Allen + Shariff

MEP Engineering | Project Management

Actionable Steps Using MEP to Reduce Transmission Rates

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Provider #E130

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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Acknowledging that COVID-19 is primarily transmitted as an airborne virus, the course will review how can MEP design help reduce those risks. We provide a base understanding of how we catch viruses including COVID-19 and review actionable items for reopening and long term strategies for pathogen control.

Learning Objectives

At the end of this course, participants will be able to:

- Understand the three primary transmission methods of COVID-19 & typical preventative measures
- Understand infectious dose & viral load
- Understand short term HVAC approaches to reduce transmission to include ventilation & filtration
- Understand long term solutions for Pathogen control including Air Sanitization
- Understand other MEP design contributors to Pathogen control

Legionella

- How long has the building/space been empty?

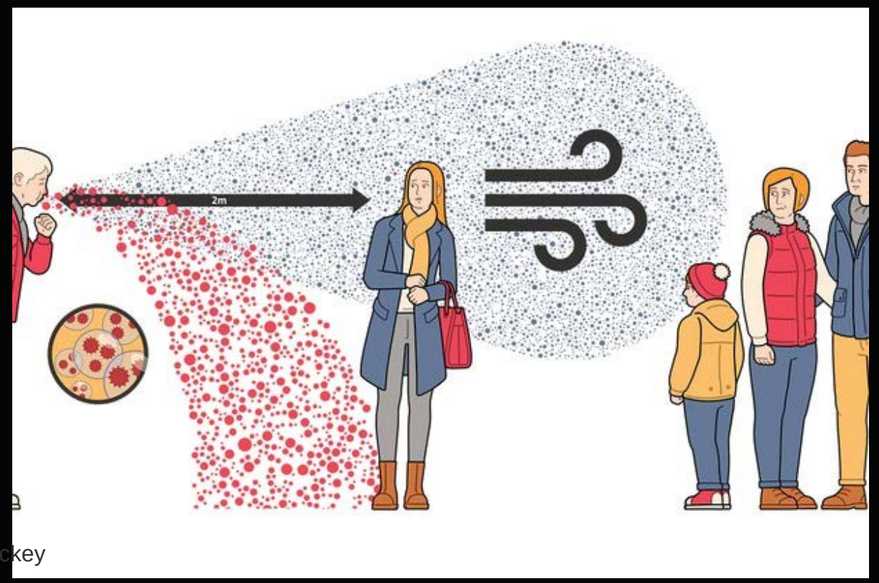
FLUSH!

hot & cold water, water heaters, decorative fountains, ice makers

https://www.cdc.gov/coronavirus/2019-ncov/php/building-water-system.html

Transmission Methods

- Fomite Transmission – Touching Surfaces
- Droplets – close contact person to person
- Aerosols– airborne longer distances



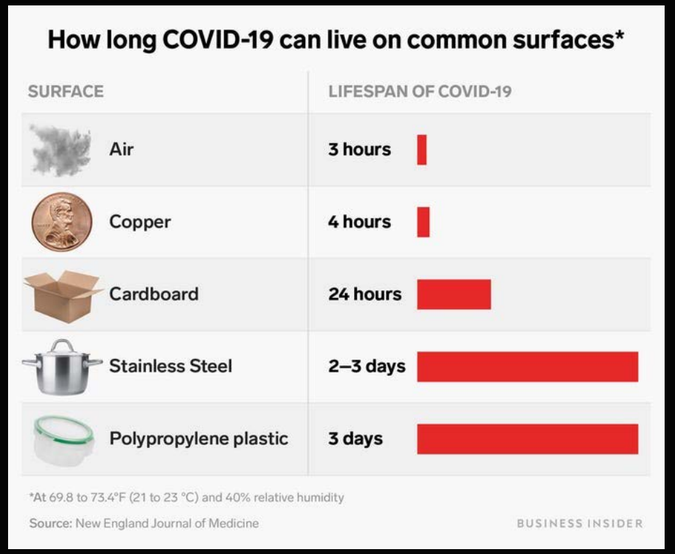
- Address each transmission method

Fomite Transmission – Touching Surfaces

- Touchless systems & devices
- Handwashing
- Hand sanitizer
- Material selection
- Clean and disinfect surfaces

“isn’t thought to be the main way the virus spreads”

https://www.cdc.gov/media/releases/2020/s0522-cdc-updates-covid-transmission.html



Pathogen	Potential length of survival on dry inanimate objects / surfaces
Campylobacter	1-4 hours[9]
Candida albicans	1-120 days[10]
Cold virus	7+ days[9]
Clostridium difficile (spores)	5 months[10]
E.Coli	1.5 hours-16 months[10]
Flu virus	24 hours[9]
Herpes virus	Up to 7 days[10]
HIV	1+ week[10]
Listeria spp. (which causes listeriosis)	1 day-months[10]
Mycobacterium tuberculosis	1 day-4 months[10]
Staphylococcus aureus (including MRSA)	7 days-7 months[10]
Salmonella typhimurium	10 days-4.2 years[10]

https://aestheticsjournal.com/feature/infection-control

Droplets – Close Contact – Person to Person

- 6’ Spacing
- Masks
- Acrylic screens
- Cover coughs & sneezes
- Single directional travel
- Orientation of desks
- Room limits

How far can Airborne Viruses Travel?

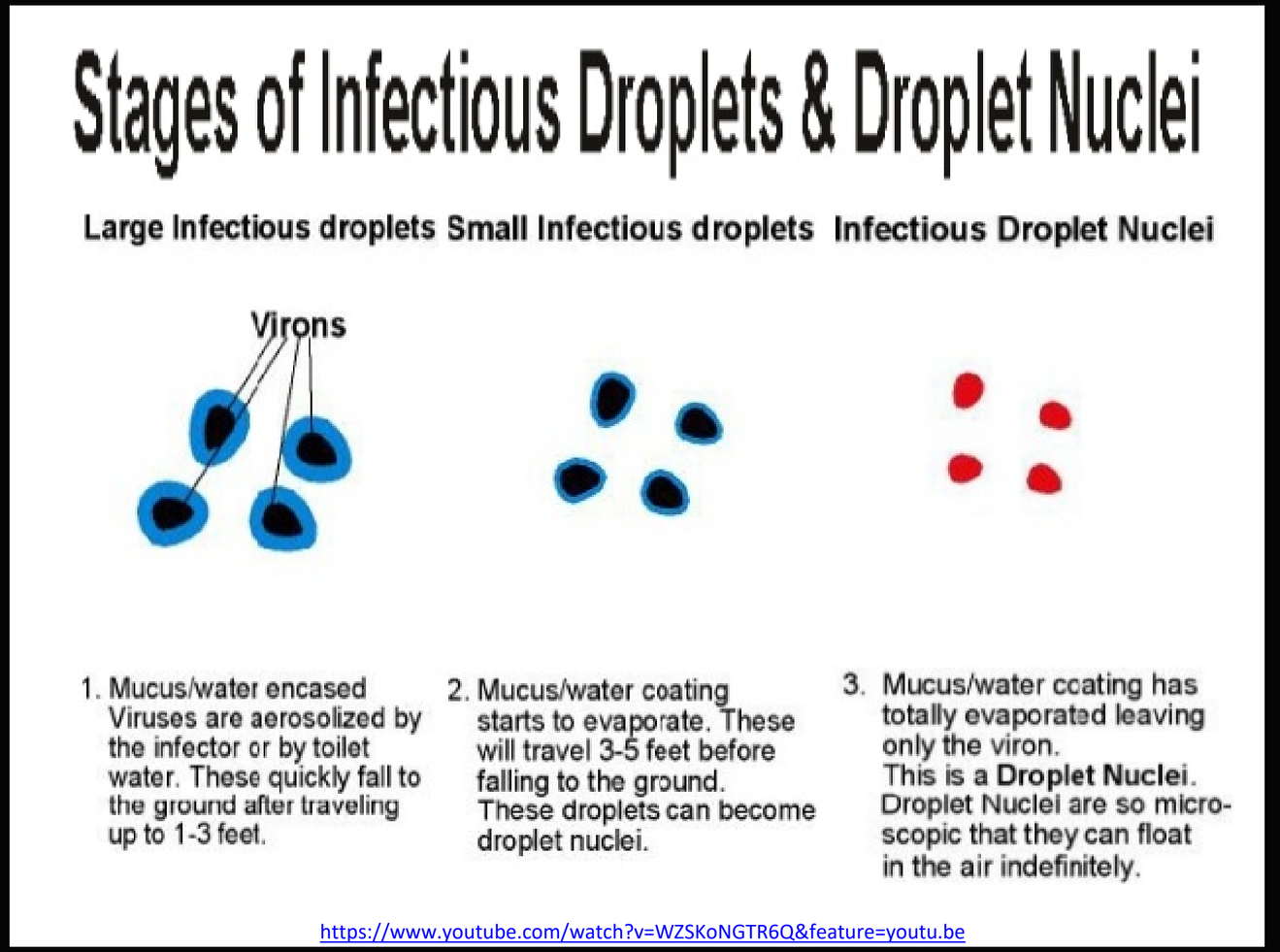
	Large/Small Droplets	Droplet Nuclei
1. Coughing	1-5 feet	160+ feet
2. Sneezing	8-15 feet	160+ feet
3. Singing, Talking	1-3 feet	160+ feet
4. Mouth Breathing	1-3 feet	160+ feet
5. Diarrhea*	5 feet+	160+ feet

*As a Result of Toilet Water Aerosolization and Mechanical Fan Dispersion into outdoor air (2003 Hong Kong SARS Virus Epidemic)

Source: https://www.slideshare.net/anjumhashmi61/h1-n1-influenza-virus-its-transmission-indoor-air-role-hvac

Aerosols – Virons – Droplet Nuclei - Micro Droplets

- Open letter to WHO - 7/20
- 238 researchers
- Super-spreader events
- Expelling virus particles
  - Breathing
  - Talking/Singing
  - Exercise
  - Coughing
  - Sneezing



https://www.youtube.com/watch?v=WZSKoNGTR6Q&feature=youtu.be

https://academic.oup.com/cid/article/doi/10.1093/cid/ciaa939/5867798?searchresult=1
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5798362/

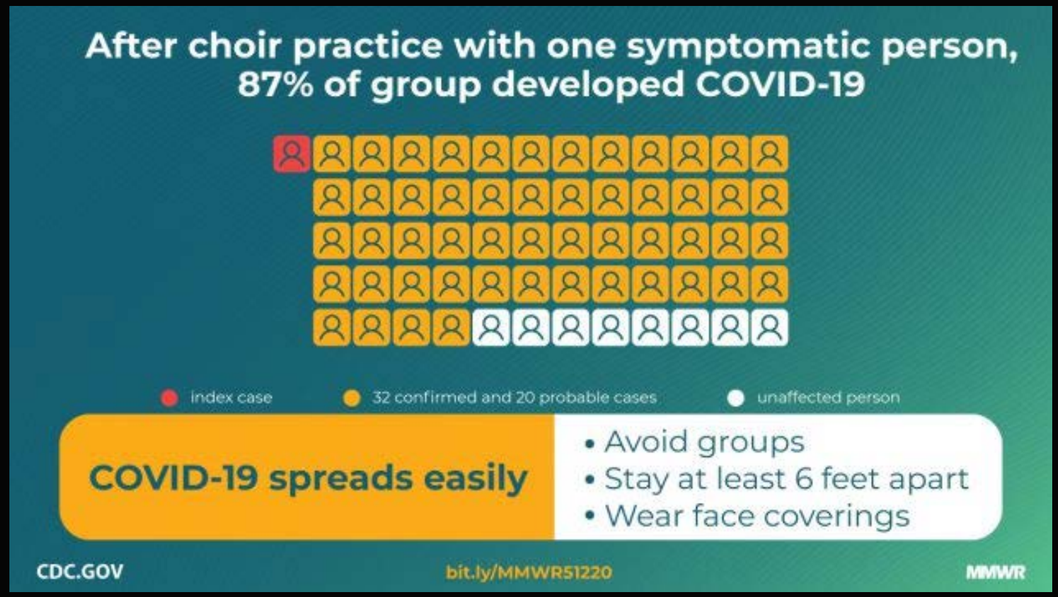
Infectious Dose Level & Viral Load

- Infectious Dose Level Estimates
- Viral Load
- Exposure duration and density

https://www.medrxiv.org/content/10.1101/2020.05.21.20108894v1.full.pdf
https://www.erinbromage.com/post/the-risks-know-them-avoid-them
https://www.sciencemediacentre.org/expert-reaction-to-questions-about-covid-19-and-viral-load/
https://www.newscientist.com/article/2238819-does-a-high-viral-load-or-infectious-dose-make-covid-19-worse/
https://www.webmd.com/lung/news/20201105/dose-of-coronavirus-timing-matters-for-infection#2

Case Study – Washington Choir Practice

- March 10, 2020
- One Carrier
- 61 people
- 2.5 hr practice
- 52 new cases
- No physical contact reported

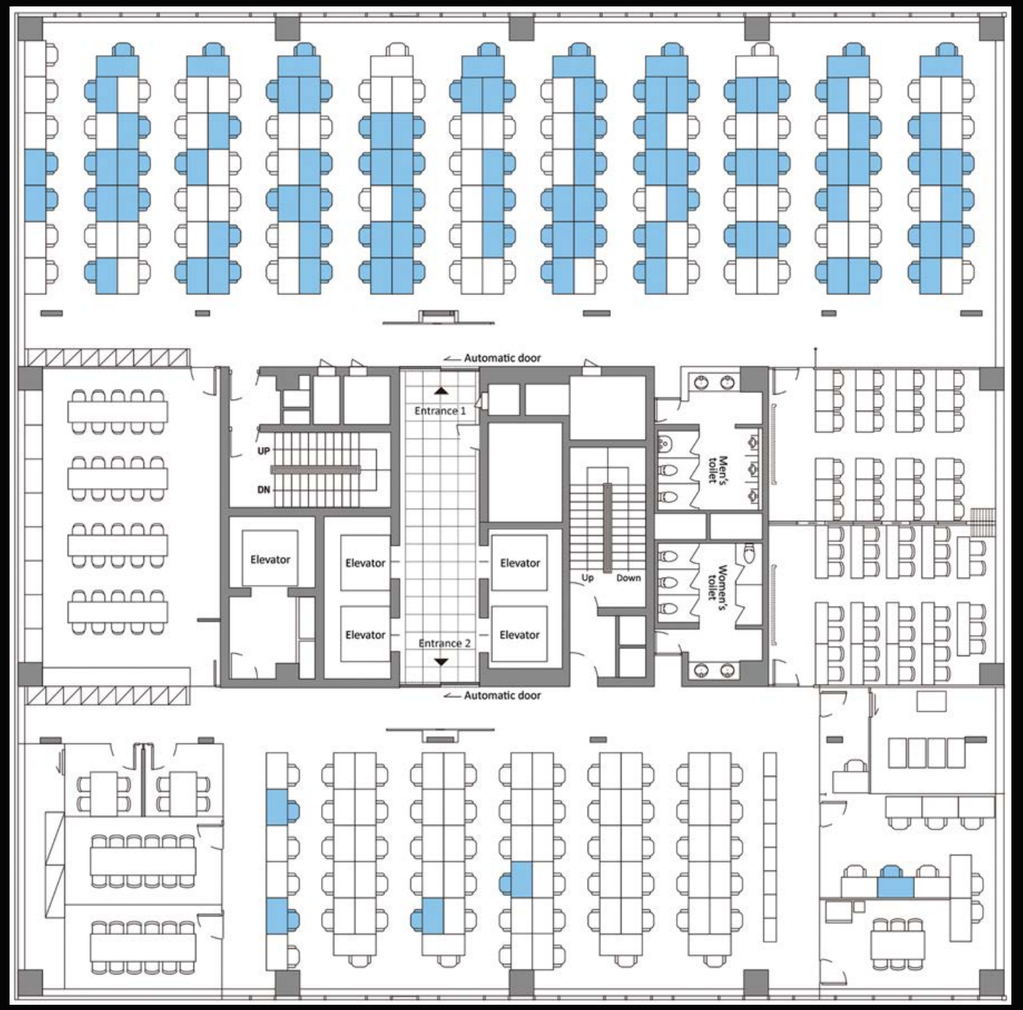


https://www.cdc.gov/mmwr/volumes/69/wr/mm6919e6.htm

Case Study – South Korean Call Center

- February/March, 2020
- 19 Story Building
- 811 employees over 3 floors
- 1,143 people tested
- 97 confirmed cases
- 94 on the same floor (216 emp)
- “duration of interaction was likely the main factor”

https://wwwnc.cdc.gov/eid/article/26/8/20-1274_article



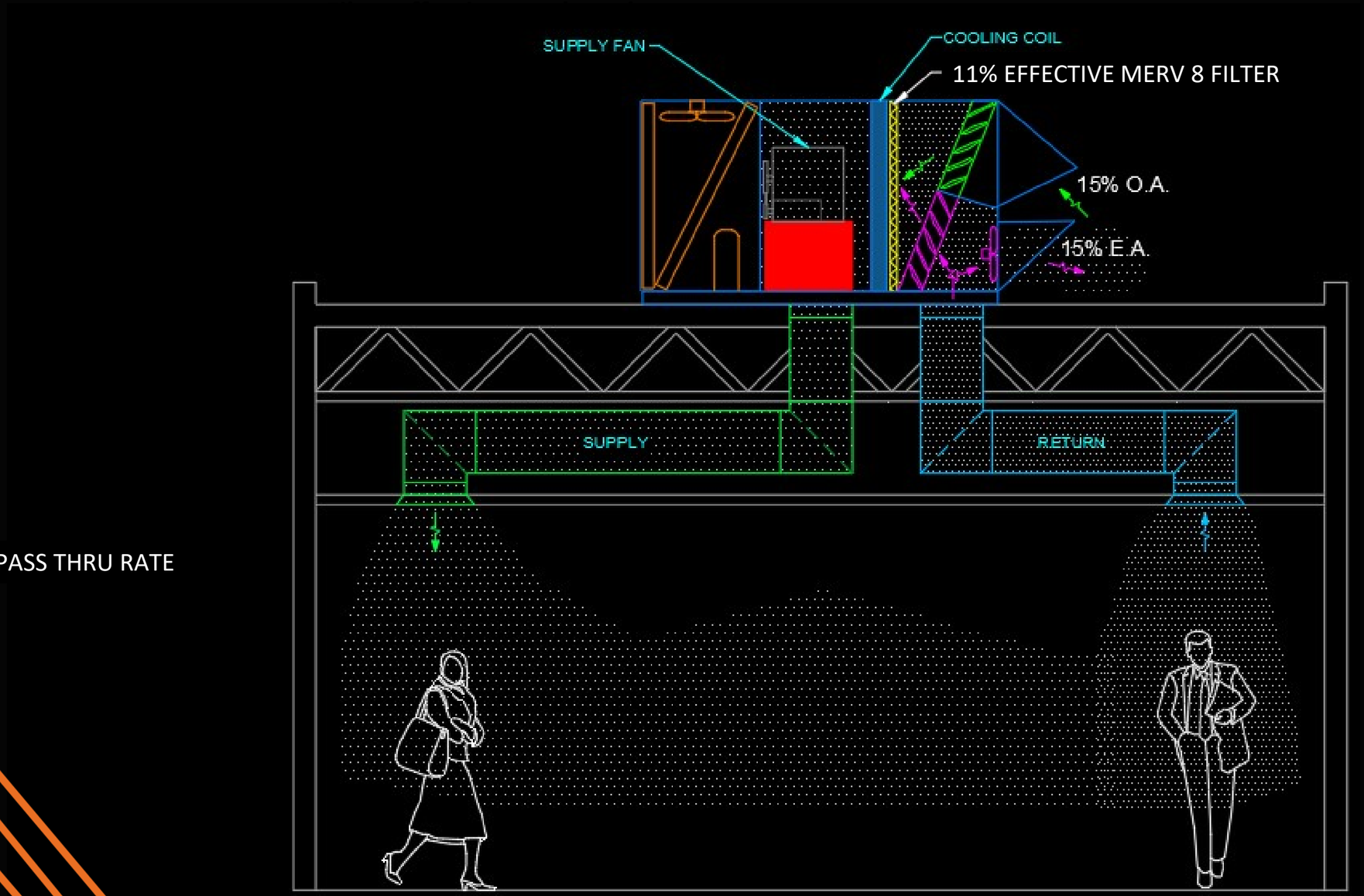
What Are We Trying To Do?

- Reduce # of virus particles in the space
- Reduce exposure below infectious dose level

3 Main Actionable Steps

- Increase Outside Air Ventilation Rates
- Increase Filtration Levels
- Air Sanitization

Typical Commercial System – Example System



75.6% PASS THRU RATE

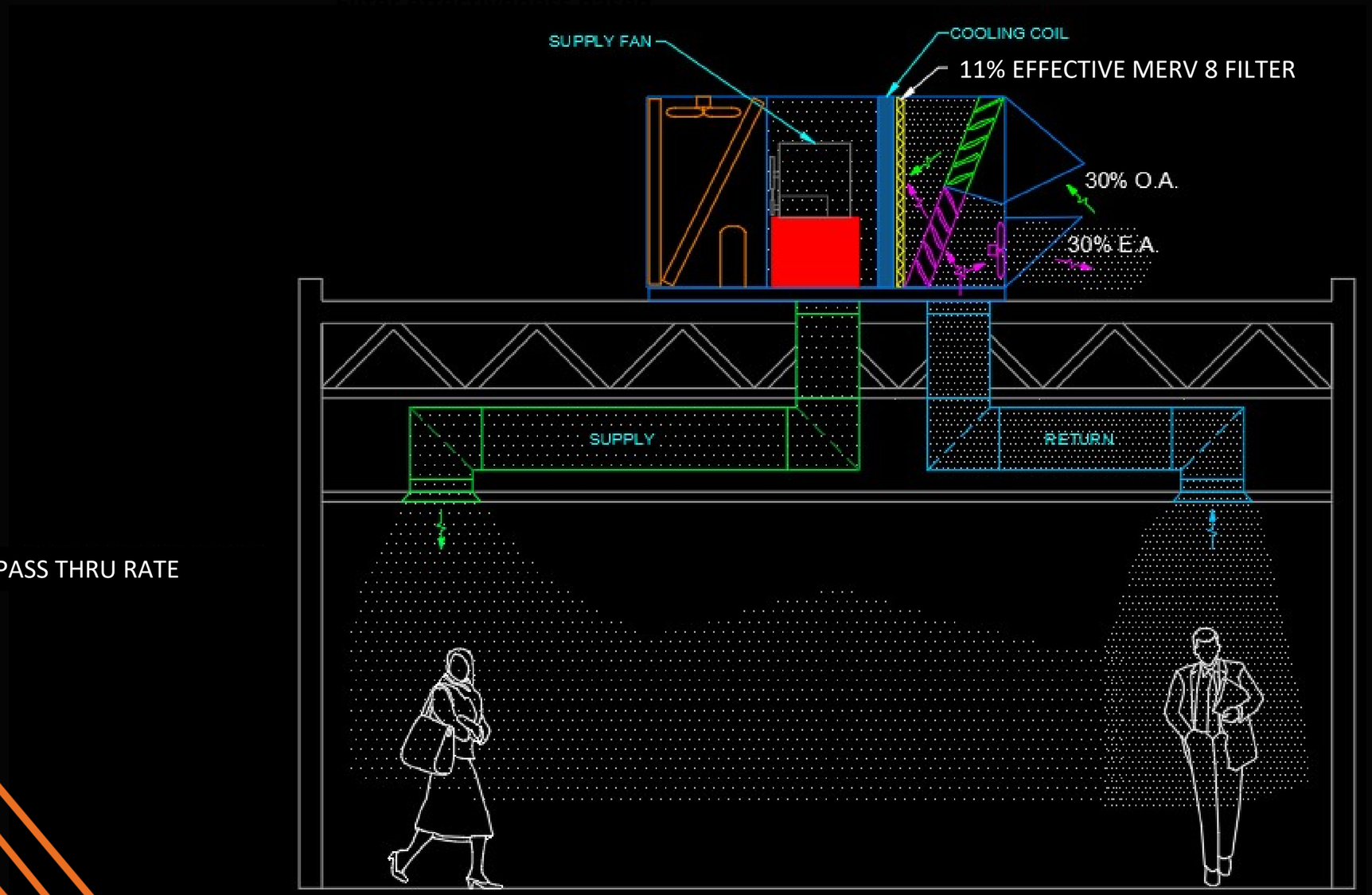
Filter effectiveness based on Swine Flu study

Increase Ventilation Rates

- Demand Control Ventilation (DCV)/CO2/Occupancy Control
- What can we do?
  - Turn off CO2 controls - Reduce CO2 setpoints
  - Increase outside air levels
  - Run longer occupied times – 2 hrs prior/2 hrs after
- Airside vs Waterside economizers

https://www.ashrae.org/technical-resources/commercial#holistic

Increase Ventilation Rates



62.5% PASS THRU RATE

Filter effectiveness based on Swine Flu study

Increase Ventilation Rates

- 1000 cfm OA = about 5 tons AC
- Capacity of existing equipment?
- Increasing capacity of new equipment
- Installed Costs
- Energy costs – Energy Star/LEED reporting
- Central Air Handlers vs VAV
- Operable Windows

Questions on Ventilation?

Increase Filtration Levels

- Goal – Filter out contaminants
- Typical commercial filters – MERV 8
- Review system & unit static to see what level MERV filter can be attained
- Increased static, increased horsepower & energy
- ASHRAE & CDC recommend MERV 13

https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

Increase Filtration Levels

Standard 52.5 Minimum Efficiency Reporting Value	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
20	n/a	n/a	< 0.30 pm particle size	Cleanrooms	≥99.999% eff. On .10-.20 pm Particles
19	n/a	n/a	Virus (unattached)	Radioactive Materials	Particles
18	n/a	n/a	Carbon Dust	Pharmaceutical Man.	Particulates
17	n/a	n/a	All Combustion smoke	Carcinogenetic Materials	≥99.97% eff. On .30 pm Particles
16	n/a	n/a	.30-1.0 pm Particle Size	General Surgery	**Bag Filter**- Nonsupported
15	>95%	n/a	All Bacteria	Hospital Inpatient Care	microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets
14	90-95%	>98%	Most Tobacco Smoke	Smoking Lounges	**Box Filter**- Rigid Style Cartridge Filters 6 to 12" deep m ay use lofted or paper media.
13	89-90%	>98%	Proplet Nuceli (Sneeze)	Superior Commercial Buildings	
12	70-75%	>95%	1.0-3.0 pm Particle Size	Superior Residential	**Bag Filter**- Nonsupported
			Legionella		microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets
11	60-65%	>95%	Humidifier Dust	Better Commercial Buildings	
			Lead Dust		**Box Filter**- Rigid Style Cartridge Filters 6 to 12" deep m ay use lofted or paper media.
10	50-55%	>95%	Milled Flour		
			Auto Emissions	Hospital Laboratories	
9	40-45%	>90%	Welding Fumes		
8	30-35%	>90%	3.0-10.0 pm Particle Size	Commercial Buildings	**Pleated Filters**- Disposable, extended surface area, thick with cotton-polyester blend media, cardboard frame
			Mold Spores		
7	25-30%	>90%	Hair Spray	Better Residential	**Cartridge Filters**- Graded density viscous coated cube or pocket filters, synthetic media
			Fabric Protector		
6	<20%	85-90%	Dusting Aids	Industrial Workplace	**Throwaway**- Disposable synthetic panel filter.
			Cement Dust		
5	<20%	80-85%	Pudding Mix	Paint Booth Inlet	
4	<20%	75-80%	>10.0 pm Particle Size	Minimal Filtration	**Throwaway**- Disposable fiberglass or synthetic panel filter.
			Pollen		
3	<20%	70-75%	Dust Mites	Residential	**Washable**- Aluminum Mesh
			Sanding Dust		
2	<20%	65-70%	Spray Paint Dust		**Electrostatic**- Self charging woven panel filter.
			Textile Fibers	Window A/C Units	
1	<20%	<65%	Carpet Fibers		

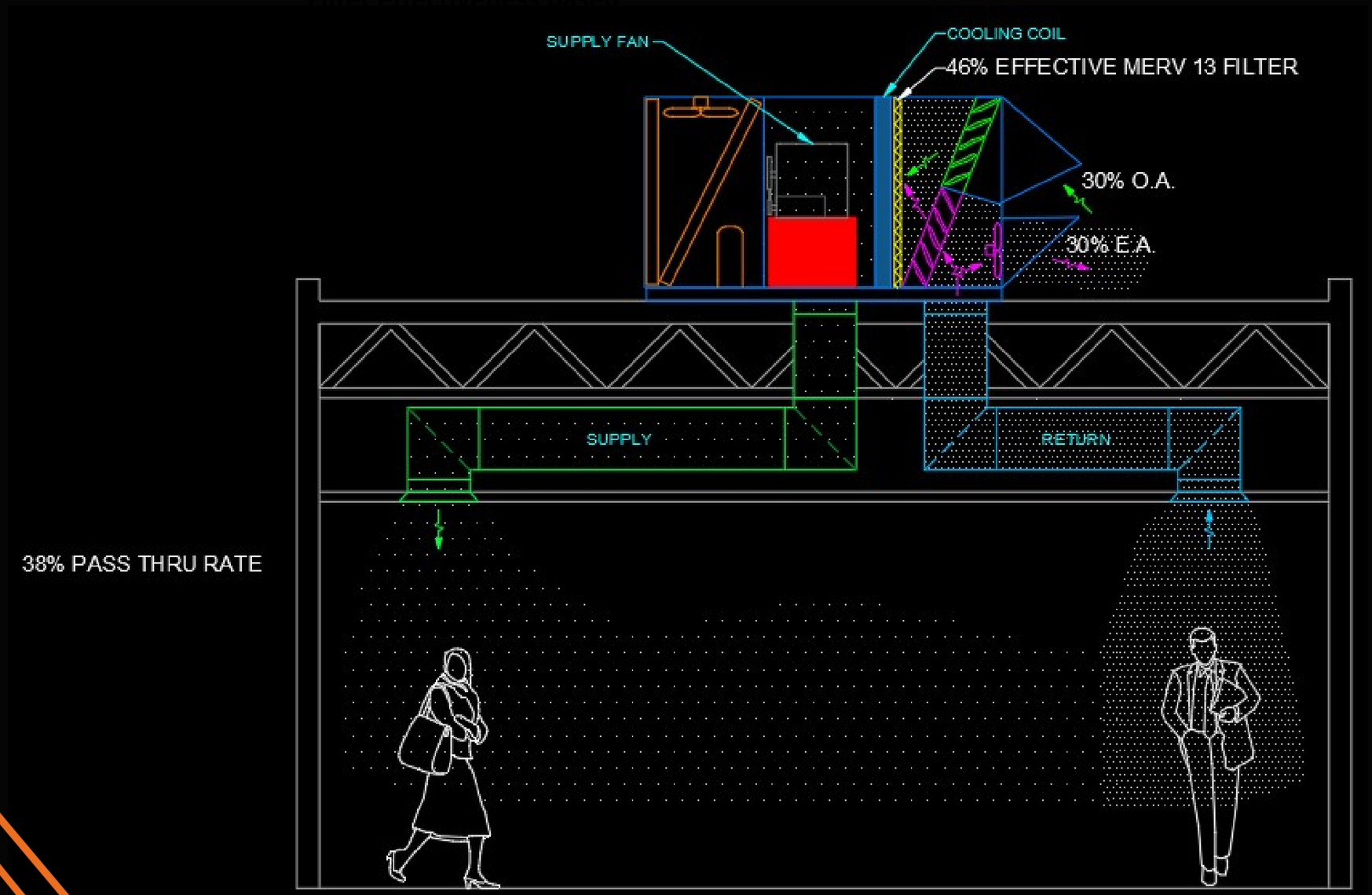
Source: http://radontestingdallas.com/merv-minimum-efficiency-reporting-value-ratings-and-filters/

Mechanical Air Filters can trap this % of Swine Flu Viruses

MERV Rating	%Viruses Arrested (captured)
1-5	1-5%
6	6.2%
7	7%
8	11%
10	12%
13	46%
15	71%
16	76%
17 (HEPA)	99.9%

https://www.slideshare.net/anjumhashmi61/h1-n1-influenza-virus-its-transmission-indoor-air-role-hvac

Increase Filtration Levels

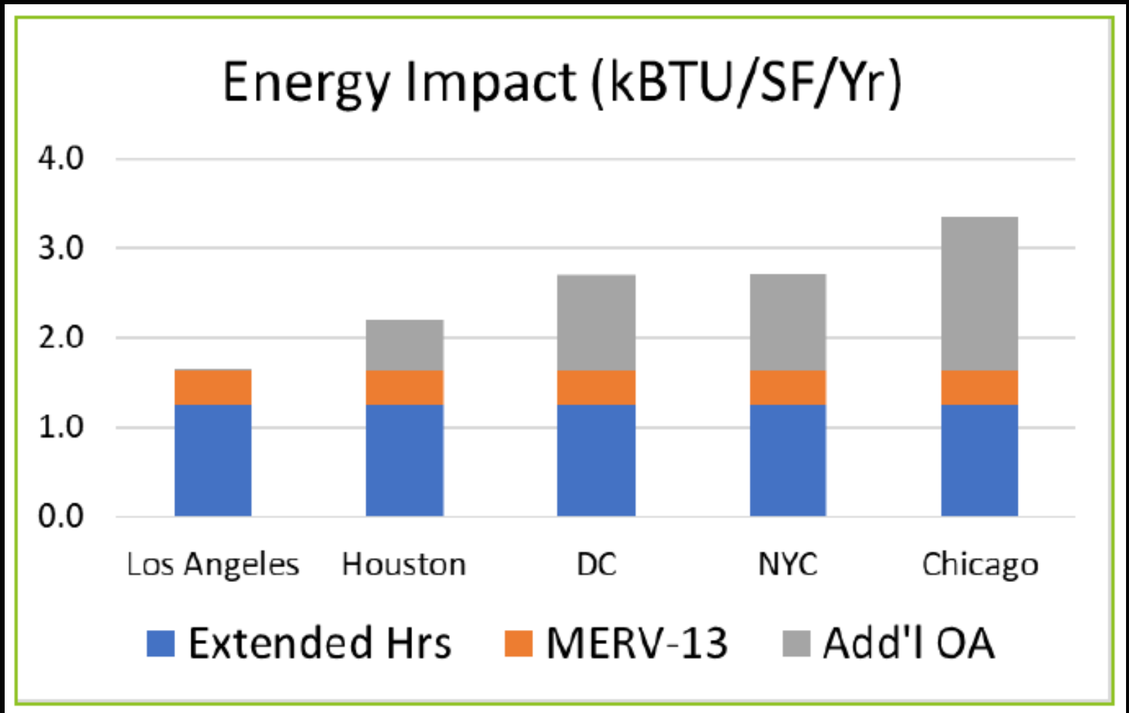


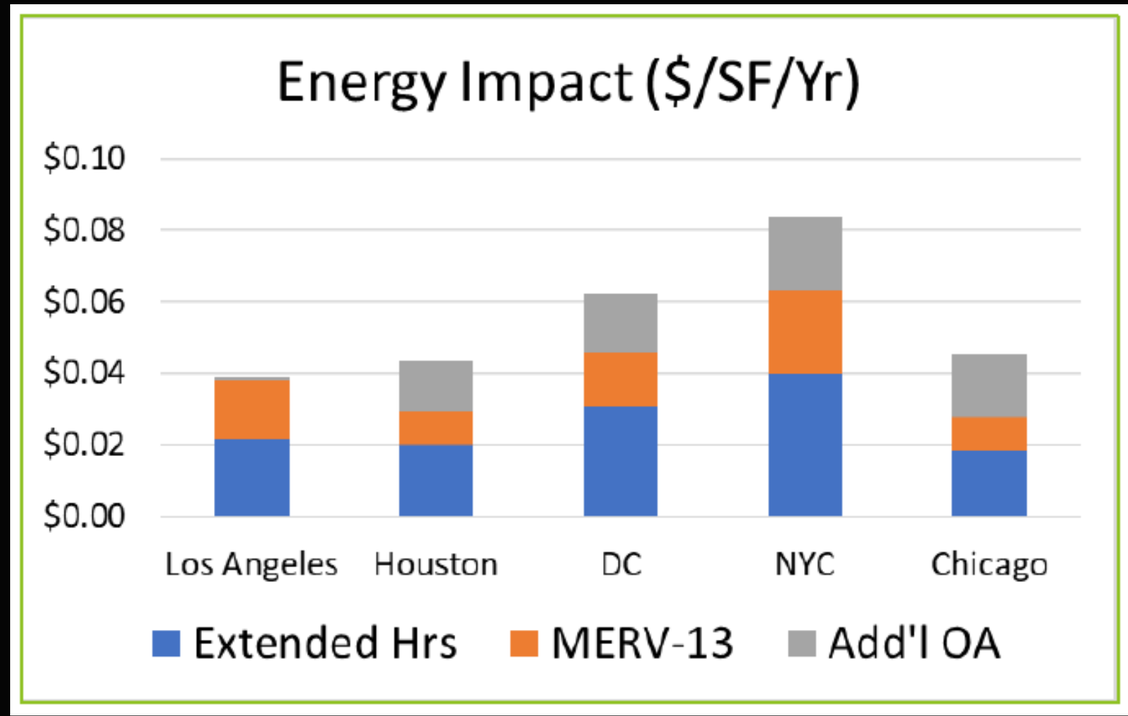
Filter effectiveness based on Swine Flu study

Increase Filtration Levels

- Like to reach MERV 13
- Filter costs are roughly double
- Likely have to change more frequently
- Central air handler vs VAV vs smaller equipment
- Leakage or bypass will reduce filtration rate
- Portable fan filter units

Costs for Steps 1 & 2





- Analysis done by ServiDyne for EnergyStar
  - 2 hrs prior & 2 hrs after
  - 50% addition OA

Questions on Filtration?

Air Sanitization - UVGI

- Goal – Actively kill pathogens in the airstream
- Most widely accepted technology is UVGI
- Ultra Violet Germicidal Irradiation
- Most Common Options
  - Upper Room
  - In Unit/Duct
- Double blind studies

https://www.ashrae.org/file%20library/about/position%20documents/filtration-and-air-cleaning-pd.pdf

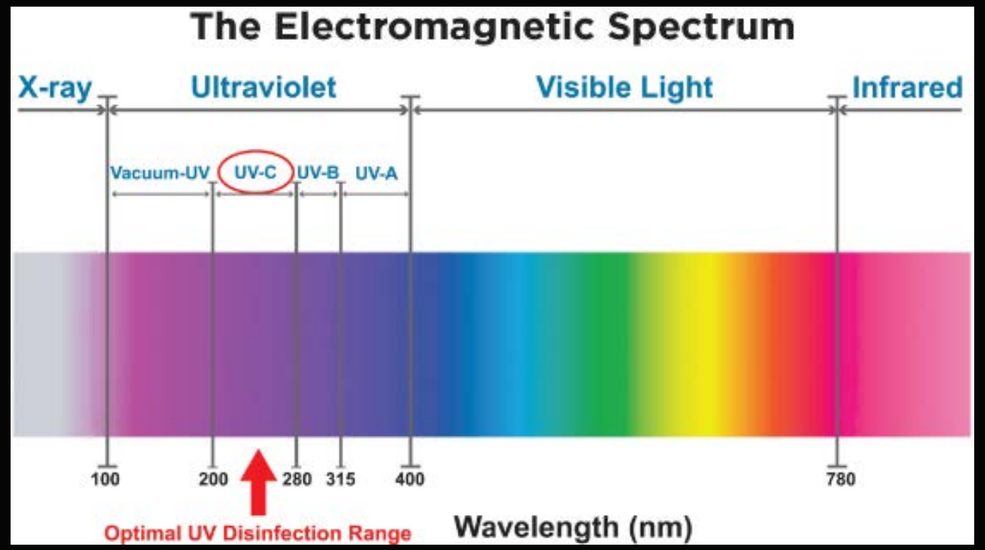
Air Sanitization – Other Technologies

- Photocatalytic Oxidation (PCO)
- Bipolar Ionization/Corona Discharge
- Pulsed Xenon (Pulsed UV)
- Vaporized Hydrogen Peroxide
- 405 nm Visible Light
- Far Ultraviolet

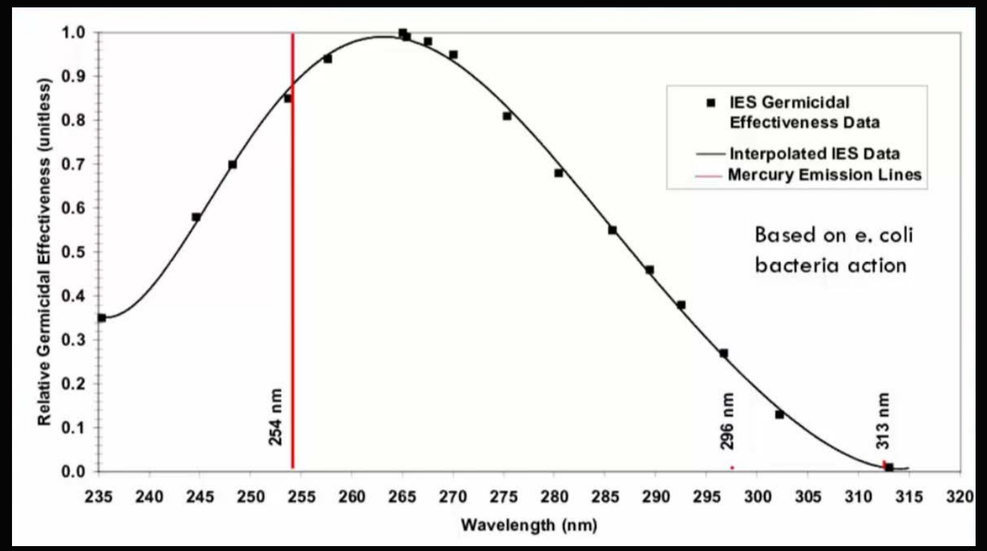
- Hit or Miss - manufacturers
- Lack of peer reviewed studies
- Higher power outputs than UVC
- not suitable for occupied spaces
- 1000 times less effective than UVC
- issues w/ large microorganisms

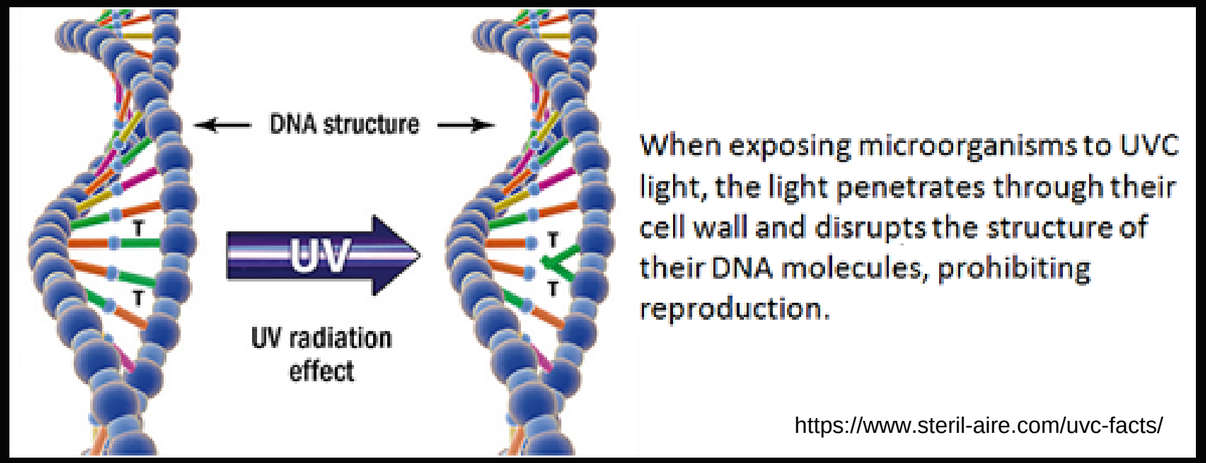
https://www.ashrae.org/file%20library/about/position%20documents/filtration-and-air-cleaning-pd.pdf
https://www.ashrae.org/technical-resources/filtration-disinfection

Air Sanitization



https://www.evoqua.com/en/brands/ETS_UV/Pages/how-ets-uv-works.aspx



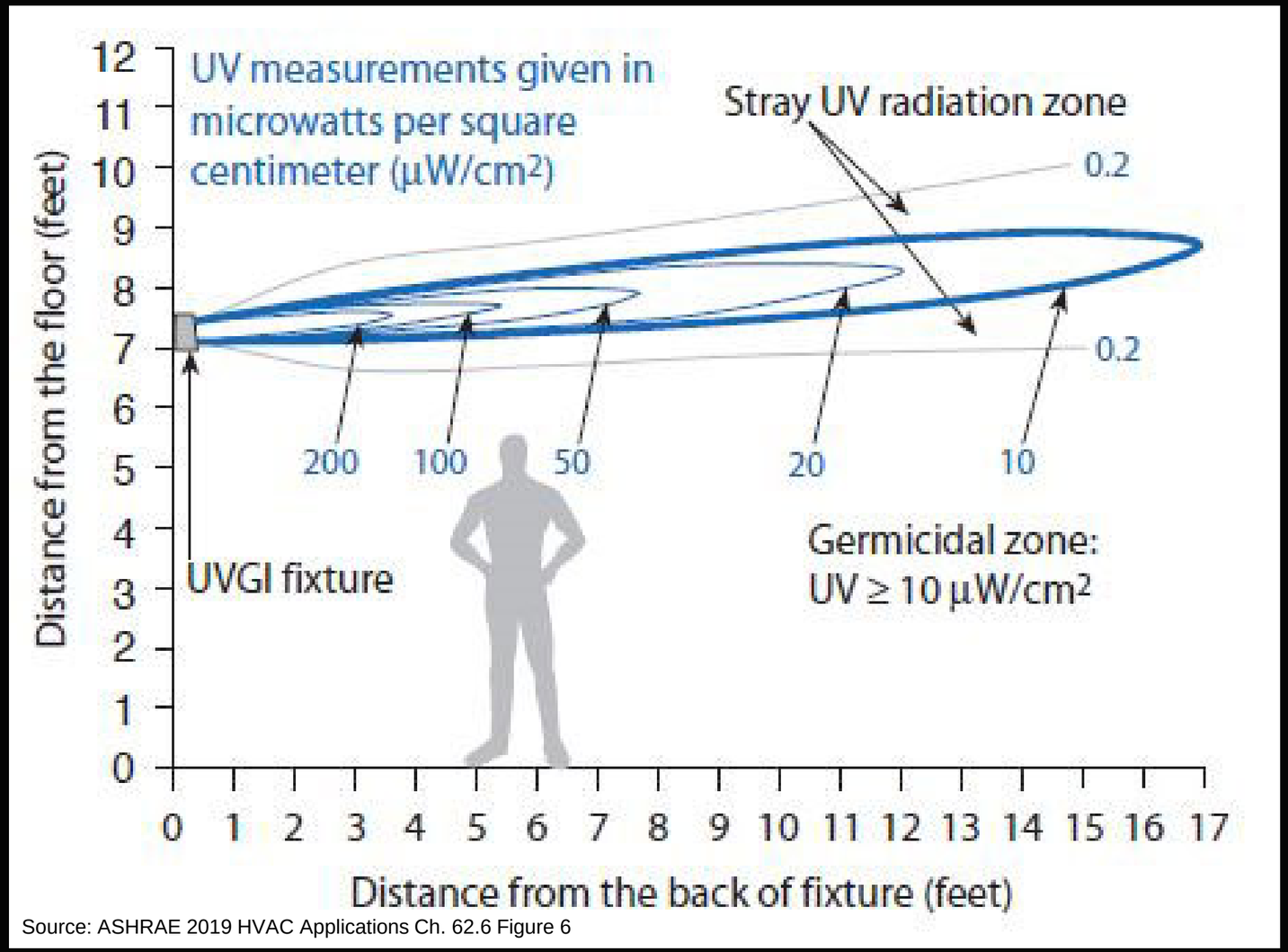


http://www.steril-aire.com/uvc-facts/

- Optimal UVC Wavelength is 265 nm
- Low Pressure Mercury UVGI produces 254 nm ~ 85% of optimal
- Breaks down the DNA

https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf

Air Sanitization – Upper Room

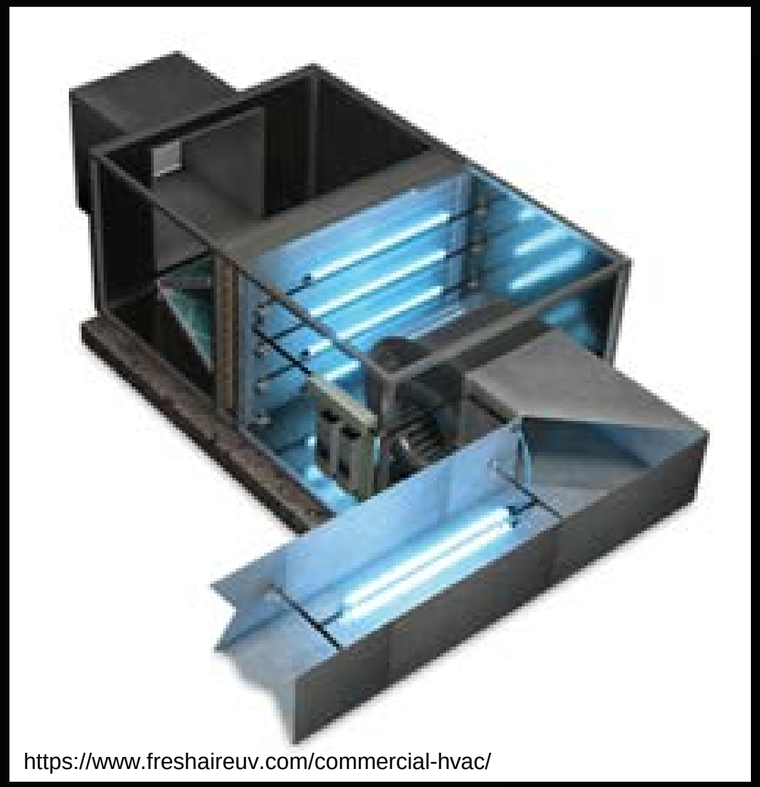


Source: ASHRAE 2019 HVAC Applications Ch. 62.6 Figure 6


https://ultraviolet.com/how-to-control-tuberculosis-germicidal-uv-lamps/

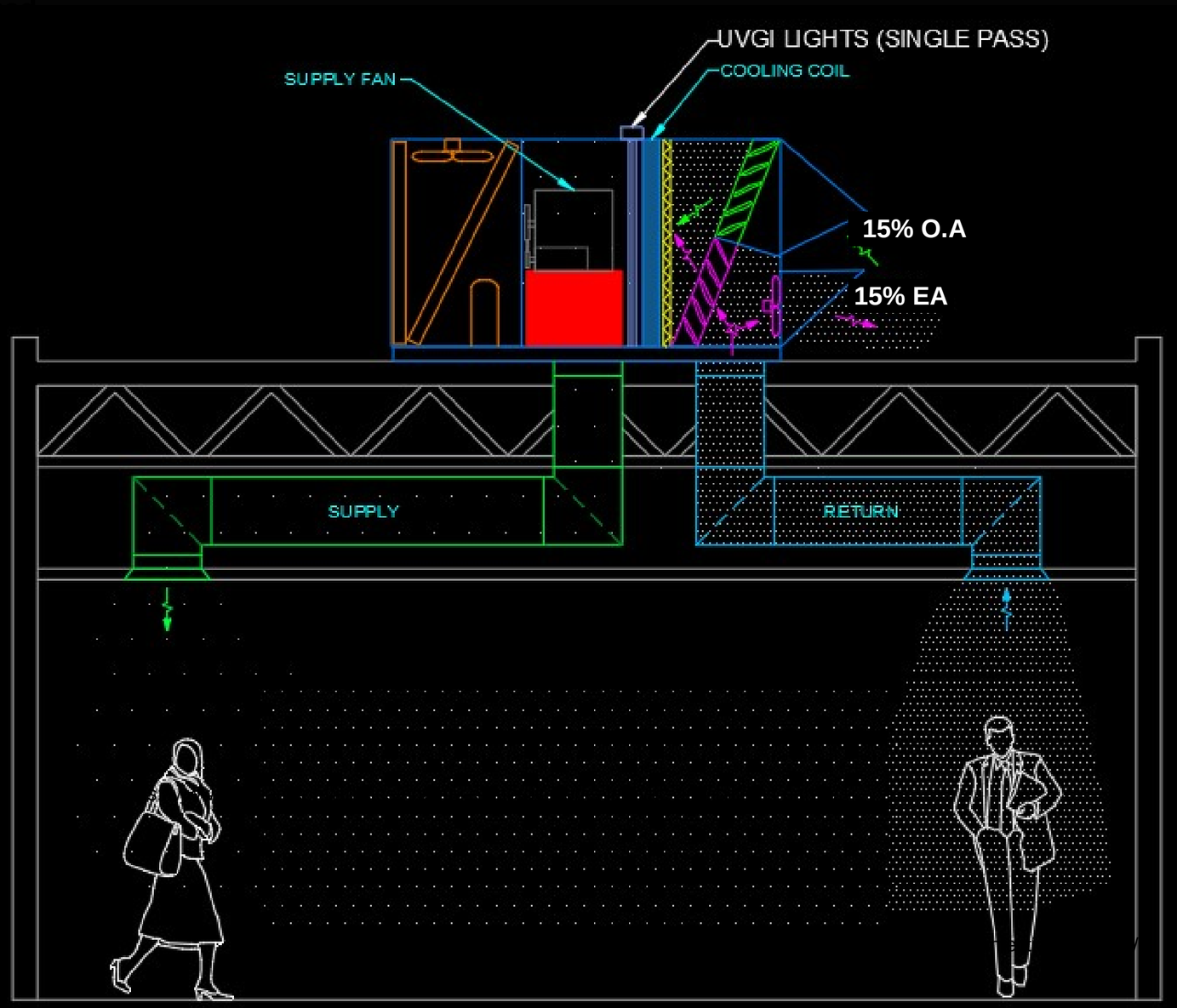
- Can be modeled using Visual

Air Sanitization – In Unit/In Duct



https://www.freshaireuv.com/commercial-hvac/

<1% PASS THRU RATE



Air Sanitization

- Installed Costs –
  Upper room ~ $1000 - $2000 ea. installed
  AHU - $.30 - $.60/cfm ~ $.5 - $1/sf
- Bulb replacements
- Problematic retrofitting in units
  -space in units
  -gaskets, wires & filters may not be UV compatible
- Relatively low operational costs

https://www.spokesman.com/stories/2018/mar/25/bend-hospital-using-ultraviolet-light-to-kill-germ/

https://www.ashrae.org/file%20library/technical%20resources/covid-19/i-p_a19_ch62_uvairandsurfacetreatment.pdf

Questions on UVGI ?

Air Sanitization – Needlepoint Bipolar Ionization

- Releases charges atoms that attach to micoparticles
- Clusters particles together for more effective filtration
- Disrupts surface proteins rendering pathogens inactive
- Should meet UL 2998 (no ozone creation)
- Considered by CDC to be “emerging technology”

https://www.ashrae.org/technical-resources/filtration-disinfection
https://www.ashrae.org/file%20library/about/position%20documents/filtration-and-air-cleaning-pd.pdf
https://globalplasmasolutions.com/

Air Sanitization – Needlepoint Bipolar Ionization

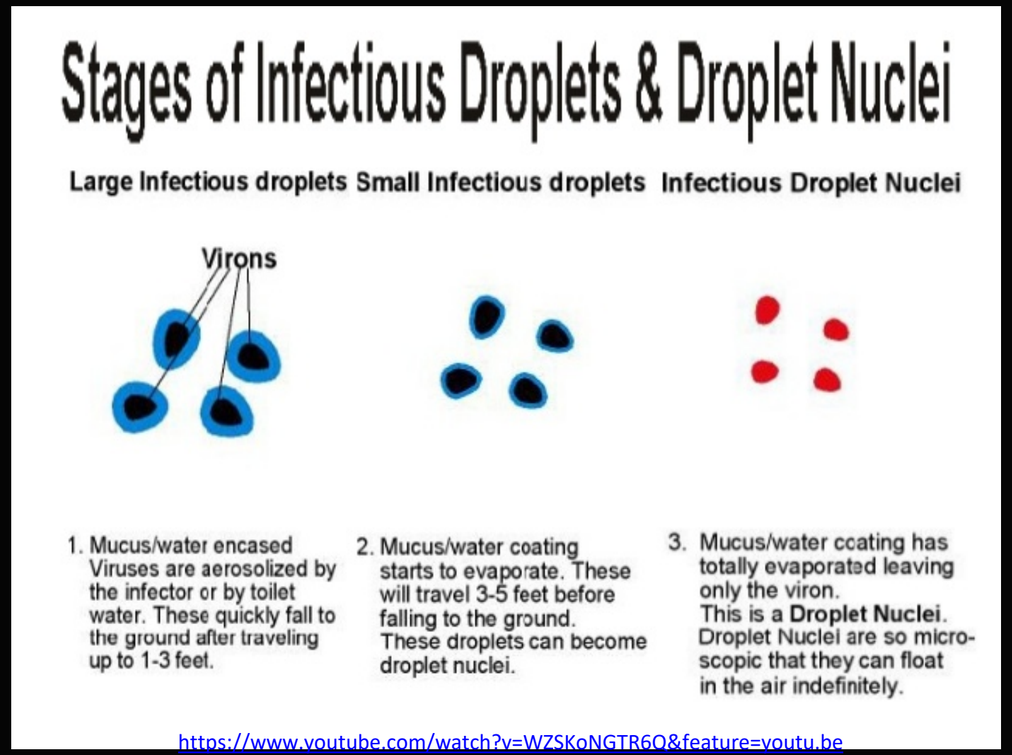
- 5 – 10 yr life
- Installed costs $.40 - $.70/sf
- More flexible options on installation
  - can go where UVGI can’t
- ASHRAE - Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered.

https://www.ashrae.org/technical-resources/filtration-disinfection
https://www.ashrae.org/file%20library/about/position%20documents/filtration-and-air-cleaning-pd.pdf

Questions on Bi-Polar Ionization ?

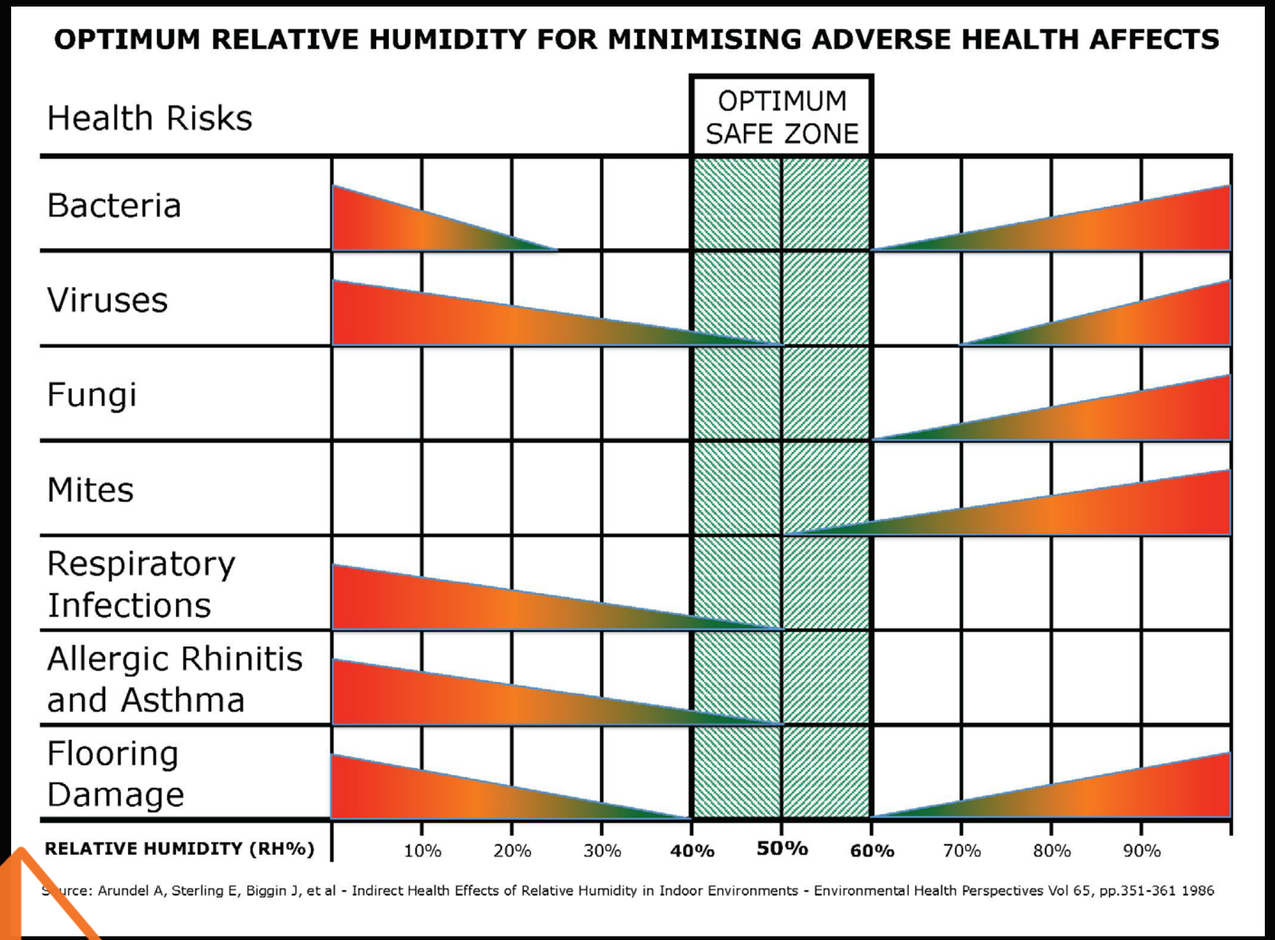
Humidity Control

- Goal – provide unfavorable conditions for bacteria, viruses, etc.
- Evaporation Rate
- Low humidity allows droplet to stay airborne longer
- Cilia hairs in airways shed pathogens better in higher humidity



https://www.youtube.com/watch?v=WZSKoNGTR6Q&feature=youtu.be

Humidity Control



- Summer – less of an issues
- Winter – main focus
- OA drys out our spaces
- Typically cost prohibitive
- Consider for high risk occupants
  - Assisted Living
  - Senior Centers
  - Medical Offices

Summary

- Address all 3 transmission methods

- Increasing OA & Filtering
  - easy steps we can do now that have a big effect

- Air Sanitization
  - great long-term strategy, reduce energy consumption
  - UVGI vs Bi-Polar Ionization

- Individual building & system analysis – find the specific solutions

- No one size fits all – engage experts

This concludes The American Institute of Architects Continuing Education Systems Course

Questions?

Allen + Shariff

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