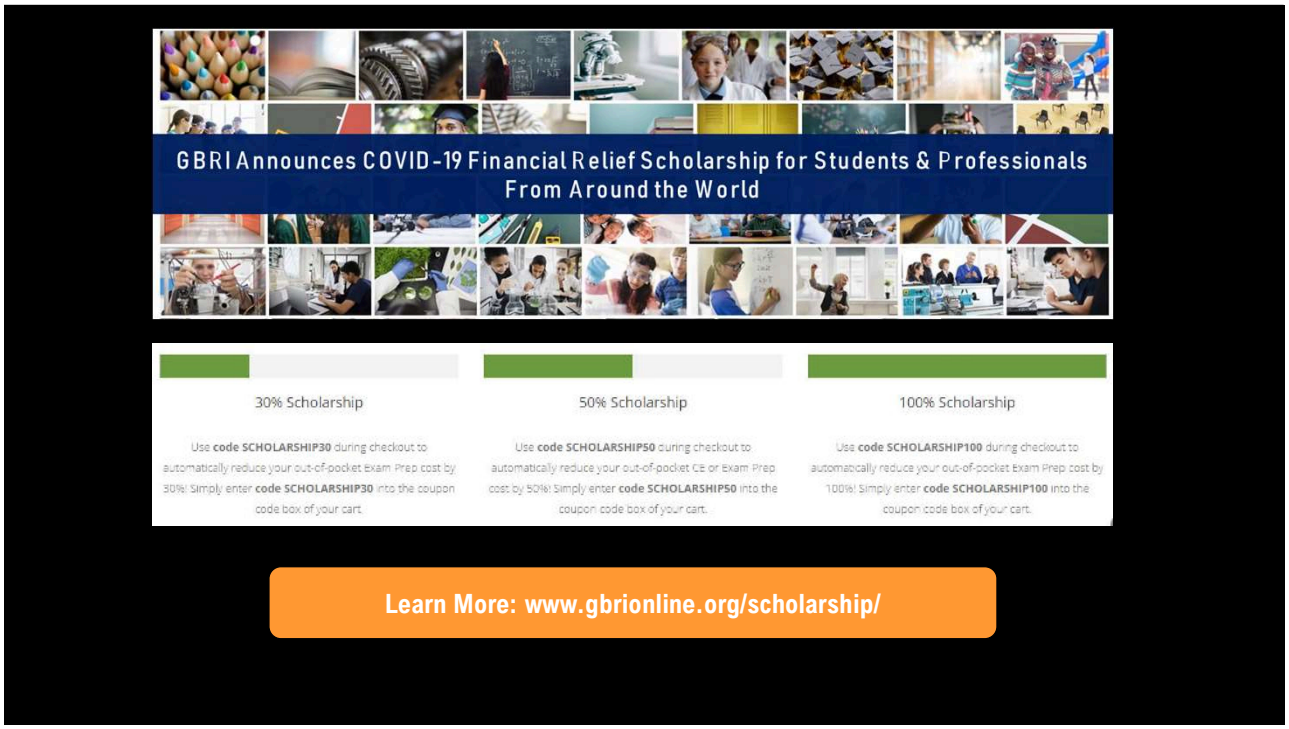
4


Sustainability Consulting: What, How and Lessons Learned
$49.00
Transforming our world: the 2030 Agenda for Sustainable Development
$49.00
The Paris Agreement: Is it an Overly Optimistic Pledge?
$49.00
The Automobile Industry's role in reducing global warming and climate change
$49.00
Lo estoy haciendo WELL! ¿Y usted?
$49.00
Sustainability in the Arab World
$49.00
Vroom: Does the Automobile Industry have permanent grease stains on its "green hands"?
LEED EXAM PREPARATION
v4 Online Modules
00-$199.00
In-Person LEED Exam Prep – Doha, Qatar
$450.00
All-Inclusive LEED v4 Green Associate Exam Prep
$199.00
In-Person LEED Green Associate Exam Prep – West Los Angeles, Oakland & Palm Springs, CA
In-Person LEED Exam Prep – Vermont and New Hampshire
$399.00
All-Inclusive LEED v4 BD+C Exam Preparation
$249.00
In-Person LEED AP BD+C Exam Prep – San Antonio, Texas
$649.00
$349.00

5


The GBRI Factor
Supporting Our Communities during COVID-19

6


GBRI Announces COVID-19 Financial Relief Scholarship for Students & Professionals From Around the World
30% Scholarship
Use code SCHOLARSHIP30 during checkout to automatically reduce your out-of-pocket Exam Prep cost by 30%! Simply enter code SCHOLARSHIP30 into the coupon code box of your cart.
50% Scholarship
Use code SCHOLARSHIP50 during checkout to automatically reduce your out-of-pocket CE or Exam Prep cost by 50%! Simply enter code SCHOLARSHIP50 into the coupon code box of your cart.
100% Scholarship
Use code SCHOLARSHIP100 during checkout to automatically reduce your out-of-pocket Exam Prep cost by 100%! Simply enter code SCHOLARSHIP100 into the coupon code box of your cart.
Learn More: www.gbrionline.org/scholarship/

7


The HVAC Factor
Protecting Indoor Spaces from COVID-19

8

CE Approval & Reporting

1 LEED & WELL General Hour | HSW LU

- Complete quiz for CE credit
- Certificates will be issued immediately after you pass the quiz.
- CE hours will be reported within 72 hours of quiz completion.

9

Course Presenter

- Director of Project Controls, MTA New York City
- President & Dir. of Sustainability at GBRI
- President, i-believe.org
- Guest Faculty at Cooper Union Engineering School, NY
- WELL Faculty
- Fitwel Ambassador

Jeslin Varghese, LEED AP, WELL AP

10

Course Objectives

- Understand the role of social interactions in the spread of COVID-19
- Understand the role of HVAC in creating an ambient IEQ
- Analyze the role of HVAC in the context of COVID 19
- Learn HVAC Operation Strategies to prevent transmission of respiratory diseases

11

12

Covid-19 is a new disease and there is **limited information** regarding risk factors for severe disease

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

NOT TRUE ANYMORE!

World Health Organization (WHO) @WHO

Preliminary investigations conducted by the Chinese authorities have found no clear evidence of human-to-human transmission of the novel #coronavirus (2019-nCoV) identified in #Wuhan, #China.

NEWS HEALTH & MEDICINE

Just breathing or talking may be enough to spread COVID-19 after all

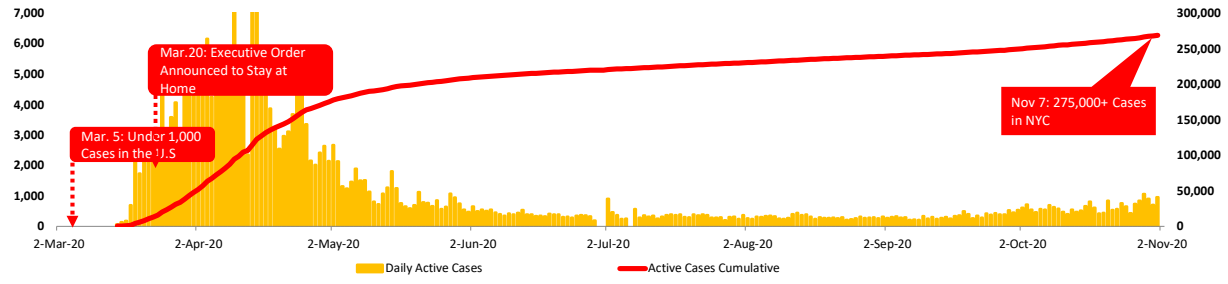
Experts had said that the virus spreads only through large droplets from a cough sneeze

Coronavirus: Tiger at Bronx Zoo tests positive for Covid-19

BBC

13

Number of Known COVID-19 Active Cases in NY City*



100	270k	24k	100k	48mil	1.2mil
Number of Active COVID-19 Cases in NY City - March 2020	Number of Active COVID-19 Cases in NY City - Nov 2020	Number of COVID-19 Deaths in NY City - Nov 2020	Number of Active COVID-19 Cases in the World - March 2020	Number of Active COVID-19 Cases in the World - Nov 2020	Number of COVID-19 Deaths in the World - Nov 2020

New York City | **World**

14

15

I am Healthy and I might not get very sick!

16

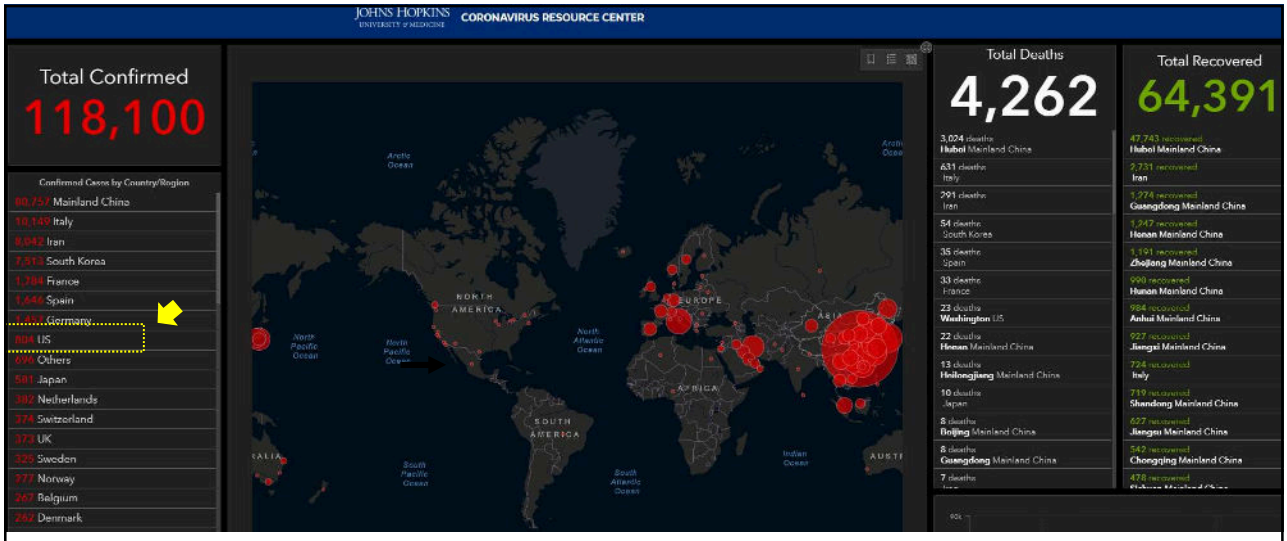
1918 Flu

500,000 Americans | **50-100 Million** Worldwide

17

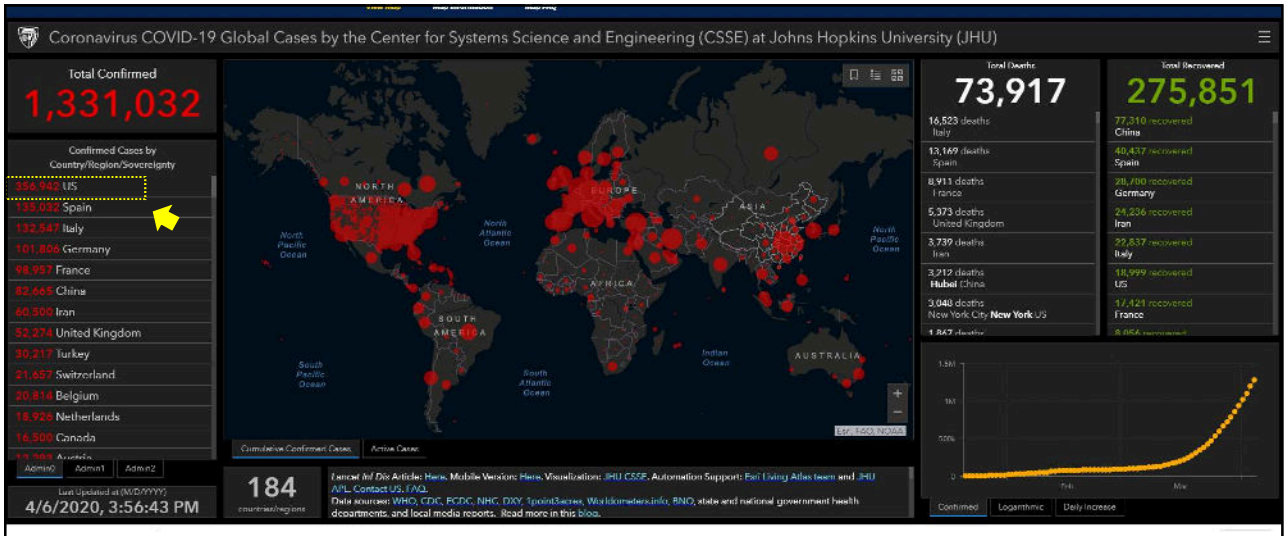
Plane Tracker

18



March 9, 2020

19

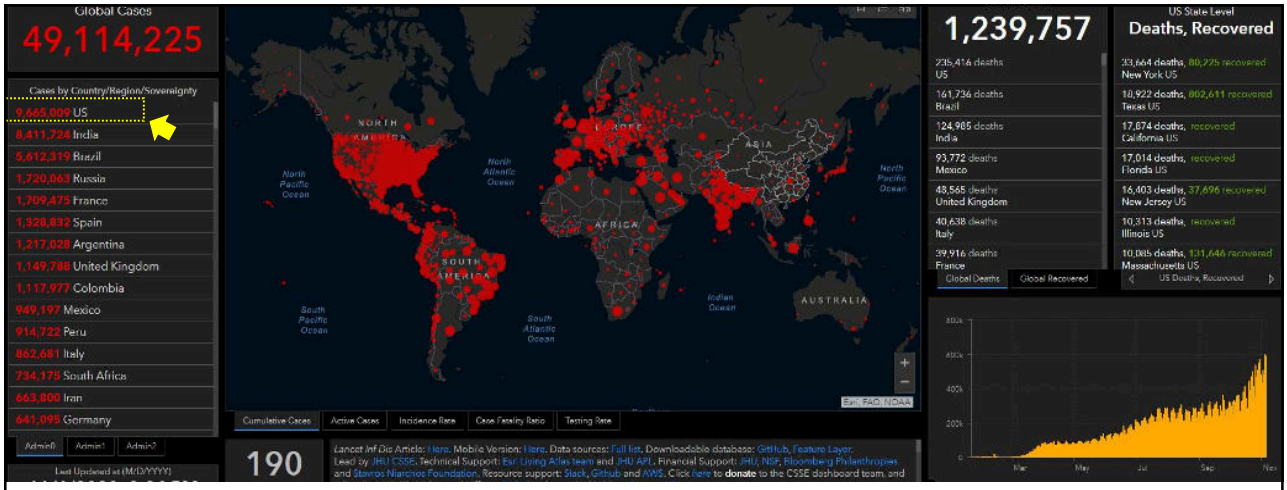


April 6, 2020

20

Oct 7, 2020

21



Nov 7, 2020

22

Social Distancing

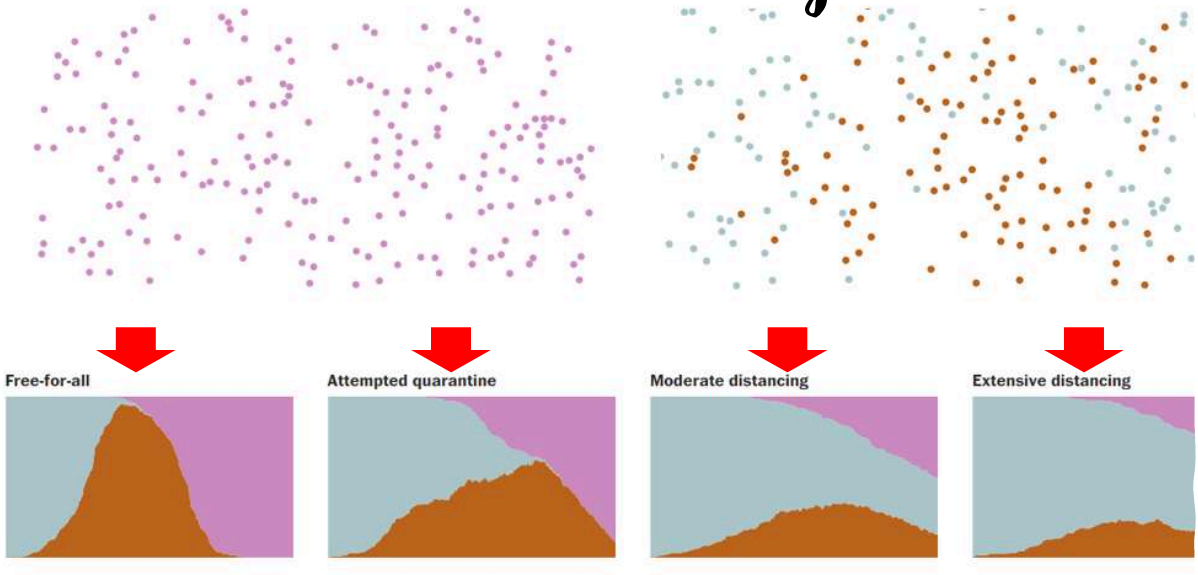


Fig.2 Simulation result from the Washington Post article; Why outbreaks like coronavirus spread exponentially, and how to "flatten the curve

23

Oct 21, 2020

Six Feet is Not Enough...

15 Minutes is too long!

Oct 21-20 - CDC updated its definition emerging evidence that the virus could travel beyond 6 feet of an infected person

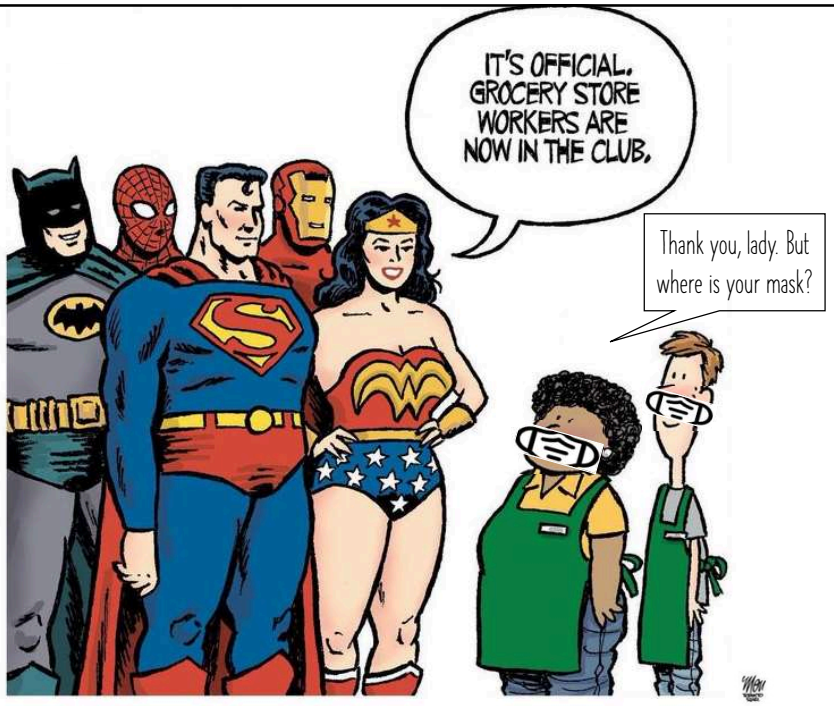
24

I am Healthy and I might not get very sick!

Image Source : Super Nurse' painted as an 'ode' to healthcare professionals around the world

25

Thank You

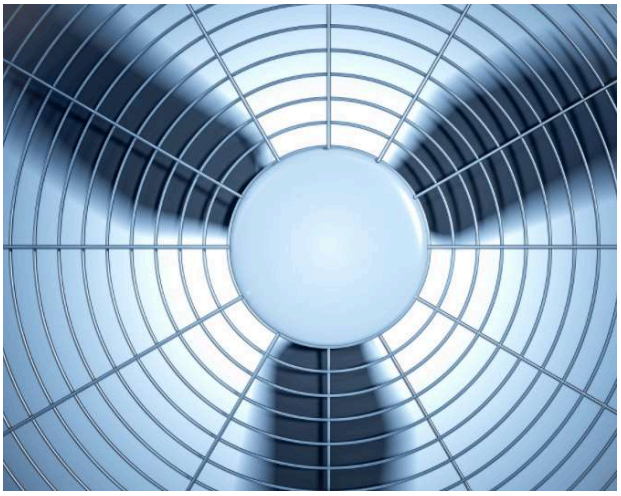


26

27

HVAC Systems

- ✓ Deliver clean air
- ✓ Remove extra heat
- ✓ Remove humidity
- ✓ Remove contaminants



28

90%

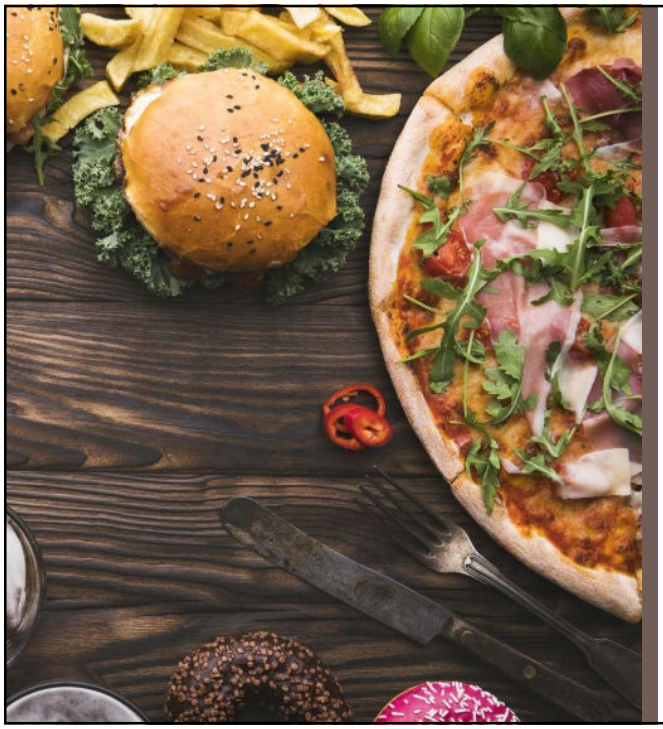
Time, we spend indoors

2 to 5 times

Concentrations of some pollutants than outdoors

29

30



Cooking

represents one of the single largest contributors, generating particulate matter (PM2.5) at concentrations **four** times greater than major haze events in Beijing.

Source: The Kitchen as a pollution hazard, NY Times

31

VOCs levels or concentrations

1000

times higher indoors

32

BRI

Building Related Illness

SBS

Sick Building Syndrome

33

Symptoms of BRI can be directly attributed to airborne building contaminants

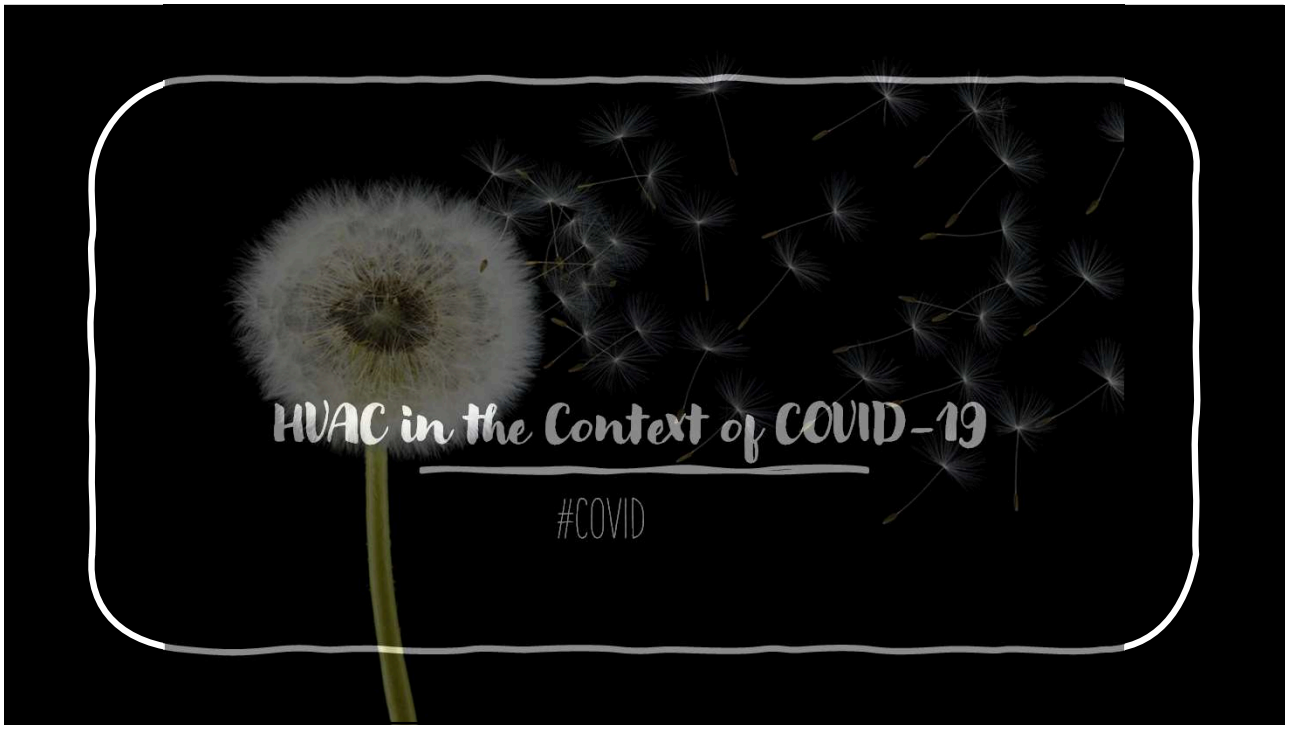
34


Although the symptoms of SBS can be linked to time spent in a building, no specific illness or cause can be identified

35


Ventilation
is recognized as an important factor influencing the transmission of airborne diseases

36



37

Sketch showing arrangement of restaurant tables and air conditioning airflow at site of outbreak of 2019 novel coronavirus disease

38

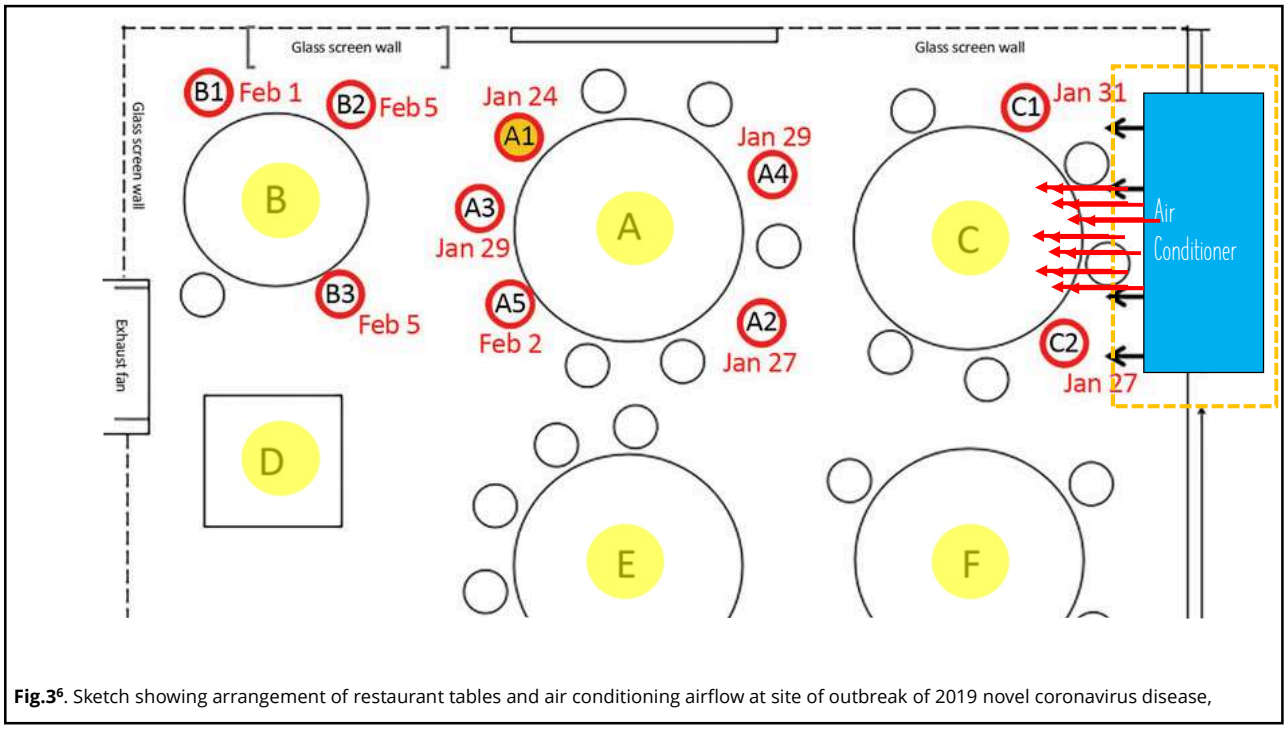
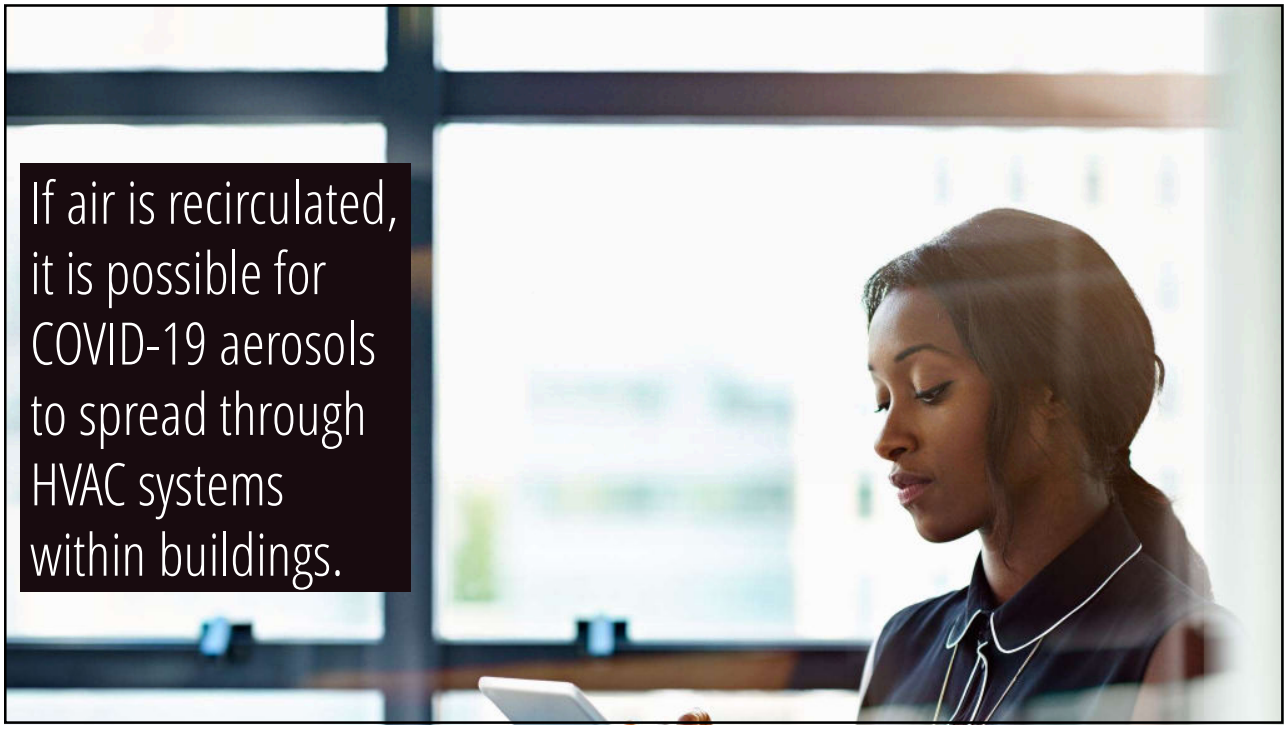


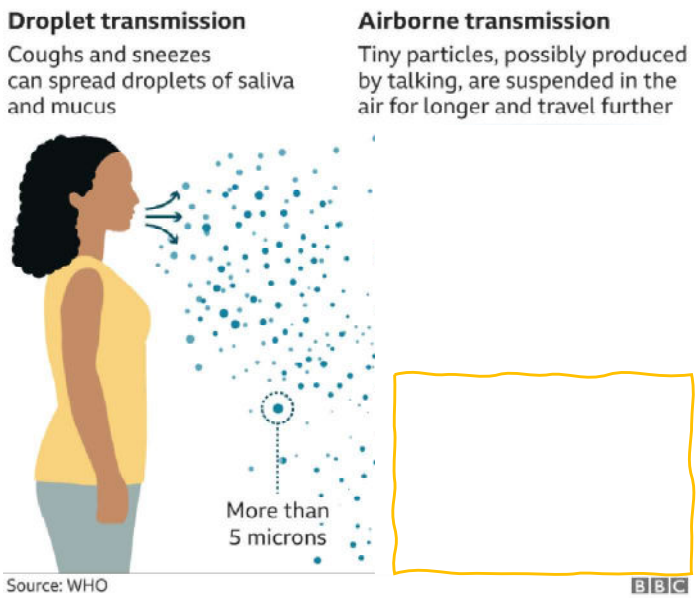
Fig.3[6]. Sketch showing arrangement of restaurant tables and air conditioning airflow at site of outbreak of 2019 novel coronavirus disease,

39



40

Difference between droplet & airborne transmission



41

Oct 29, 2020

Source: Long-distance airborne dispersal of SARS-CoV-2 in COVID-19 wards - Karolina Nissen, Janina Krambrich, Dario Akaberi, Tove Hoffman, Jiaxin Ling, Åke Lundkvist, Erik Salaneck

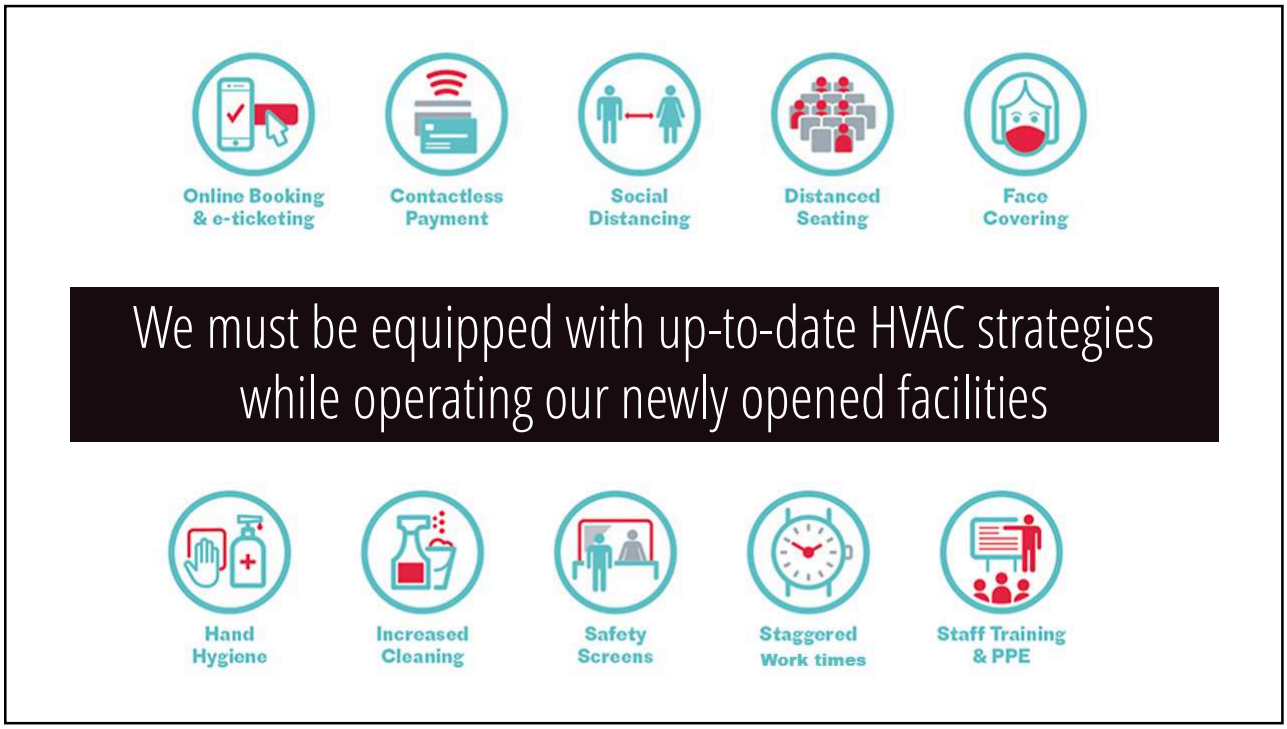
42

Growing Evidence

- The virus can stay alive beyond 6 feet
- Airborne transmission is a route of infection.
- Aerosols can stay floating in the air for hours and can travel long distances

43

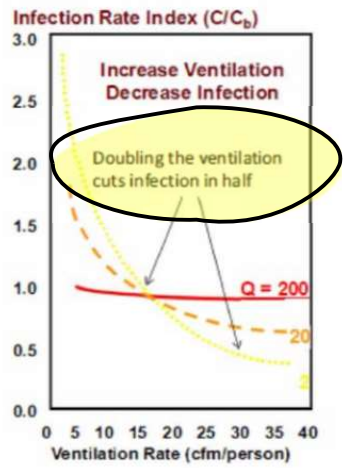
44


Online Booking & e-ticketing
Contactless Payment
Social Distancing
Distanced Seating
Face Covering
We must be equipped with up-to-date HVAC strategies while operating our newly opened facilities
Hand Hygiene
Increased Cleaning
Safety Screens
Staggered Work times
Staff Training & PPE

45


HVAC Operation Strategies
#Together-We-Will

46



Ventilation Rate

Image Source - Energy-Recovery-Best-Practices-During-a-Pandemic/Airxchange.com

47

$$ACH = \frac{60Q}{Vol}$$

Q = CFM of your device
Vol - Volume of your room

Air Change Per Hour

48

$$ACH = \frac{60Q}{Vol}$$

Q = CFM of your device
Vol - Volume of your room

Typical Air Changes Per Hour Table

Residential	
Basements	3-4
Bedrooms	5-6
Bathrooms	6-7
Family Living Rooms	6-8
Kitchens	7-8
Laundry	8-9
Light Commercial	
Offices	
Business Offices	6-8
Lunch Break Rooms	7-8
Conference Rooms	8-12
Medical Procedure Offices	9-10
Copy Rooms	10-12
Main Computer Rooms	10-14
Smoking Area	13-15
Restaurants	
Dining Area	8-10
Food Staging	10-12
Kitchens	14-18
Bars	15-20
Public Buildings	
Hallways	6-8
Retail Stores	6-10
Foyers	8-10
Churches	8-12
Restrooms	10-12
Auditoriums	12-14
Smoking Rooms	15-20

49

$$ACH = \frac{60Q}{Vol}$$

Q = CFM of your device
Vol - Volume of your room

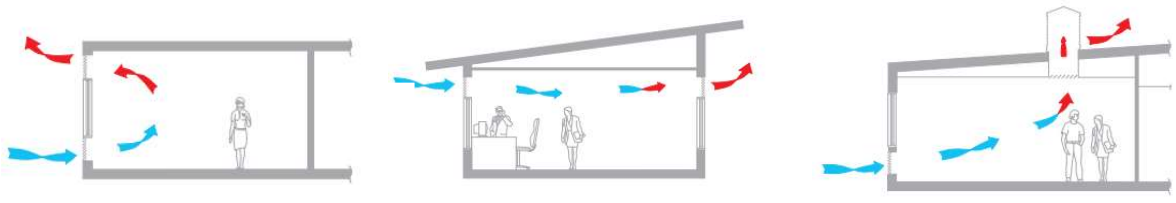
TABLE B.1. AIR CHANGES/HOUR (ACH) AND TIME REQUIRED FOR AIRBORNE-CONTAMINANT REMOVAL BY EFFICIENCY *

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

Source: https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html

50

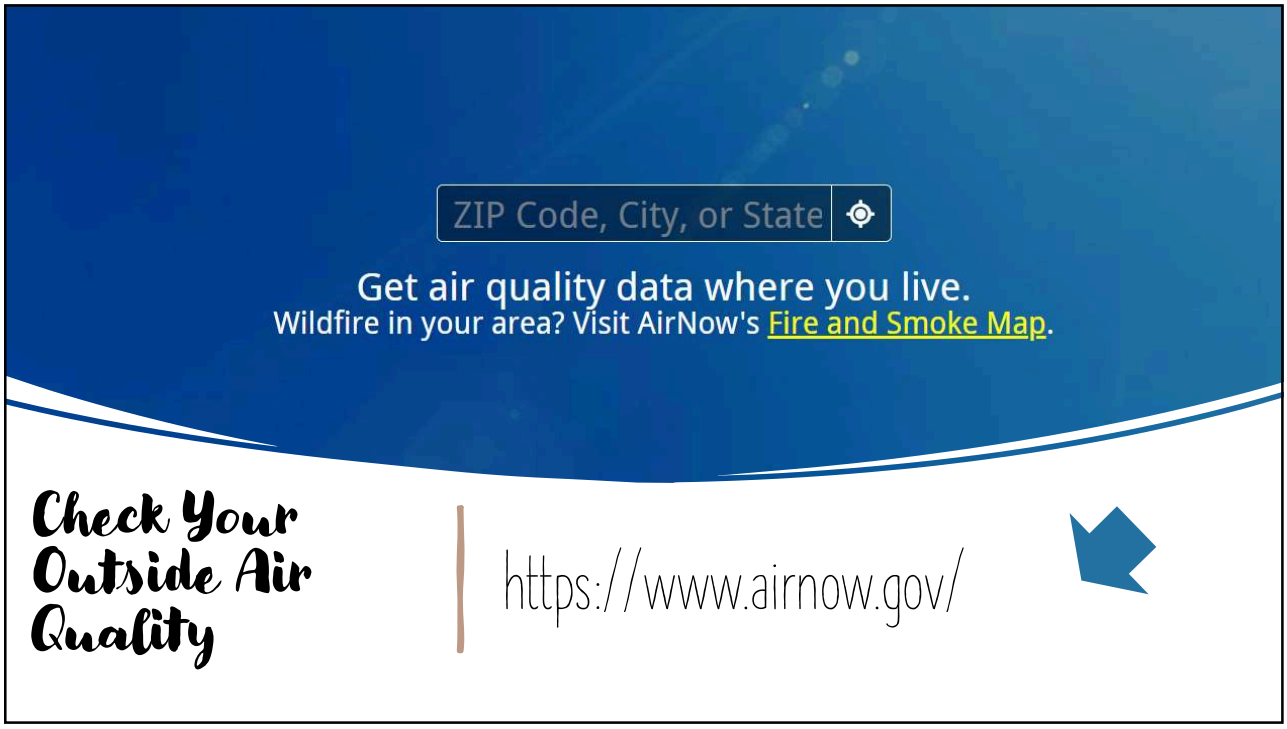
Natural Ventilation



Single-sided ventilation | Cross ventilation | Passive stack ventilation

Image Source – stock pictures

51



52

HVAC system control strategies can usually be modified to increase ventilation to a certain extent in the occupied zones.

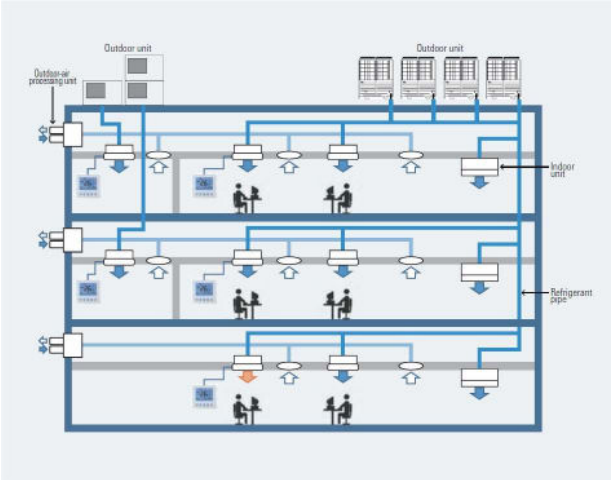


Image Source – Renesas.com/individual-air-conditioning-system

53

Mixed Mode

- ✓ Window or Attic fans
- ✓ Full outside air when possible
- ✓ Open dampers fully to provide 100% outdoor air
- ✓ Natural ventilation when possible

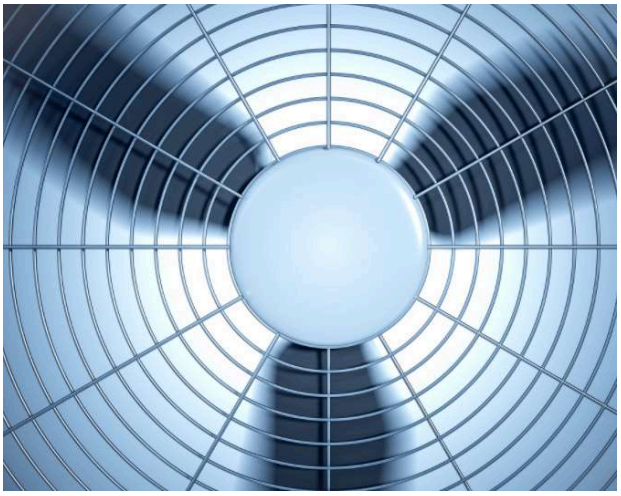


Image Source – stock pictures

54

Avoid air recirculation…

55

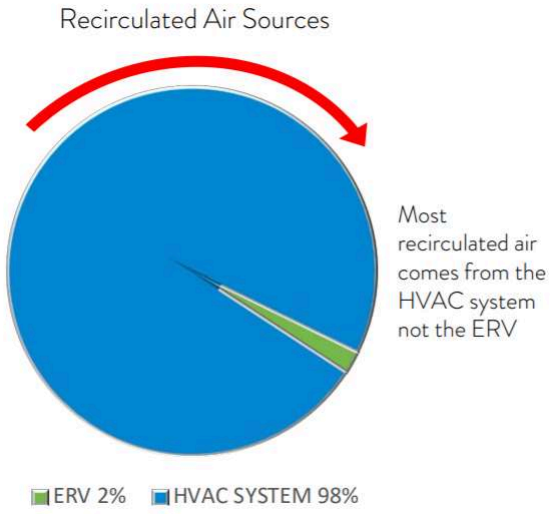
Maximizing outdoor air intake could become a costly strategy…

56

Minimum outside air as required by ASHRAE Standard 62.1 with a filter with MERV-13

57

Using Energy Recovery Units



ASHRAE's Position document

REHVA's guidance document

58

59

90%

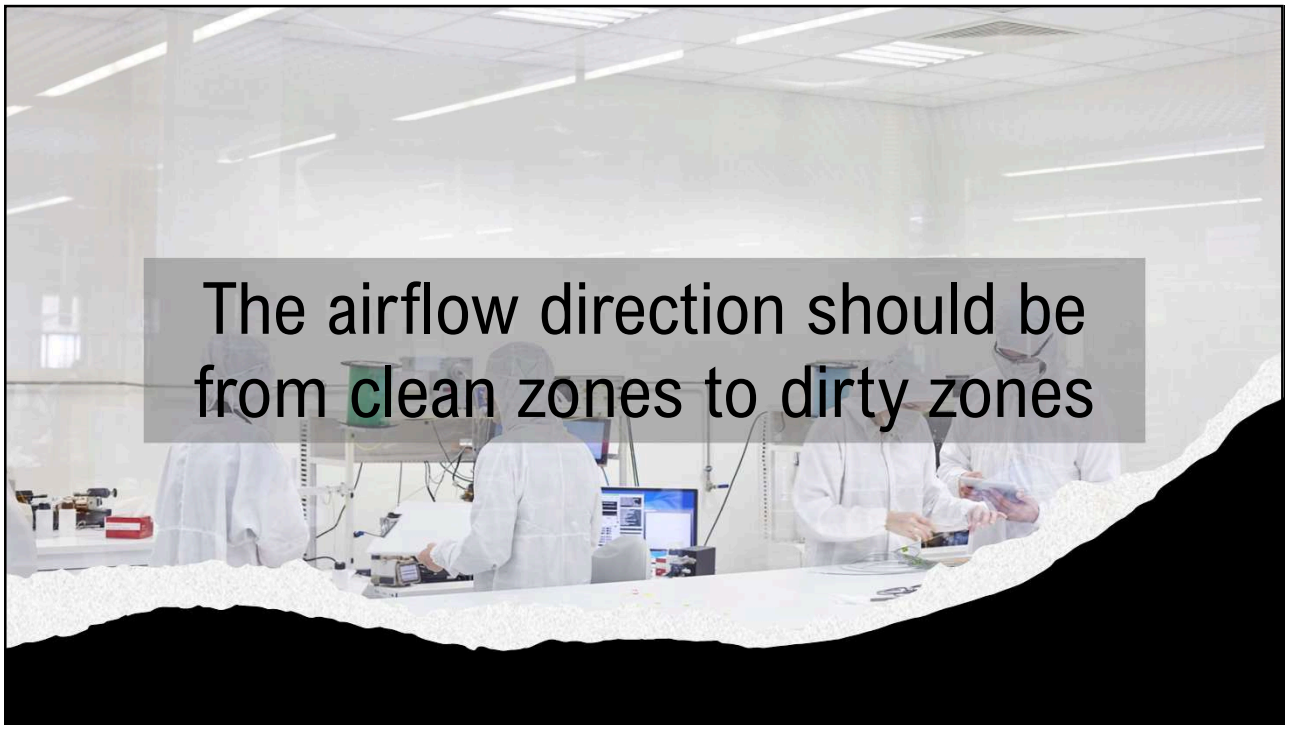
of schools in the U.S fail to meet minimum ventilation requirements

60

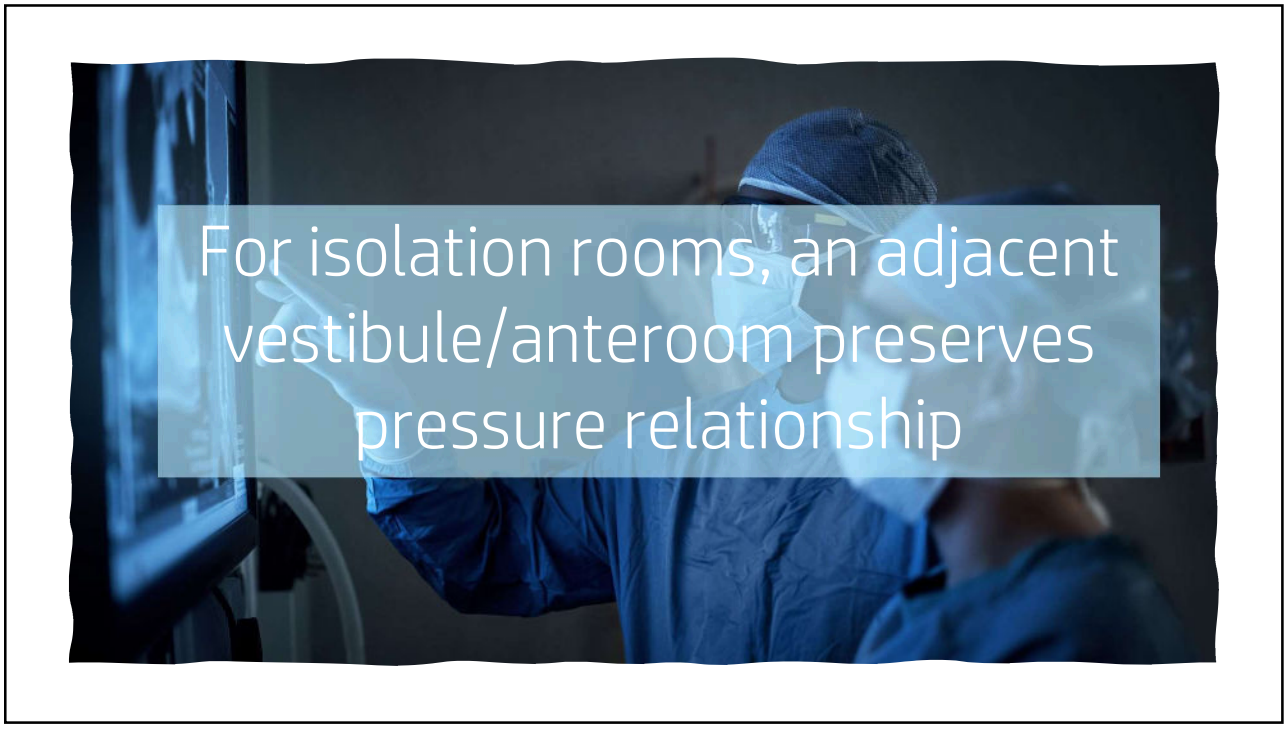
61

Airflow Direction

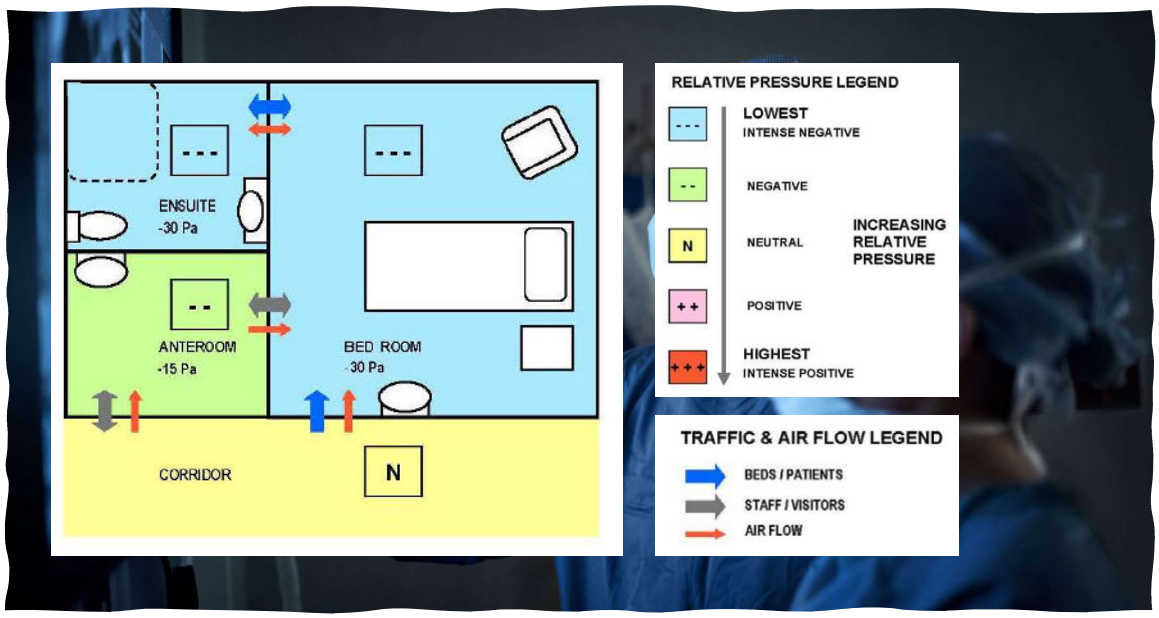
62


The airflow direction should be from clean zones to dirty zones

63


For isolation rooms, an adjacent vestibule/anteroom preserves pressure relationship

64



Isolation Rooms - Guideline Section - International Health Facility Guidelines

65

Filtration

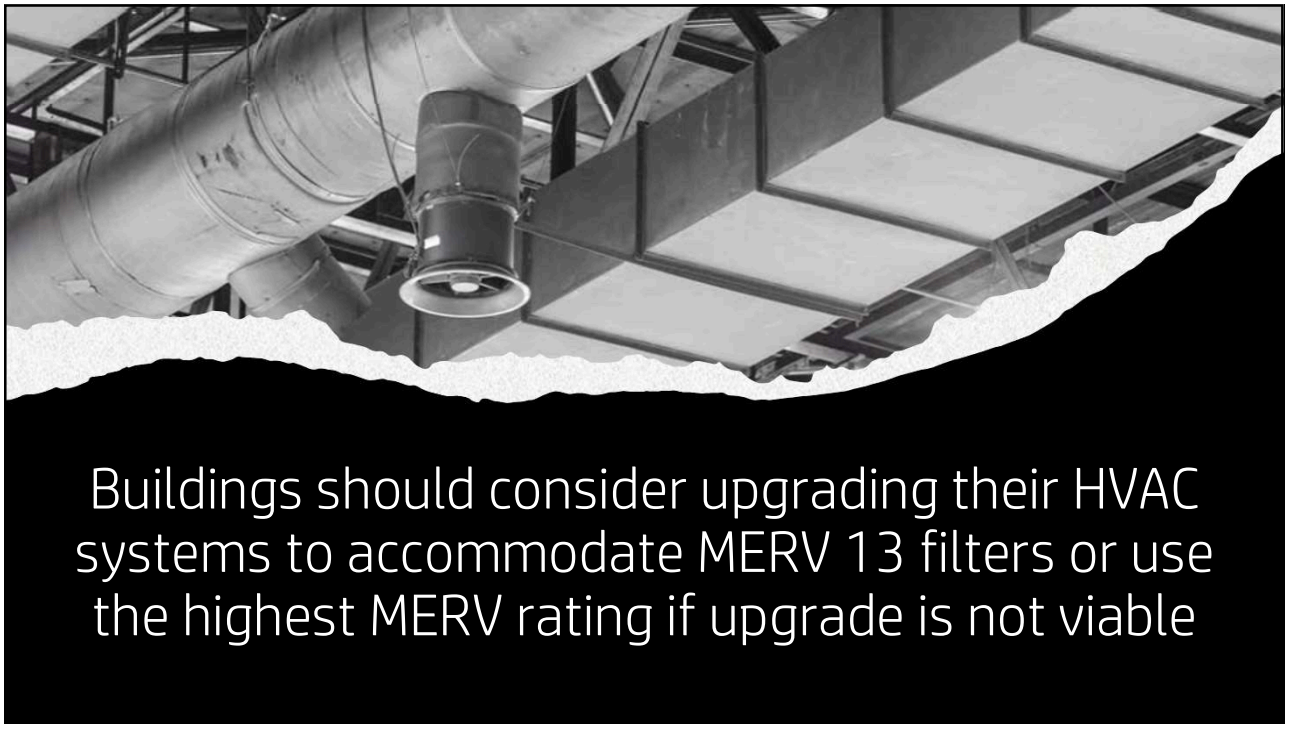
66

Air Filters & Efficiency

CLASSIFICATION	Arrestance or Dust Spot Efficiency	US ASHRAE 52.2	European Union EN779 Class		Typical Controlled Contaminant	Application
PRE Filter (G Class)	AFI <65 %	MERV 1	G1	Am< 65%	Particle bigger than 10.0μm (Pollen) (Spanish moss) (Dust mites) (Sanding dust) (Spray paint dust) (Textile fibers)	Gross filter, domestic and commercial
	AFI 65%-70%	MERV 2	G2	65% ≤ Am< 80%		
	AFI 70%-75%	MERV 3				
	AFI 75%-80%	MERV 4				
	AFI 80%-85%	MERV 5	G3	80% ≤ Am<90%	Particle size within 3.0μm-10.0μm (Mold) (Spores) (Hair spray) (Cement dust) (Snuff) (Powdered milk)	Commercial, industrial, paint shop
	AFI 85%-90%	MERV 6				
	NBS 25%-30%	MERV 7	G4	90% ≤ Am		
	NBS 30%-35%	MERV 8				
MEDIUM Filter (F Class)	NBS 40%-45%	MERV 9	F5	40% ≤ Em< 60%	Particle Size within 1.0μm-3.0μm (Lead dust) (Milled flour) (Coal dust) (Auto emissions) (Nebulizer drop) (Welding fumes)	IAQ concerned commercial & industrial, medical
	NBS 50%-55%	MERV 10				
	NBS 60%-65%	MERV 11	F6	60% ≤ Em< 80%		
	NBS 70%-75%	MERV 12				
	NBS 80%-85%	MERV 13	F7	80% ≤ Em< 90%	Particle size within 0.3μm-1.0μm (All bacteria) (cooking oil) (Most smoke) (Copier toner) (Most face powder) (Most paint pigments)	IAQ concerned commercial, industrial, medical, food etc
	NBS 90%-95%	MERV 14	F8	90% ≤ Em< 95%		
	NBS>95%	MERV 15	F9	95% ≤ Em		
		MERV 16				

1. AFI : American Filter Institute 8. Am : Average Arrestance Efficiency for Coarse Filters 2. NBS : National Bureau of Standards 9. Em : Average Efficiency for Fine Filters 3. ASHRAE : American Society of Heating Refrigerating & Air-conditioning Engineers 10. IEST : Institute of Environmental Sciences and Technology 4. MERV : Minimum Efficiency Reporting Value 5. MPPS : Most Penetrating Particle Size 6. HEPA : High Efficiency Particulate Air Filter 7. ULPA : Ultra Low Penetration Air Filter

67



68

Air Filters & Efficiency

CLASSIFICATION	Mean Fractional Efficiency	IEST RP-CC001.3	European Union EN1822 Class		Typical Controlled Contaminant	Application
HEPA Filter (H Class)	≥ 95% at 0.3μm	n/a	H10	≥ 85% at MPPS	Particle size bigger than 0.3μm (Virus [unattached]) (Carbon dust) (Sea salt) (All combustion smoke) (Radon progeny)	All types of cleanrooms
	≥ 98% at 0.3μm		H11	≥ 95% at MPPS		
	≥ 99.97% at 0.3μm	TYPE A				
	≥ 99.99% at 0.3μm	TYPE C	H12	≥ 99.5% at MPPS		
	≥ 99.995% at 0.3μm		H13	≥ 99.95% at MPPS		
	≥ 99.999% at 0.3μm	TYPE D	H14	≥ 99.995% at MPPS		
ULPA Filter (U Class)	≥ 99.9995% at 0.12μm	TYPE F	U15	≥ 99.9995% at MPPS	Particle size bigger than 0.12μm	super cleanroom
	≥ 99.99995% at 0.12μm		U16	≥ 99.99995% at MPPS		
	≥ 99.999995% at 0.12μm		U17	≥ 99.999995% at MPPS		

69

Air Filters & Efficiency

Smallest Particles

MERV Rating	Air Filter will trap Air Particles size .3 to 1.0 microns	Air Filter will trap Air Particles size 1.0 to 3.0 microns	Air Filter will trap Air Particles size 3 to 10 microns	Filter Type ~ Removes These Particles
MERV 1	< 20%	< 20%	< 20%	Fiberglass & Aluminum Mesh
MERV 2	< 20%	< 20%	< 20%	~
MERV 3	< 20%	< 20%	< 20%	Pollen, Dust Mites, Spray Paint,
MERV 4	< 20%	< 20%	< 20%	Carpet Fibres
MERV 5	< 20%	< 20%	20% - 34%	Cheap Disposable Filters
MERV 6	< 20%	< 20%	35% - 49%	~
MERV 7	< 20%	< 20%	50% - 69%	Mold Spores, Cooking Dusts,
MERV 8	< 20%	< 20%	70% - 85%	Hair Spray, Furniture Polish
MERV 9	< 20%	Less than 50%	85% or Better	Better Home Box Filters
MERV10	< 20%	50% to 64%	85% or Better	~
MERV 11	< 20%	65% - 79%	85% or Better	Lead Dust, Flour, Auto
MERV 12	< 20%	80% - 90%	90% or Better	Fumes,Welding Fumes
MERV 13	Less than 75%	90% or Better	90% or Better	Superior Commercial Filters
MERV 14	75% - 84%	90% or Better	90% or Better	~
MERV 15	85% - 94%	95% or Better	90% or Better	Bacteria, Smoke, Sneezes
MERV 16	95% or Better	95% or Better	90% or Better	
HEPA & ULPA Filters	99.97%	99% or Better	99% or Better	HEPA & ULPA
	99.997%	99% or Better	99% or Better	~
	99.9997%	99% or Better	99% or Better	Viruses, Carbon Dust, <.30 pm
	99.99997%	99% or Better	99% or Better	

Image Source – Lakeair/https://www.lakeair.com/merv-rating-explanation/

70

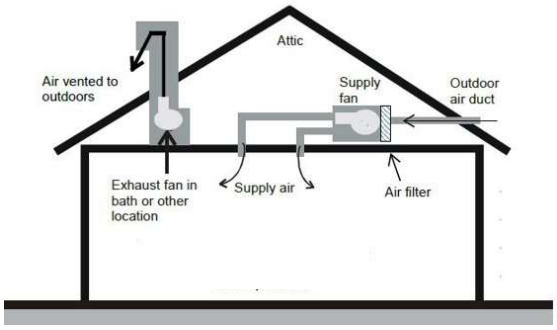
Portable Air Cleaners

71

By themselves, portable air cleaners and HVAC filters are not enough to protect people from the virus that causes COVID-19.

72

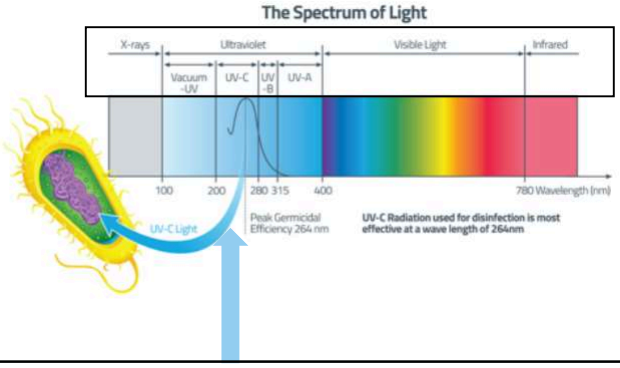
Exhaust fan



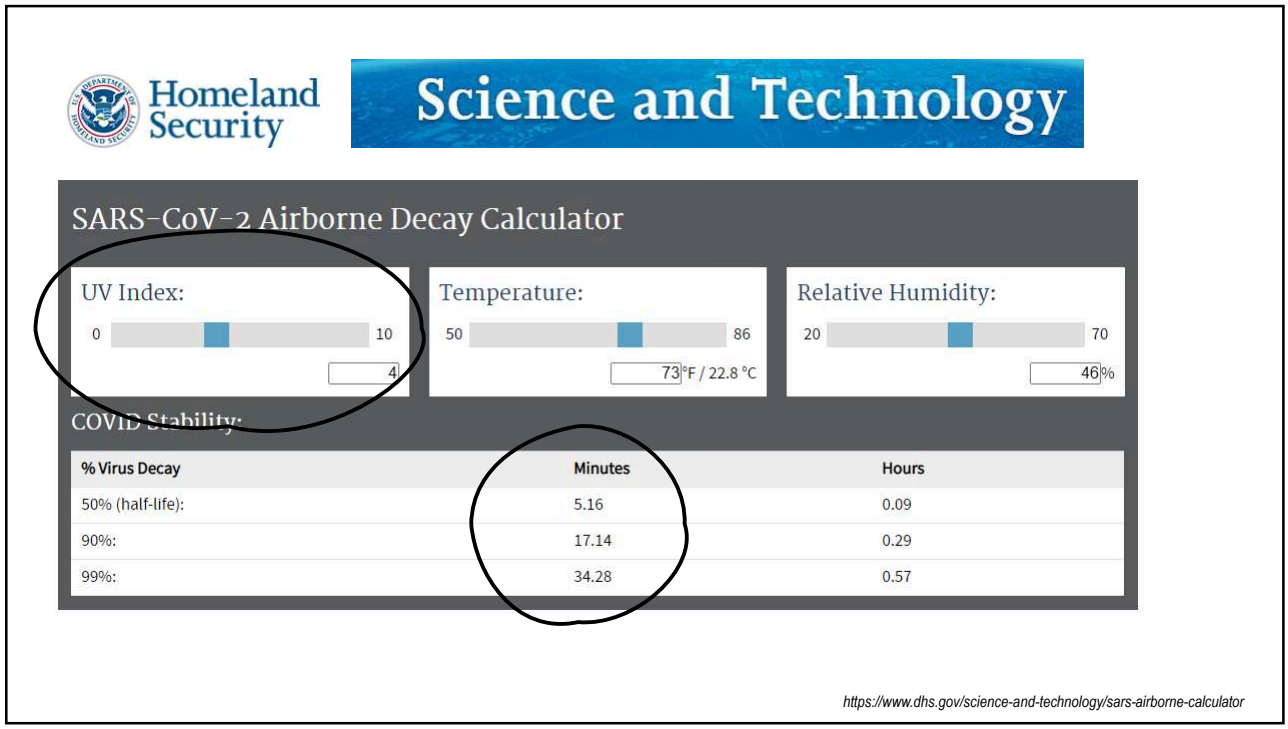
Commercial Exhaust Fan

73

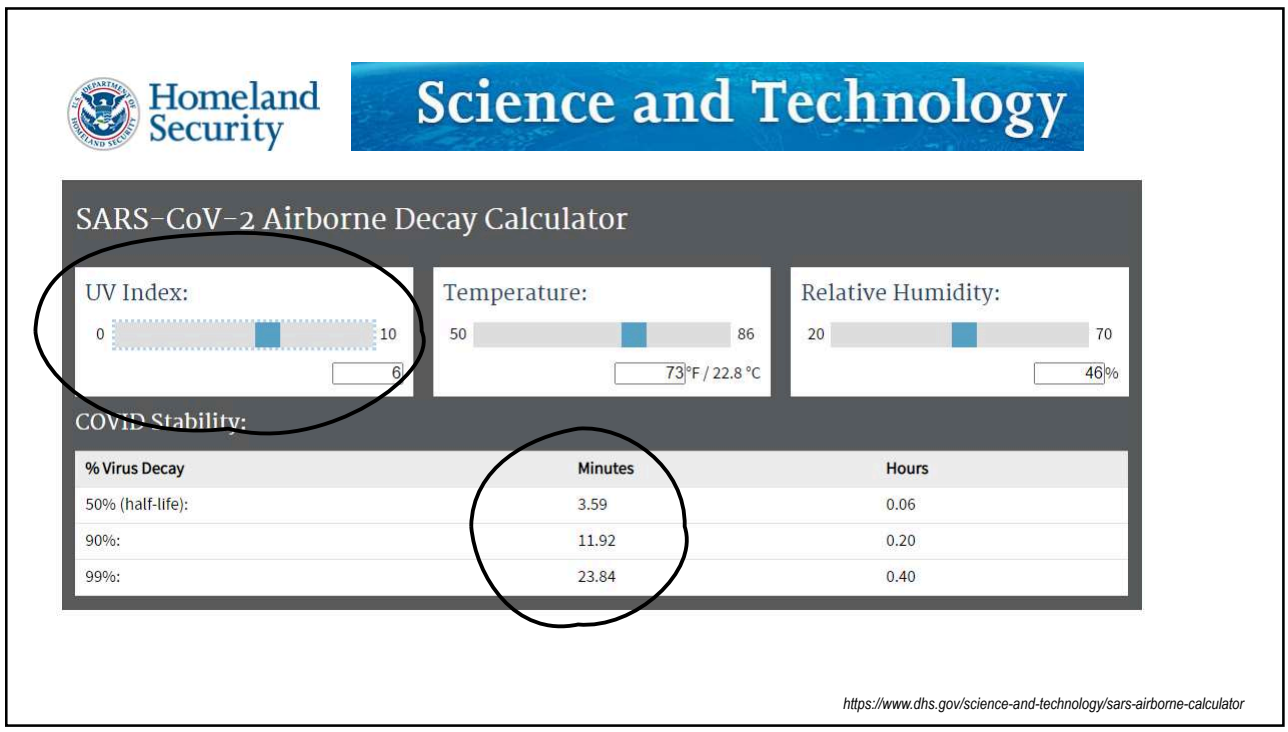
Ultraviolet (UV) germicidal irradiation (UVGI)



74


Homeland Security
Science and Technology
SARS-CoV-2 Airborne Decay Calculator
UV Index:
0
10
4
Temperature:
50
86
73 °F / 22.8 °C
Relative Humidity:
20
70
46 %
COVID Stability:
% Virus Decay
Minutes
Hours
50% (half-life):
5.16
0.09
90%:
17.14
0.29
99%:
34.28
0.57
https://www.dhs.gov/science-and-technology/sars-airborne-calculator

75


Homeland Security
Science and Technology
SARS-CoV-2 Airborne Decay Calculator
UV Index:
0
10
6
Temperature:
50
86
73 °F / 22.8 °C
Relative Humidity:
20
70
46 %
COVID Stability:
% Virus Decay
Minutes
Hours
50% (half-life):
3.59
0.06
90%:
11.92
0.20
99%:
23.84
0.40
https://www.dhs.gov/science-and-technology/sars-airborne-calculator

76

Applications

- ✓ Upper-air disinfection
- ✓ In-duct air disinfection
- ✓ Duct surface disinfection
- ✓ Room decontamination

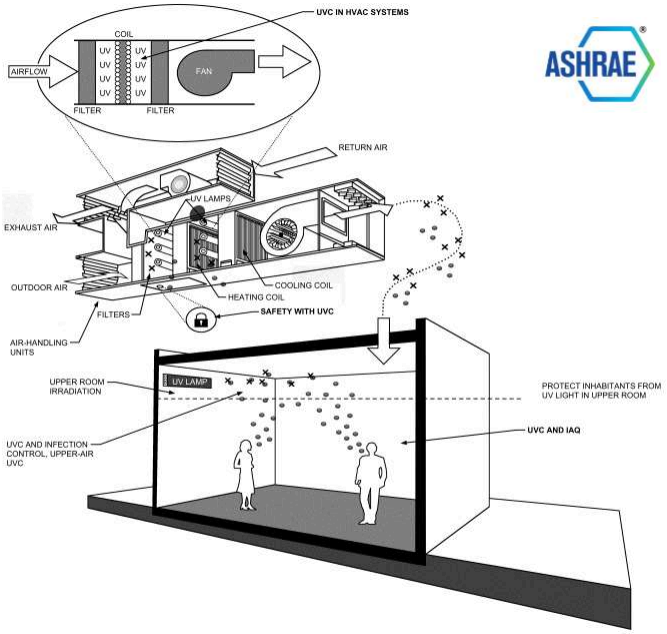


Fig. 1 Potential Applications of UVC to Control Microorganisms in Air and on Surfaces
(ASHRAE 2009)

77

78

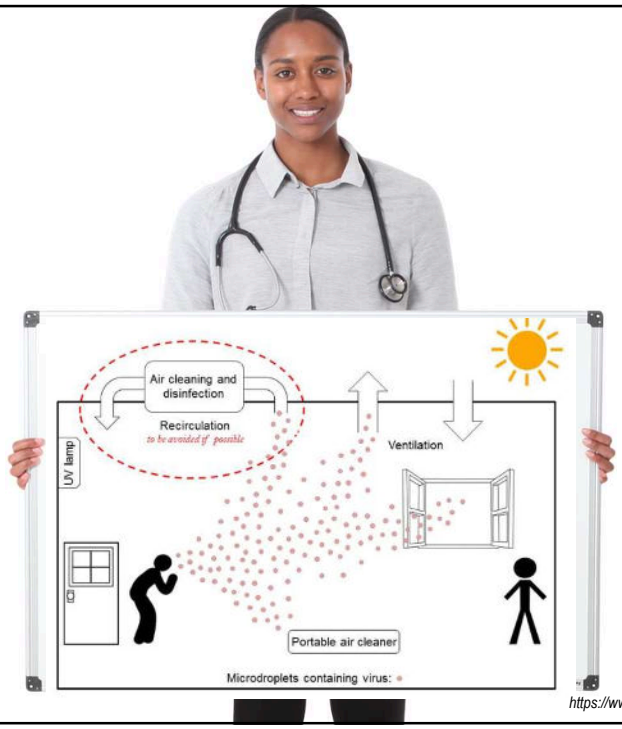
Other operational measures

79

What Can We Do NOW? Act Personally!

- Wear masks *for sure*
- Avoid Crowded places
- Social Distancing
- Support your local businesses
- Volunteer when possible

80



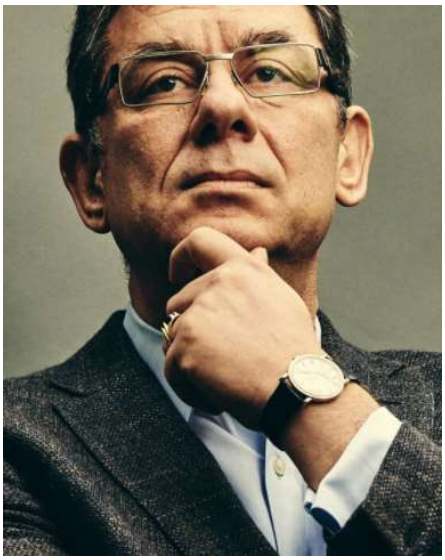
https://www.sciencedirect.com/science/article/pii/S0160412020317876

81

The New York Times

Pfizer's Early Data Shows Vaccine Is More Than 90% Effective

Pfizer announced positive early results from its coronavirus vaccine trial, cementing the lead in a frenzied global race that has unfolded at record-breaking speed.



82

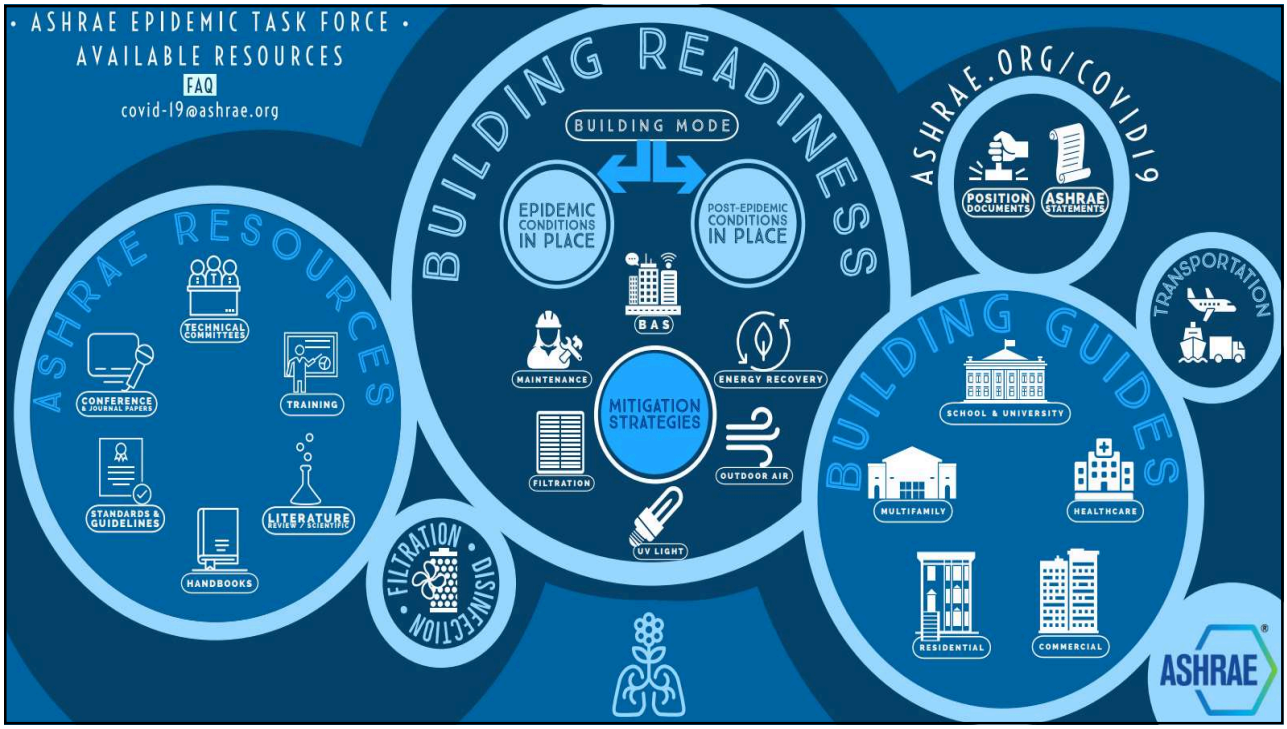
Resource guide from Industry leaders and Professional Organizations

#Together-We-Will

83

ASHRAE

84



85

- **ASHRAE leadership has approved the following two statements regarding transmission of SARS-CoV-2 and the operation of HVAC systems during the COVID-19 pandemic.**

- 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.

- Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

86

REHVA & CIBSE

87

88

USGBC

Healthy Economy Strategy

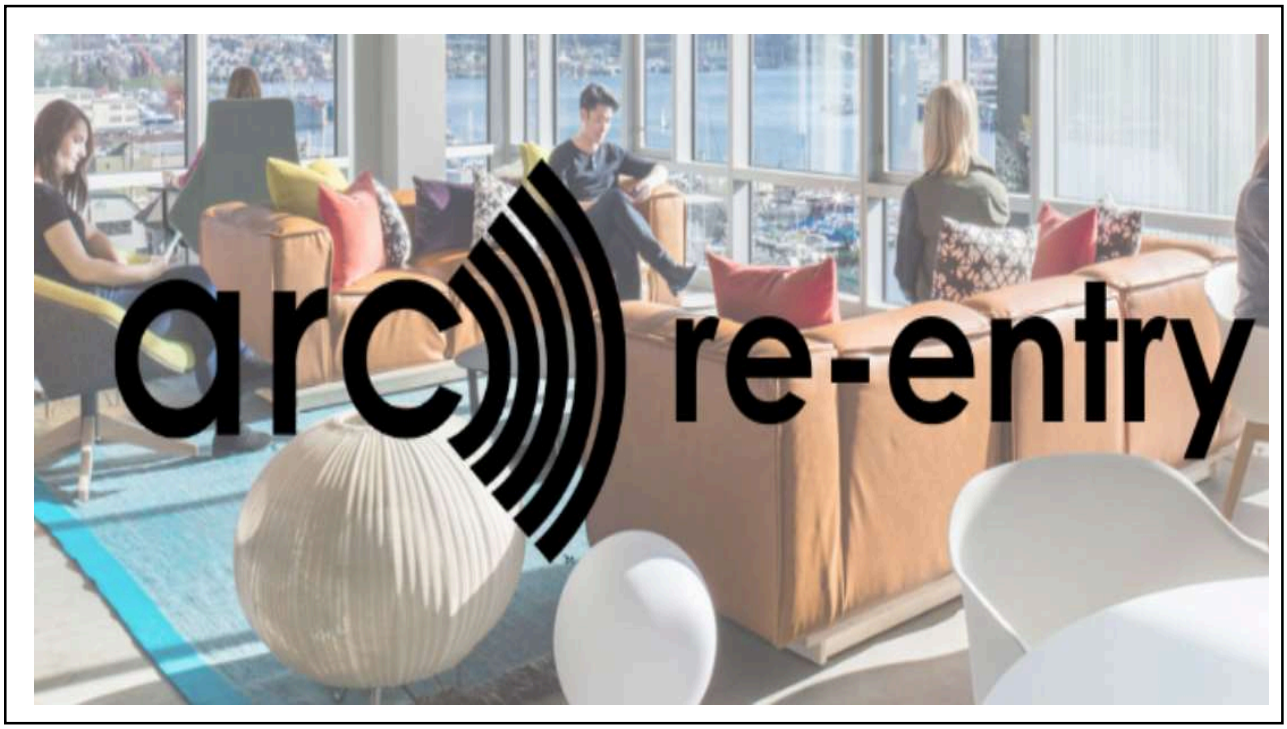
89

LEED Pilot Credits

The pilot credits outline sustainable best practices that align with public health and industry guidelines related to cleaning and disinfecting, workplace re-occupancy, HVAC and plumbing operations.

- Safety First: Cleaning and Disinfecting Your Space credit
- Safety First: Re-enter Your Workspace credit
- Safety First: Building Water System Recommissioning credit
- Safety First: Managing Indoor Air Quality During COVID-19 credit
- Safety First: Pandemic Planning credit
- Safety First: Social Equity in Pandemic Planning credit

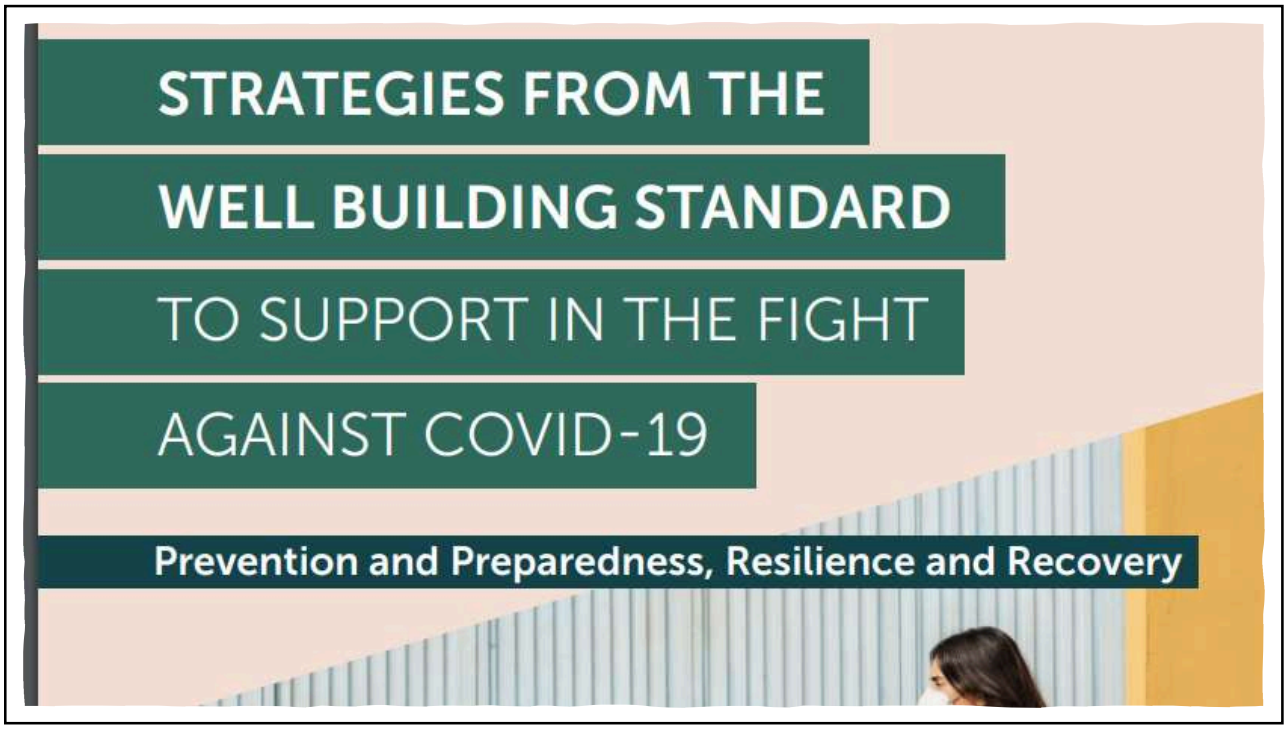
90



91

IWBI

92



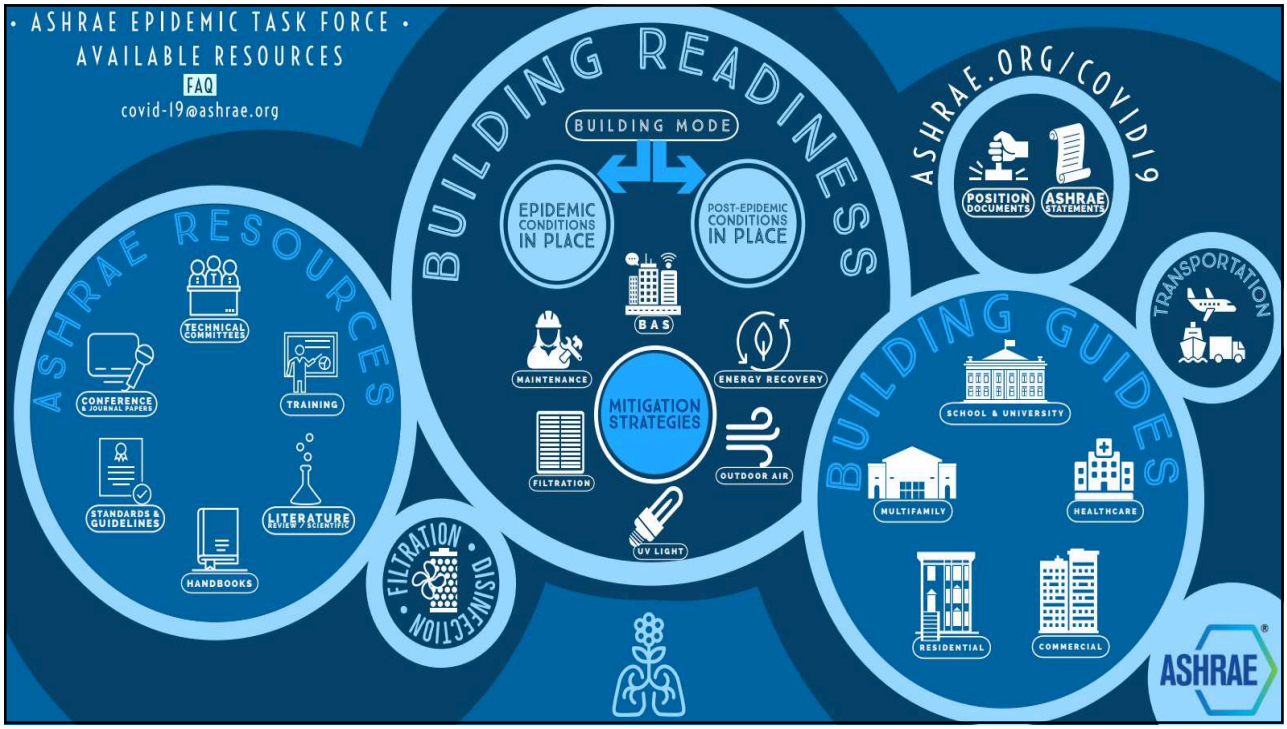
93

Harvard
Healthy Buildings
program

94


SCHOOLS
FOR HEALTH
How School Buildings Influence Student Health, Thinking and Performance
HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

95


• ASHRAE EPIDEMIC TASK FORCE •
AVAILABLE RESOURCES
FAQ
covid-19@ashrae.org
ASHRAE RESOURCES
TECHNICAL COMMITTEES
CONFERENCE & JOURNAL PAPERS
TRAINING
STANDARDS & GUIDELINES
LITERATURE REVIEW / SCIENTIFIC
HANDBOOKS
BUILDING READINESS
BUILDING MODE
EPIDEMIC CONDITIONS IN PLACE
POST-EPIDEMIC CONDITIONS IN PLACE
BAS
MAINTENANCE
ENERGY RECOVERY
MITIGATION STRATEGIES
FILTRATION
OUTDOOR AIR
UV LIGHT
FILTRATION • DISINFECTION
ASHRAE.ORG/COVID19
POSITION DOCUMENTS
ASHRAE STATEMENTS
TRANSPORTATION
BUILDING GUIDES
SCHOOL & UNIVERSITY
MULTIFAMILY
HEALTHCARE
RESIDENTIAL
COMMERCIAL
ASHRAE

96

References

1. CDC- People with certain medical conditions-https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html
2. WHO Tweet
3. *Coronavirus: Tiger at Bronx Zoo tests positive for Covid-19* - https://www.bbc.com/news/world-us-canada-52177586
4. Why outbreaks like coronavirus spread exponentially, and how to "flatten the curve"https://www.washingtonpost.com/graphics/2020/world/corona-simulator/
5. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020 https://wwwnc.cdc.gov/eid/article/26/7/20-0764_article
6. Figures from the study "COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020" https://wwwnc.cdc.gov/eid/article/26/7/20-0764-f1
7. U.S. Environmental Protection Agency. 1989. Report to Congress on indoor air quality: Volume 2. EPA/400/1-89/001C. Washington, DC.
8. U.S. Environmental Protection Agency. 1987. The total exposure assessment methodology (TEAM) study: Summary and analysis. EPA/600/6-87/002a. Washington, DC
9. Indoor Air Facts No. 4 -Sick Building Syndrome https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf
10. Ventilation control for airborne transmission of human exhaled bio-aerosols in buildings https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6072925/
11. Volatile Organic Compounds' Impact on Indoor Air Quality -https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality
12. Causes of indoor air pollution - https://worldgbc.org/clean-air-buildings/causes
13. Ventilation control for airborne transmission of human exhaled bio-aerosols in buildings- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6072925/
14. WHO - Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed - file:///C:/Users/Jeslin%20HP/Downloads/WHO-2019-nCoV-IPC-2020.4-eng.pdf
15. Ultraviolet germicidal irradiation: Possible method for respirator disinfection to facilitate reuse during the COVID-19 pandemic - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7214862/
16. IES Committee Report: Germicidal Ultraviolet (GUV) – Frequently Asked Questions - https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf

97

References

17. ASHRAE Guide to the COVID 19 Pages – Infographic - https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-covid19-infographic-.pdf
18. CORONAVIRUS, SARS-COV-2, COVID-19 AND HVAC SYSTEMS - https://www.cibse.org/coronavirus-covid-19/coronavirus-covid-19-and-hvac-systems
19. Emerging from the lockdown from CIBSE - https://www.cibse.org/coronavirus-covid-19/emerging-from-lockdown
20. REHVA COVID-19 Directory - https://www.rehva.eu/activities/covid-19-guidance?no_cache=1
21. LEED Safety First pilot credits - https://www.usgbc.org/about/covid-19-resources
22. Strategies from the well building standard to support in the fight against COVID-19 https://a.storyblok.com/f/52232/x/f12ca80093/strategiesfromwell-covid19-v2.pdf
23. 5-step guide to checking ventilation rates in classrooms - https://schools.forhealth.org/wp-content/uploads/sites/19/2020/08/Harvard-Healthy-Buildings-program-How-to-assess-classroom-ventilation-08-28-2020.pdf
24. Reopening America: Strategies for Safer Buildings - https://www.aia.org/resources/6299247-reopening-america-strategies-for-safer-bui?editing=true&tools=true
25. Risk Management Plan for Buildings - https://www.aia.org/resources/6299432-risk-management-plan-for-buildings?editing=true&tools=true
26. Re-occupancy Assessment Tool - https://www.aia.org/resources/6292441-re-occupancy-assessment-tool
27. AIA COVID-19 ArchMap - https://network.aia.org/communities/community-home?CommunityKey=b3add4bc-0bdf-4492-b3ad-6212b96a84b0
28. Natural Ventilation for Infection Control in Health-Care Settings - https://www.who.int/water_sanitation_health/publications/natural_ventilation.pdf
29. 6 feet not enough - https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/contact-tracing-plan/appendix.html#contact
30. Safe Use of ERV - https://www.rehva.eu/fileadmin/user_upload/REHVA_COVID-19_guidance_document_ver2_20200403_1.pdf
31. Energy-Recovery-Best-Practices-During-a-Pandemic.pdf - https://www.airxchange.com/wp-content/uploads/2020/05/Energy-Recovery-Best-Practices-During-a-Pandemic.pdf
32. practical-guidance-for-epidemic-operation-of-ervs-1 -https://www.airxchange.com/wp-content/uploads/2020/06/practical-guidance-for-epidemic-operation-of-ervs-1.pdf
33. Uv- White paper - https://iuva.org/resources/covid-19/UV%20101%20-%20Overview%20of%20Ultraviolet%20Disinfection%20-%20White%20Paper.pdf
34. https://branchpattern.com/research/facility-infection-risk-estimator-v2-0/
35. https://www.ashe.org/negative-pressure-rooms
36. https://www.tandfonline.com/doi/full/10.1080/02786826.2020.1829536
37. https://www.dhs.gov/science-and-technology/sars-airborne-calculator
38. *Isolation Rooms - Guideline Section - International Health Facility Guidelines - http://healthfacilityguidelines.com/ViewPDF/ViewIndexPDF/iHFG_part_d_isolation_rooms*

98


FREE
LIVE NOVEMBER 17TH @12PM ET
Climate Change And Health: A Lunchtime Chat With Dr. Joan Schiller

99

100


Thank You!
pathway@gbrionline.org
210-858-7783
Chat at www.GBRIonline.org

101