CHRISTIE CounterAct™

UVC disinfection systems: Game-changing technology for improving indoor air quality

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Isn’t it time we cared about indoor air quality?

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We care about water quality

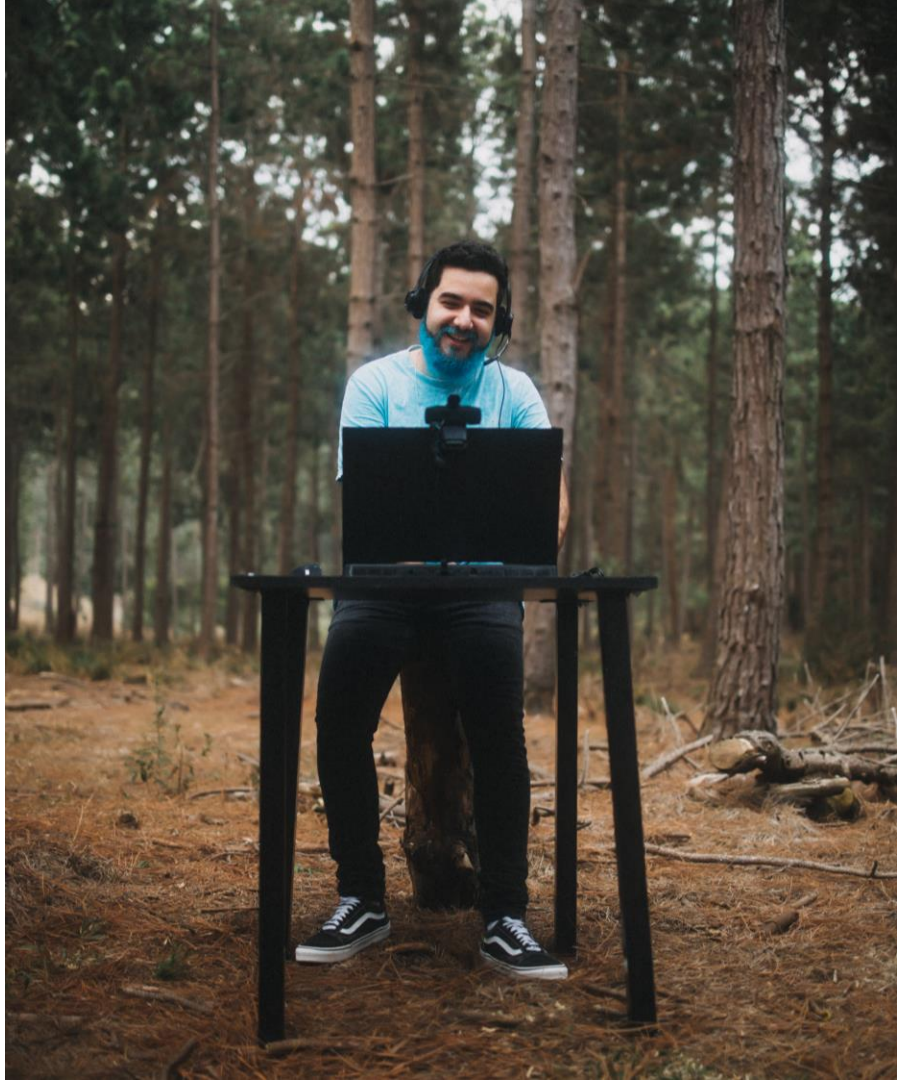
What's in our indoor air?

Oxygen (O^2), carbon monoxide (CO), and carbon dioxide (CO^2)

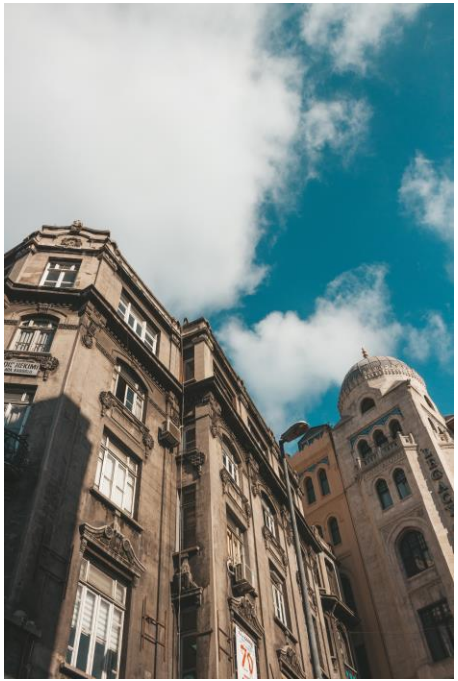
Volatile Organic Compounds (VOCs) and airborne particles

Bacteria and viruses (Pathogens)

What’s ‘ideal’ air quality?



Why not just pump in large amounts of outside air?



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Compare performance based on ACH or eACH

TABLE 1 Airborne contaminant removal in a fully mixed, empty room with no aerosol-generating source.

ACH	TIME (MIN) REQUIRED FOR REMOVAL (99% EFFICIENCY)	TIME (MIN) 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

Note: Data taken from CDC's "Guidelines for Environmental Infection Control in Health-Care Facilities," Appendix B.[7]

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Let’s compare technologies

	UV disinfection	Filtration (HEPA)	Fresh air (outside)
Fixed install			
HVAC			
Portable			

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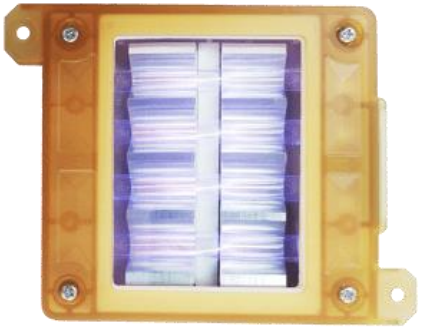
Technology Comparison



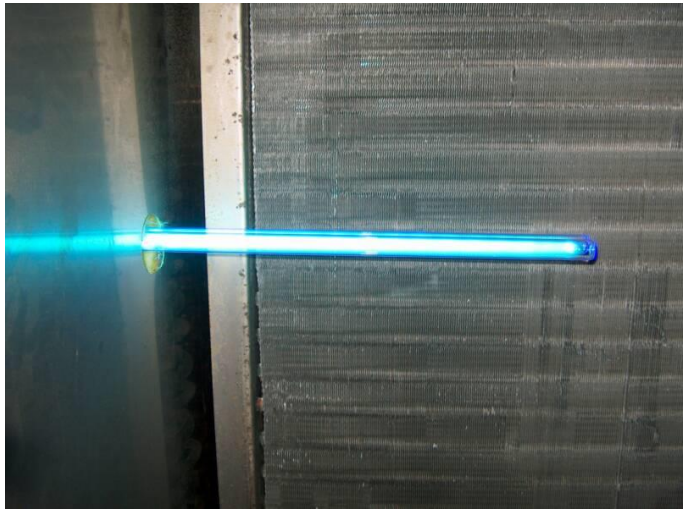
Far-UVC lamp

Air filter
HEPA, MERV 1-16?

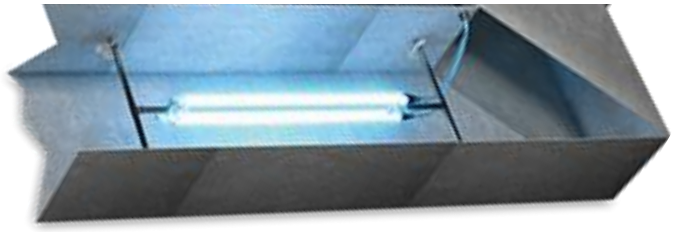
Let’s compare technologies

	UV disinfection	Filtration (HEPA)	Fresh air (outside)
Fixed install			
HVAC			
Portable			

HVAC



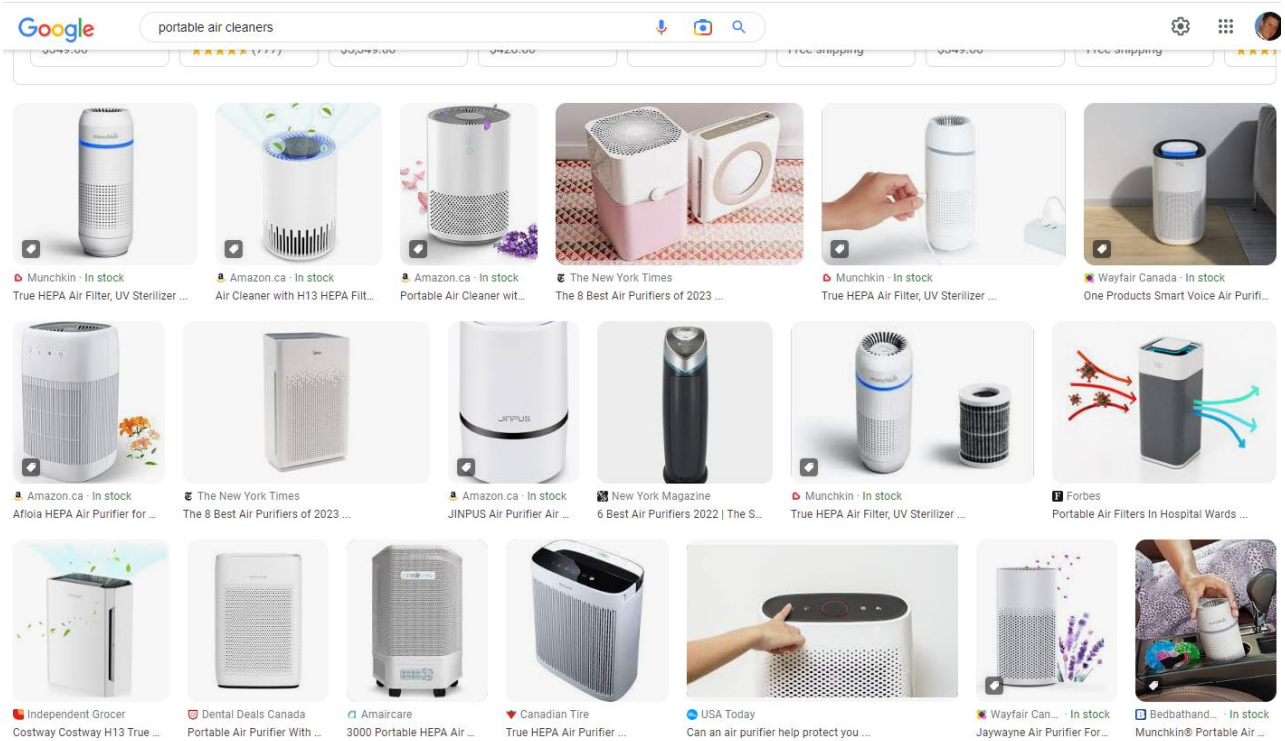
UVC light on cooling coils



In-duct systems

https://powervac.ca/ultraviolet-lighting/

Portable air cleaners



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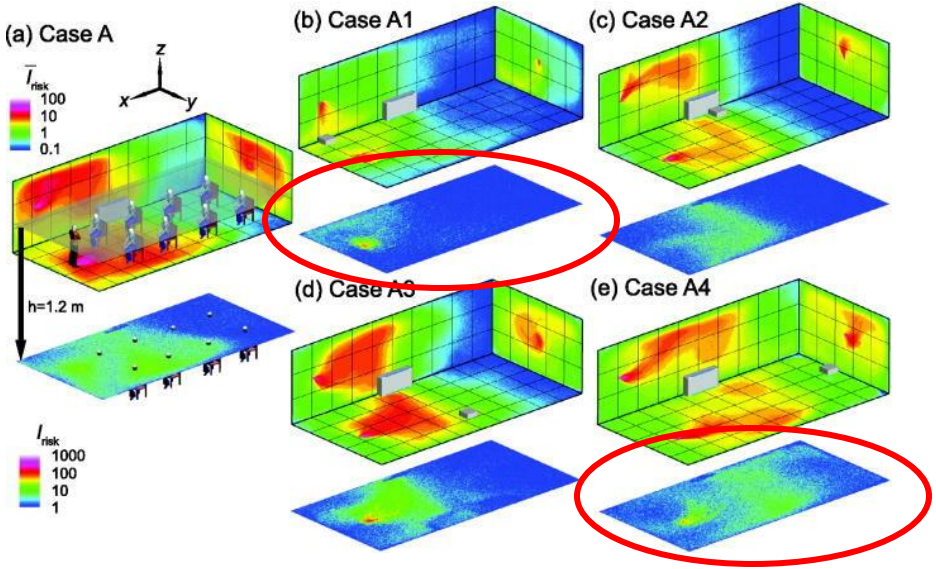
Challenges of portable air cleaners

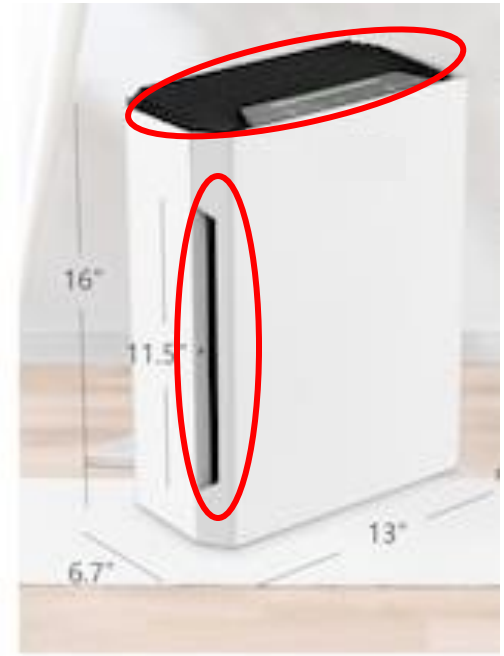
1. Need to co-locate portable unit with source

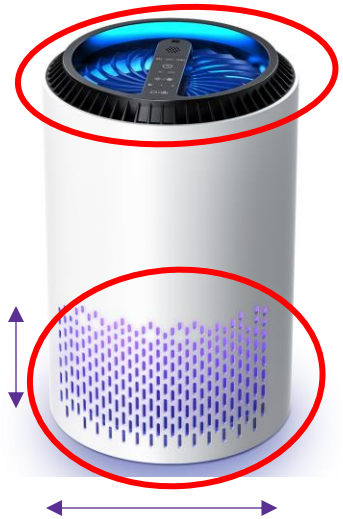


The risk index maps of the classroom for an infector in the front of the classroom with (a) no box fan air cleaner placed (case A), (b) the air cleaner placed in the front of the classroom (case A1), (c) in the middle of the classroom near the horizontal unit ventilator (HUV) (case A2), (d) in the middle but away from the HUV (case A3), and (e) in the back of the classroom (case A4). The wall contour maps show the spatially averaged risk index along x, y, and z directions, respectively. The risk index distribution at x-y plane at the breathing level of a sitting individual (1.2 m) is also provided. Source: Physics of Fluids 33, 057107 (2021)

Challenges of portable air cleaners

2. Air inlet and outlet openings are small





A portable air cleaners case study

Room volume (LxWxH):
2.5m x 2.5m x 2.5m = 15.6m^3

$$\text{ACH} = \frac{Airflow\ Rate\ (\frac{m^3}{hr})}{Room\ Volume\ (m^3)}$$

Table 1 Measured velocity of the HEPA filter and calculated airflow rates. (Points *a*, *b*, *c*, *d*, *e* are five points at the opening of the air cleaner, in which point *b* is located on the center of the air cleaner

Speed	Velocity (m/s)						Airflow rate (m^3/s)	Airflow rate (m^3/h)	ACH*
	Point *a*	Point *b*	Point *c*	Point *d*	Point *e*	Mean			
Speed 1	1.99	1.71	1.97	1.98	1.83	1.90	0.027	97.65	0.9
Speed 2	3.75	3.40	3.88	3.79	3.44	3.65	0.052	188.10	1.7
Speed 3	5.70	4.84	5.3	5.2	4.85	5.18	0.070	266.70	2.5
Speed 4	7.75	6.65	7.15	7.4	6.6	7.11	0.10	366.19	3.4
Speed 5	11.25	9.4	10.8	10.95	9.55	10.39	0.15	535.13	4.9

* The air change rate is for a room of 6.7 m × 6 m × 2.7 m.

Fig. 1 A photo of the tested cleaner (left) and the inner structure of the portable air cleaner IQAir (right). Latter diagram from http://www.iqair.com/EU/ENG/products/Cleanroom.htm

Speed 1: 95.6 / 15.6 = 6.2 ACH

Speed 2: 188.1 / 15.6 = 12 ACH

https://link.springer.com/content/pdf/10.1007/s12273-010-0005-4.pdf

A portable air cleaners case study

Table 5 Noise levels when the portable air cleaner was turned on (dB). The background noise level was 32.6 dB at the time of measurement

Speed	Locations						
	HEPA	Bed 1	Bed 2	Bed 3	Bed 4	Bed 5	Bed 6
Speed 1	57.1	35.3	34.9	36.2	37.2	36.7	35.5
Speed 2	66.7	40.9	40.5	39.5	41.9	41.6	40.1
Speed 3	69.3	46.7	44.6	44.0	46.8	46.5	45.9
Speed 4	73.6	51.0	49.6	48.7	51.7	51.9	49.3
Speed 5	81.3	58.2	56.8	55.6	58.6	58.8	56.8

Fig. 1 A photo of the tested cleaner (left) and the inner structure of the portable air cleaner IQAir (right). Latter diagram from http://www.iqair.com/EU/ENG/products/Cleanroom.htm

LEVELS OF NOISE In decibels (dB)

PAINFUL & DANGEROUS		
Use hearing protection or avoid	140	· Fireworks · Gun shots · Custom car stereos (at full volume)
	130	· Jackhammers · Ambulances
UNCOMFORTABLE		
Dangerous over 30 seconds	120	· Jet planes (during take off)
VERY LOUD		
Dangerous over 30 minutes	110	· Concerts (any genre of music) · Car horns · Sporting events
	100	· Snowmobiles · MP3 players (at full volume)
	90	· Lawnmowers · Power tools · Blenders · Hair dryers
Over 85 dB for extended periods can cause permanent hearing loss.		
LOUD		
	80	· Alarm clocks
	70	· Traffic · Vacuums
MODERATE		
	60	· Normal conversation · Dishwashers
	50	· Moderate rainfall
SOFT		
	40	· Quiet library
	30	· Whisper
FAINT		
	20	· Leaves rustling

https://link.springer.com/content/pdf/10.1007/s12273-010-0005-4.pdf

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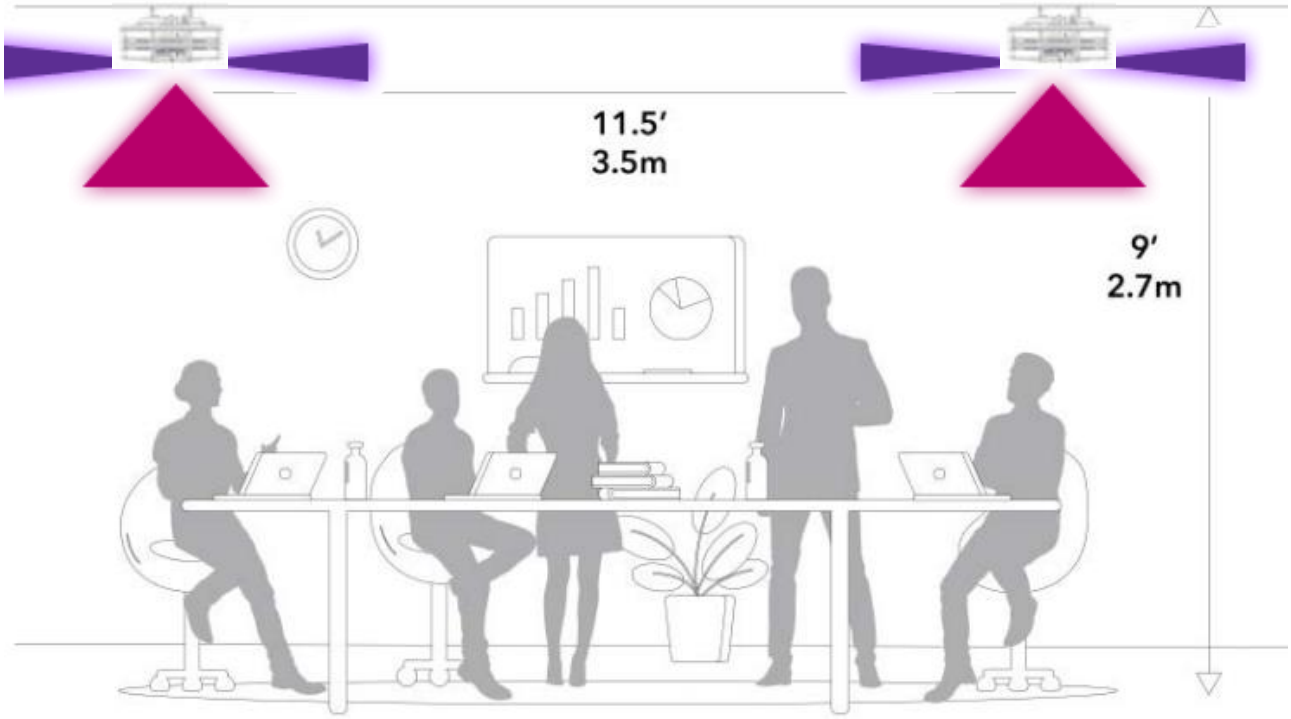
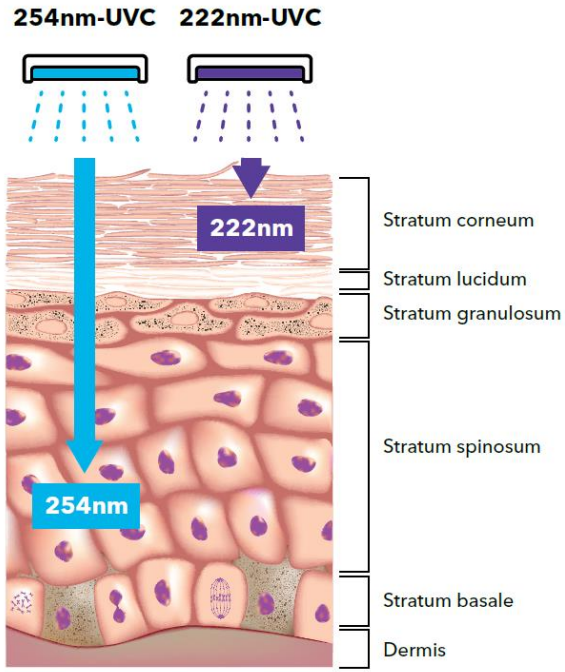
Permanently mounted (fixed install) UVC Systems



Permanently mounted (fixed install)

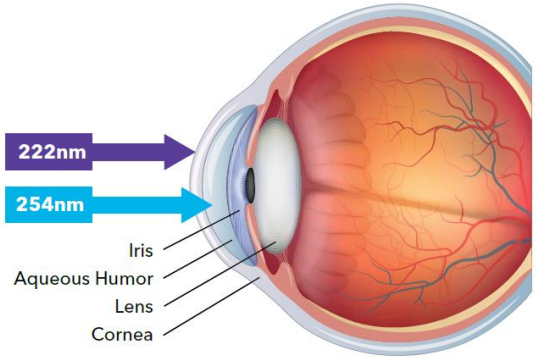
Structure of the epidermis

Penetration of epidermis of 254nm vs 222nm



Anatomy of the eye

DNA absorbance relative to wavelength



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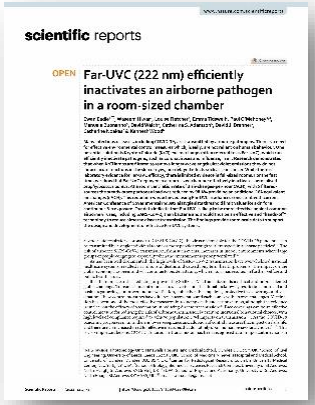
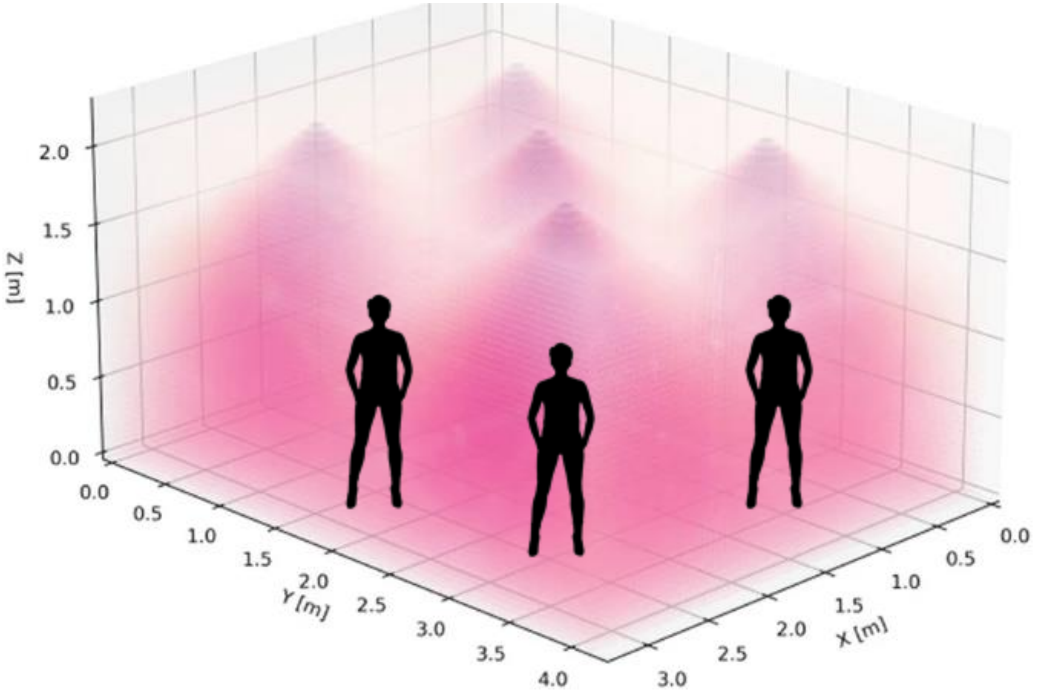
Permanently mounted (fixed install)





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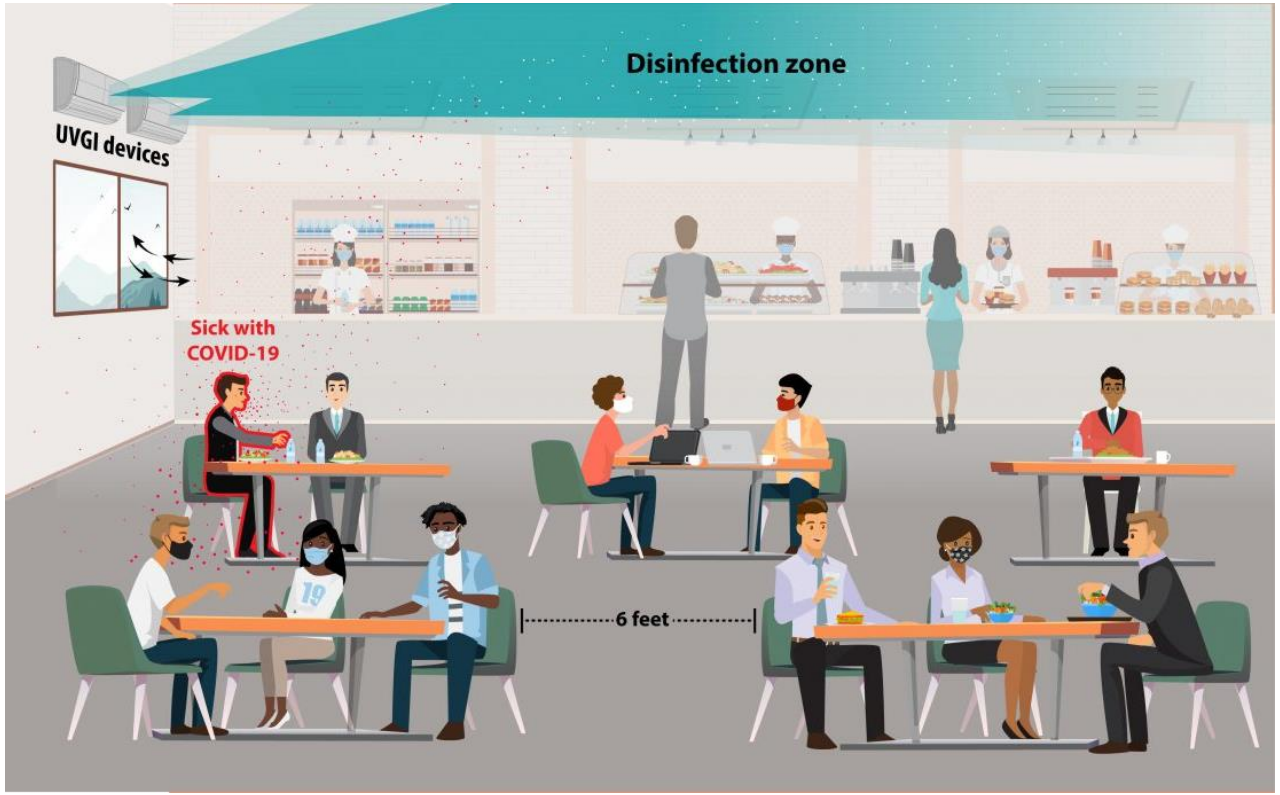
Permanently mounted (fixed install)



Source: CDC

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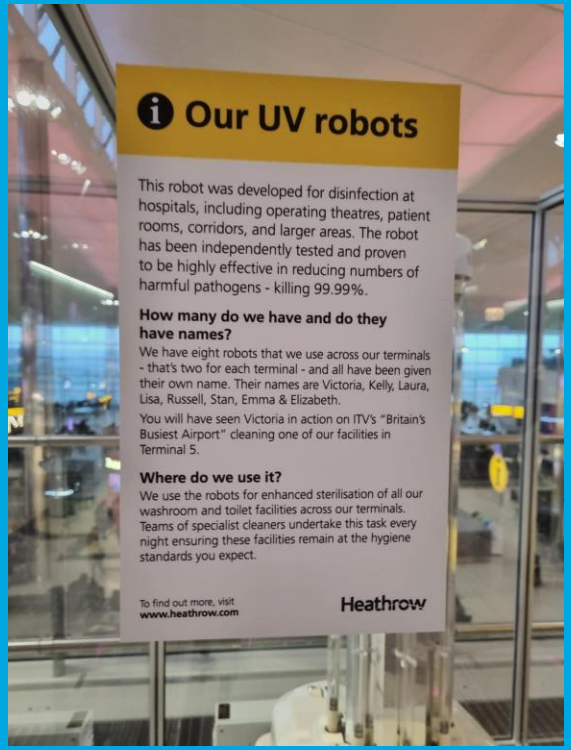

Heathrow Terminal 2 – disinfection robots

Permanently mounted (fixed install)

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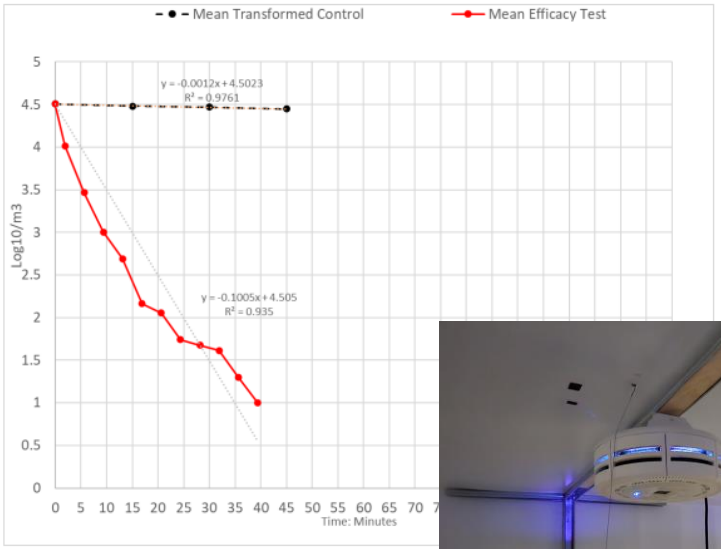
SMART BUILDINGS ARE CLEAN BUILDINGS

The technology you need right now is UVC disinfection

CounterAct UR10 third-party full room airborne efficacy testing

Figure 3. Decay rate of airborne *S. aureus* in efficacy and control tests



- Effective Air Changes per Hour: **10-12 eACH**
- Test chamber room size: 12x9x8(H) ft = 25m^3 volume
- Pathogen: Staphylococcus aureus (ATC #6538)
- Testing included soiling (simulating respiratory droplets/real-world conditions): Per ASTM E2197

In summary

- Target minimum 10+ ACH or eACH
- Fresh air is best
- Fixed install UVC disinfection great for retrofit environments

Thank you

ChristieDigital.com/UV

ISE booth: 3K600

*All references to “disinfect”, “disinfecting”, and “disinfection” refer generally to the reduction of pathogenic bioburden and are not intended to refer to any specific definition as may be used by any governmental or regulatory authority including the US Food and Drug Administration and the US Environmental Protection Agency. The pathogen-reducing efficacy of Christie CounterAct products and their use in occupied spaces is dependent on many site-specific factors as well as proper installation and operation within specifications and in accordance with the American Conference of Governmental Institutional Hygienists (ACGIH) guidelines. Ushio’s Care222® filtered Far UV-C technology (“Care222 Technology”) is protected under US and non-U.S. patents covering apparatuses and methods for inactivating viruses or killing bacteria with combinations of a light source and an optical filter that block potentially harmful UV-C wavelengths. Inventions in these patents are credited to Dr. David Brenner, et al., and assigned to Columbia University. Ushio Inc. is the worldwide exclusive licensee of these patents.

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