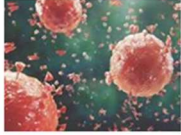


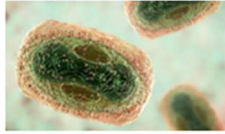
**WHAT EXPERTS AND
AUTHORITATIVE BODIES ARE
NOW SAYING ABOUT THE NEED TO
MAKE INDOOR AIR SAFE
.... AND HOW**

An Information Briefing by

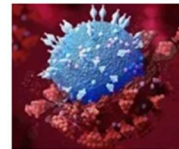
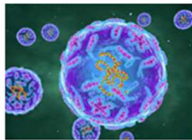




WHY IS OUR INDOOR AIR NOT SAFE



FROM VIRULENT INFECTIOUS PATHOGENS?



THE SHORT ANSWER. IT IS NOT DESIGNED TO BE.

Governments at all levels in North America reference the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 62.1 Standard ***Ventilation and Acceptable Air Quality*** in their local building codes.

However, as ASHRAE noted in their December 5th 2022 submission to the EPA:

“...Public health and building science have not been well connected and the importance of HVAC-based infection controls was not emphasized for far too long...”

“...Existing buildings are generally not resilient with respect to challenges like the COVID pandemic. Design practices today do not require that buildings be able to adapt to severe infectious disease outbreaks (whereas they do for earthquakes and floods)...”

ASHRAE established an Epidemic Task Force (ETF) at the beginning of the COVID-19 pandemic in 2020. It plans to develop a new standard to mitigate risk from respiratory pathogens like influenza and future novel pathogens like SARS-CoV-2. Meanwhile its technical committees such as TC9.7 (Educational Facilities) are coming out with new guidance documents based on the work of the ETF.



THERE IS NOT ENOUGH 'FRESH' OUTDOOR AIR

For most indoor air spaces, ventilation codes require about **3 air changes per hour** of 'fresh' outdoor air to dilute the build-up of indoor air pollutants.

(The actual formula involves a certain amount of fresh air per person plus a certain amount per square foot of space ... but it works out to be about this.)

In earlier times, before the awareness of the need to reduce buildings' energy use, this number was much higher ...about twice as high.

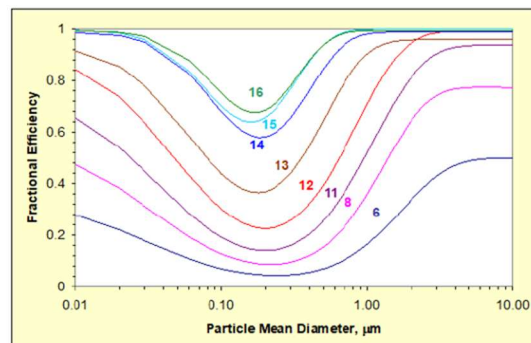
Note that 'fresh' outdoor air is not necessarily clean air and air filters may be needed on both outdoor air supplies and recirculated air.

But generally, the source of infectious airborne pathogens will be indoors, not outdoors.



AND FILTERS USED ON RECIRCULATED AIR ARE NOT EFFICIENT ENOUGH FOR SUB-MICRON PARTICLES

Filters used in buildings' heating, ventilating and air condition (HVAC) systems have a *Minimum Efficiency Reporting Value* (MERV) rating showing the filter's ability to capture particles between 0.3 and 10 microns (μm)



Source: ASHRAE

Before the COVID-19 pandemic a common MERV rating used in buildings was MERV-8. As a pandemic measure, some buildings upgraded their systems to use MERV-13 or MERV-14 filters. But these are still relatively inefficient for sub-micron particles of 0.3 microns or less.



IT IS MOSTLY SUB-MICRON PARTICLES THAT CAUSE THE SPREAD OF VIRAL INFECTIOUS DISEASES¹

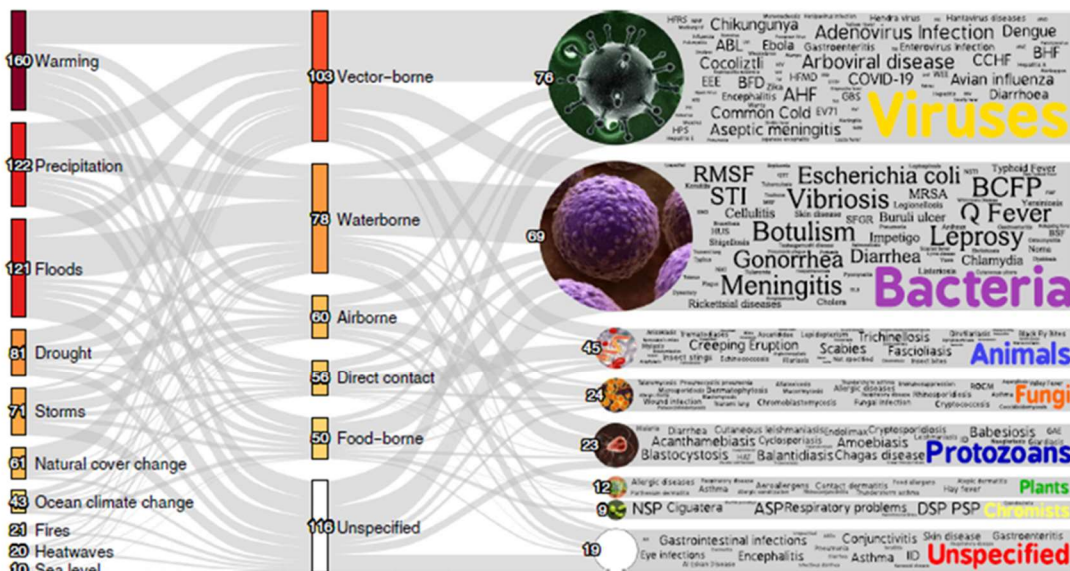


¹ Source: <https://www.visualcapitalist.com/visualizing-relative-size-of-particles/>



THE SITUATION CAN BE EXPECTED TO GET WORSE

“Over half of known human pathogenic diseases can be aggravated by climate change¹.”



¹ Source: Nature Climate Change, August 2022, <https://www.nature.com/articles/s41558-022-01426-1>



SOLVING THE PROBLEM ...

1. THINK BEYOND VACCINES

Experts working on this persistent global threat to public health are calling for a **vaccines-plus** approach that employs a range of public health and financial support measures to complement vaccination.

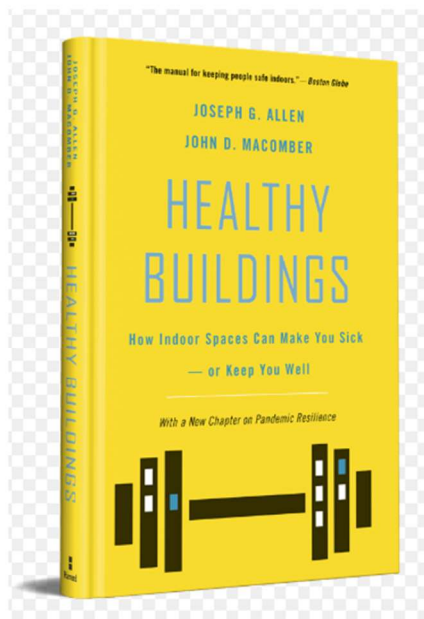
Under the Prevention class of measures they recommend that governments should regulate and incentivise the development and deployment of structural prevention measures (e.g. ventilation, air filtration) to mitigate airborne transmission, with an early emphasis on high-risk settings.¹

¹ Source: Nature, November 2022, <https://www.nature.com/articles/s41586-022-05398-2>



SOLVING THE PROBLEM ...

2. BUILDINGS AS THE FIRST LINE OF DEFENSE



Healthy Buildings experts stress the importance of understanding how buildings (in which we spend 90% of our time) can make us sick.

The new chapter on pandemic resilience in the latest edition of this best selling book is titled **Buildings as a First Line of Defense against Covid and Other Airborne Infectious Diseases.**

Why the “first line”? Vaccines (when available and used) protect people who are exposed.

Structural prevention measures can lower the chances of exposure in the first place.



WE NEED TO EFFECTIVELY DOUBLE VENTILATION RATES

In November 2022 the Lancet COVID-19 Commission Task Force on Safe Work, Safe School, and Safe Travel set out **Proposed Non-infectious Air Delivery Rates (NADR) for Reducing Exposure to Airborne Respiratory Infectious Diseases.**

	Volumetric flow rate per volume	Volumetric flow rate per person		Volumetric flow rate per floor area	
	ACHe	cfm/person	L/s/person	cfm/ft ²	L/s/m ²
Good	4	21	10	0.75 + ASHRAE minimum outdoor air ventilation	3.8 + ASHRAE minimum outdoor air ventilation
Better	6	30	14	1.0 + ASHRAE minimum outdoor air ventilation	5.1 + ASHRAE minimum outdoor air ventilation
Best	>6	>30	>14	>1.0 + ASHRAE minimum outdoor air ventilation	>5.1 + ASHRAE minimum outdoor air ventilation

The NADR is the sum of the clean outside air rate plus the rate for recirculated air filtered or treated to be equivalent in effect to clean outside air. This approach is expected in the new ASHRAE standard being developed in 2023 that will now take infection risk into account.



SOLVING THE PROBLEM ...

3. HIGH EFFICIENCY TECHNOLOGIES TO CLEAN AIR



The latest guidance out from authoritative bodies such as ASHRAE and the Ontario Society of Professional Engineers recommend the use of in-room **HEPA and UV-C technologies** to supplement the ventilation and air cleaning provided by buildings' HVAC systems.

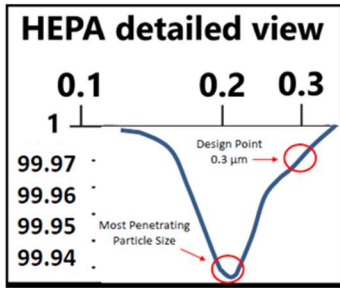


The key to lowering the exposure of people to indoor risks is having much higher air exchange rates of clean outside air (or cleaned indoor air).

It is possible to double (or more) the effective clean outside air exchange rate without having the energy penalty of needing to heat or cool additional outside air... and outside air might not be that clean in the first place.



WHY HEPA FILTERS?



Source: ASHRAE

HEPA class:	H-12	H-13	H-14
MPPS removal efficiency	99.5%	99.95%	99.995%

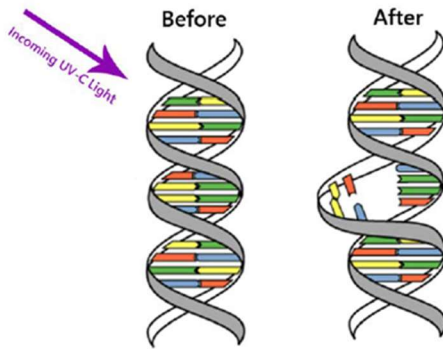
HEPA filters provide very high efficiency in the particle size range that matters for viruses... at least **99.97% at 0.3 microns**. The most penetrating particle size (MPPS) is smaller, so the efficiencies will be a bit less. Different classes of HEPA filter are rated for efficiency at their MPPS.

It is usually not feasible to retrofit existing HVAC systems with HEPA filters due to high pressure drops and the likelihood that systems will need new filter racks to allow sufficient sealing to prevent filter bypass.

HEPA filter units can be added as in-room ceiling mount, wall mount or portable air cleaners



WHY UV-C DISINFECTION?



Non-chemical **Germicidal UV-C Irradiation** technology has been proven over many decades to kill and inactivate microscopic pathogens such as viruses and bacteria.

Applied with the proper dose, UV-C acts rapidly to damage the DNA of such pathogens to render them unable to replicate, leaving the cells inactive.

Enclosed UV-C units can be added as in-room ceiling mount, wall mount or portable air cleaners. It is common for these to also include HEPA filters.

Upper air UVGI units are ceiling mount or high wall mount units that emit UV-C into the room above the occupied space to treat air without risk to the occupants.



An upper air UVGI model



START WITH THE MOST AT RISK



The COVID-19 pandemic in 2021 and 2021 and then the “tridemic” of SARS-CoV-2, Influenza and RSV in the fall and winter of 2022 have pointed out who are the **most at risk**:

children in daycares, pre-schools and K-12 schools and **seniors** in long term care homes.

These are also hubs of our community, so infectious outbreaks happening here spread out and have serious and costly effects across all society.

It seems obvious that this is where our first priority efforts should start. The economic case is clear.



GOVERNMENTS ARE BEGINNING TO TAKE NOTICE

A recent article in Nature covers some of the same terrain as this presentation and provides examples of actions being taken by governments worldwide¹.

Indoor air is full of flu and COVID viruses. Will countries clean it up?

The current pandemic has focused attention to the importance of healthy indoor air and could spur lasting improvements to the air we breathe.

This article is very informative and a highly recommended read.

¹ Source: Diseases in the Room, Nature, March 2023, <https://www.nature.com/articles/d41586-023-00642-9>

