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Hospital-grade air purification made portable

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– INDOOR AIR QUALITY - THE REALITIES

People spend more than 90% of their time indoors

Indoor air quality can be 2 to 5 x worse than outdoor quality

Indoor air pollution is ranked as one of the top 5 environmental risks to public health

50% of illnesses are caused by aggravated indoor air pollution

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Source: US Environmental Protection Agency

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GOAL 3: Good Health and Well-Being

Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

Indicator 3.9.1: *Mortality rate attributed to household and ambient air pollution.*

GOAL 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

Indicator 11.6.2: *Annual mean levels of particulate matter* (i.e. PM2.5 and PM10) in cities (population weighted).

Science AAAS

"We expect to have *clean water* from the taps.

We expect to have *clean and safe food* when we buy it in the supermarket.

In the same way, we should expect *clean air* in our buildings and any shared spaces."

– INDOOR AIR QUALITY: PRESS

The Economist

Indoor-air quality has attracted little government attention. But achieving clean, pathogen-free air in buildings and indoor public spaces is possible

THE WALL STREET JOURNAL

How Covid could help us breathe easier at the office

WIRED

The pandemic taught us the benefits of ventilation. But keeping our indoor air clean has plenty of other benefits.

theguardian

Is it time to protect air quality indoors?

THE TIMES

In the office or dining out - how clean is the air we breathe?

FT FINANCIAL TIMES

The battle against indoor air pollution - The air in our buildings can be as harmful as the air outside

TIME

Covid-19 is transmitted through aerosols. We have enough evidence, now it is time to act

The New York Times

How bad indoor air quality can affect your brain

Science AAAS

Researchers call for a paradigm shift to combat indoor respiratory infection.

- INDOOR AIR QUALITY - THE PROBLEM CAN BE DIVIDED INTO TWO CATEGORIES

1 PARTICULATE MATTER (PM2.5) AND AIRBORNE PATHOGENS (organisms that cause disease)

Examples: Diesel, Petrol, Smoke, Dust, Dirt, Covid-19, common flu, cold, mould, pollen

Cause: Car pollution, forest fires, cooking and catering, poor building materials, infected individuals exhaling aerosols containing pathogens

Risk factors: External ambient air, shared spaces, high occupancy, poor ventilation

Mitigation: Air purification or fresh air dilution

2 DANGEROUS GASES

Examples: CO2, Carbon Monoxide and some VOCs

Cause: Car pollution, cooking, poor building materials, aerosols, and cleansers/disinfectants

Risk factors: Poor outdoor air quality and insufficient ventilation

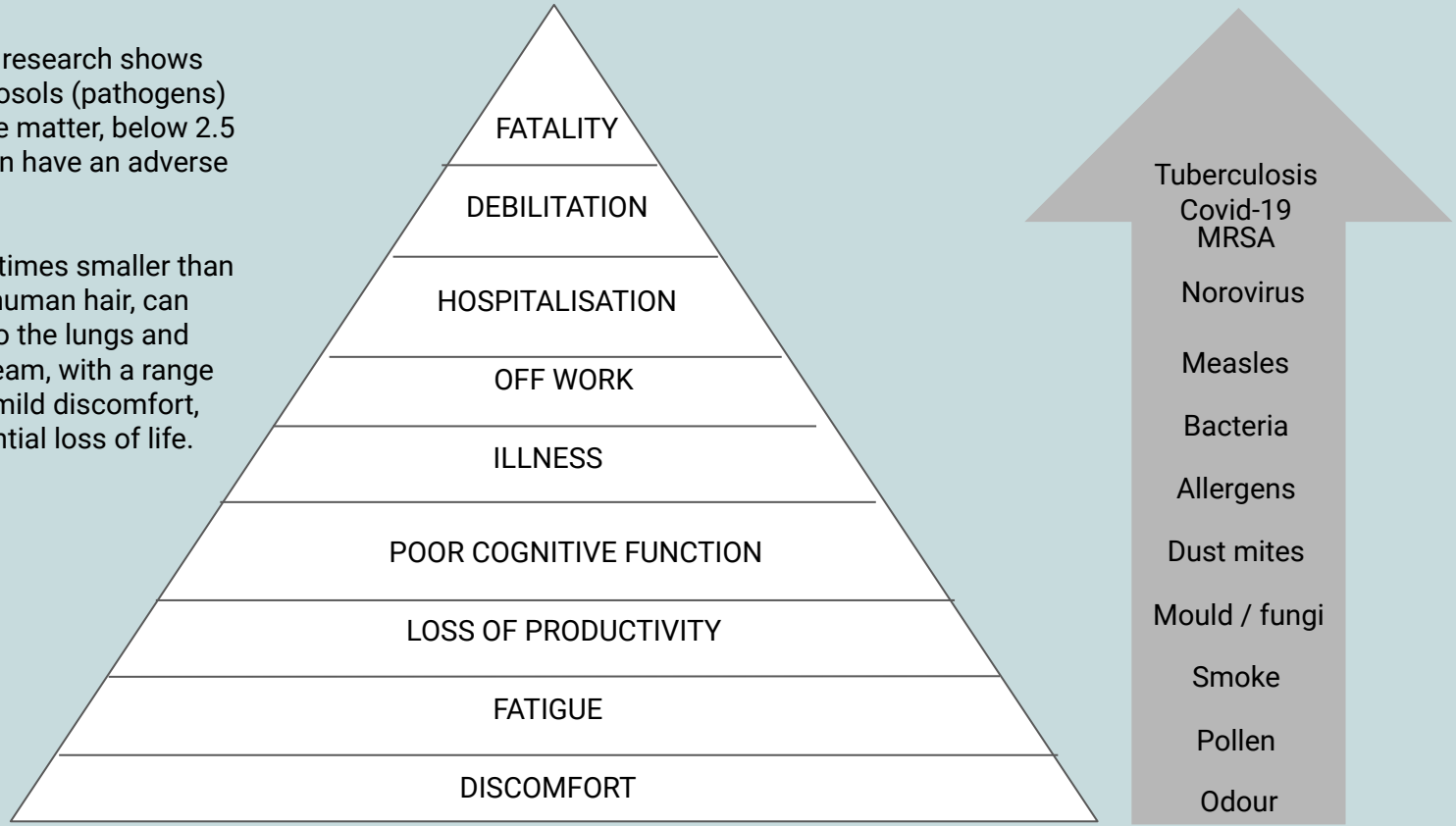
Mitigation: VOCs are highly regulated. Fresh air ventilation improves oxygen levels.

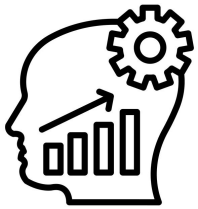
High quality air purification devices address both PM2.5 and airborne disease transmission

–POTENTIAL IMPACT OF FINE PARTICULATE MATTER (PM2.5) INCLUDING PATHOGENS

A growing body of research shows that infectious aerosols (pathogens) and fine particulate matter, below 2.5 microns in size, can have an adverse effect on health.

Such particles, 30 times smaller than the diameter of a human hair, can penetrate deep into the lungs and enter the bloodstream, with a range of impacts - from mild discomfort, escalating to potential loss of life.





Clean air enhances cognitive function, retention and productivity

By sustaining 20% lower air pollution levels in the classroom, the development of a child's working memory can improve by 6%.

Philips Foundation and the University of Manchester

After cleaning the indoor air, employers have seen workplace productivity increase by up to 11%.

World Green Building Council

A study showed that, with better air quality, cognitive scores were 61% higher across nine functional domains, including crisis response, strategy, and focused activity level.

Harvard Center for Health and the Global Environment

– VENTILATION AS A MEANS TO IMPROVE INDOOR AIR QUALITY

Ventilation is the provision of fresh air to and extraction of stale air from an indoor space, to

- provide ***oxygen*** for metabolism;
- ***dilute pollutants***, like carbon dioxide, *fine particulate matter* PM2.5 and odours and;
- ***reduce the density of pathogens*** that cause airborne transmitted diseases (viruses and bacteria).

There are two types of intentional ventilation, Natural (windows and doors) and Mechanical (HVAC systems). Ventilation benefits include Comfort and Efficiency as well as better Health and Wellbeing

Pre Covid pandemic, building regulations across the world recommended between 3 and 10 litres of ventilation per person per second in modern building construction. Many older buildings, including schools, have very poor or no ventilation whatsoever. As a result of the Covid pandemic, the WHO and health and safety authorities globally have increased ventilation recommendations to **10 litres per person per second**, and where that is not possible, make up the difference with air purification devices that use HEPA filters.

Increasing outdoor ventilation is not always straightforward

- “Fresh Air” is not always clean, and introducing polluted outside air can bring very negative health effects
- Mechanical ventilation requires expensive capital outlays
- There are large associated energy costs associated with conditioning outdoor air to comfortable indoor temperatures.
- In older buildings, it is simply not possible to increase ventilation

Appropriate ventilation that meets new guidelines conflicts with government policy to reduce carbon footprints of buildings.

– IMPROVE INDOOR AIR QUALITY : AIR PURIFICATION TO BRIDGE THE VENTILATION GAP

Mechanical ventilation is not always feasible and can be very expensive to install. Ventilation results in high energy consumption to condition outside air, increasing carbon footprints.

Air purification can be a substitute to ventilation as it removes pollutants (e.g. fine particulate matters) and pathogens (e.g. viruses and bacteria) from the air. Cleaning through air purification, using well engineered and independently tested machines, is an efficient and relatively inexpensive way to make up for the lack of ventilation introducing outdoor air.

The EPA [1] shows that: **TOTAL VENTILATION = Intake of OUTSIDE air + purification of INSIDE air with HEPA filtration**

If fresh air ventilation is uneconomic or unfeasible, air purification is a good substitute, as recommended by WHO[2], US CDC[3] and UK SAGE[4]. Furthermore energy consumption will be lower and carbon footprint smaller:

CDC: “these systems reduce the concentration of airborne particles, including SARS-CoV-2 particles without the need for conditioning outdoor air”
SAGE: “These devices, based on HEPA filtration and UVC, are recommended for settings where the ventilation is poor. Such devices should be evidenced by relevant test data”.

IAQ Solutions

PORTABLE AIR PURIFIER

- ✓ Removes pollutants and pathogens
- ✓ Easy installation
- ✓ Flexible and modular use
- ✓ Cost efficient
- ✗ No improvement in oxygen levels

VS

INSTALL/UPGRADE CENTRAL HVAC SYSTEM

- ✓ Improved oxygen and VOC composition
- ✓ Removes and dilutes pollutants and pathogens
- ✗ High capital cost
- ✗ Disruptive installation & high maintenance
- ✗ Only one central point of purification
- ✗ High energy consumption and large carbon footprint

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1. US Environmental Protection Agency
2. WHO
3. US CDC.
4. UK Gov SAGE

– RENSAIR - A CLEAN AIR SOLUTION

HOSPITAL-GRADE TECHNOLOGY

HEPA 13 filter and ozone free light

TESTED BY INDEPENDENT LABORATORIES

Documented effectiveness

PATENTED SOLUTION

Unique system delivers industry-leading effectiveness

EASY TO USE

No installation required, simply plug it in

LARGE CLEANING CAPACITY

Cleans 560m^3/hour (20,00ft^3/hour)

LOW & SAFE MAINTENANCE

9,000 hour (~1 year) continuous run time

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– APPLICATION SCOPE

Rensair air purifiers remove a minimum of 99.97% of fine particulate matter from the air, from from allergens to z-genomes.

RNA & DNA VIRUSES

Throughout Nature

BACTERIAL SPORES

Spoiled Foods, Kitchens

POLLEN

Windows, Doors, Carpets

MOULD SPORES

Moist Places, Bathrooms

FUNGI

Ceiling Tiles, Faulty HVAC

VEHICLE PARTICULATES

Diesel and Petrol Emissions

DUST MITE ALLERGENS

Furniture, Carpets

PET DANDER

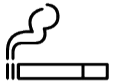
Pets, Floors, Carpets

STAPHYLOCOCCUS

Food Production, Skin

ODOURS

Burnt Food, Garbage Cleaning



TOBACCO SMOKE

Cigarettes, Cigars, Pipes

HOUSEHOLD DUST

Skin, Hair, Soil, Plastic, Clothing

A collaborative approach

Rensair works with clients to develop excellent air quality environments that meet building regulations, as well as government recommendations to mitigate the risks of Covid airborne transmission.

Air quality solutions utilise Rensair's portable hospital-grade air purifiers, which are simple to install and "plug and play".

In determining a solution for a client, Rensair takes into account a location's existing ventilation, occupancy, size and use of different spaces. We provide air purification calculations and advice on where to place units.

Clients receive key information about air quality, airborne disease transmission risks and full training on Rensair technology.

– GENERATING AN AIR PURIFICATION SOLUTION: INPUTS

4 Risk Factors affecting Covid-19 airborne transmission risks

Concentration of particles, and thus Covid19 transmission risk, is a function of

- *Occupancy* of a room
- The *volume* of air in a room per person
- Current *ventilation* rate in the room
- *Activities* carried out in the room (top Log chart shows particle emissions from different activities)

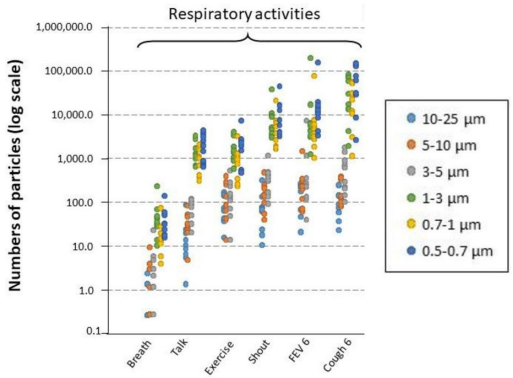
Note how particle concentration increases substantially in poorly ventilated, densely occupied spaces, even if attended by a relatively small number of occupants (blue line in Office chart), rather than in large open spaces, even if the latter has a large number of people (Sports Hall chart).

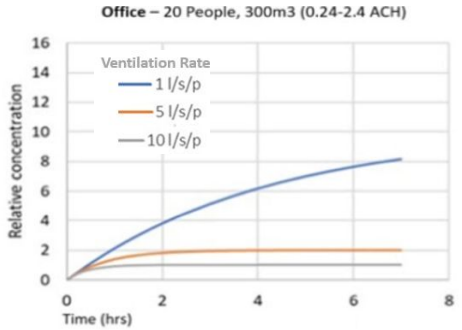
Air Quality Requirements

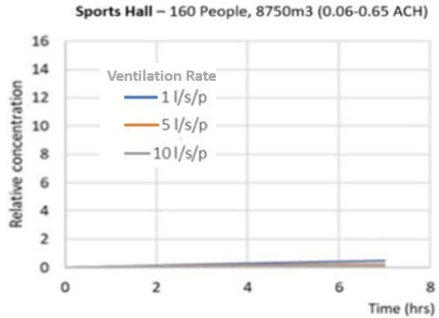
Define a good air quality standard to reduce PM2.5 and mitigate Covid-19 airborne transmission.
Target WHO recommendation of 10 litres / second / person (lsp)
There is a significant reduction in particle concentration even with 5 l/s/p (Orange line in Office chart)

Calculate an Air Strategy

Align the Air Quality Requirements with the 4 Transmission Risk Factors.
Calculate the recommended Ventilation rate, and if insufficient, determine the Air Purification requirement.
Provide a table showing the Ventilation and Purification requirements in m3 and Air Changes per Hour and the Solution provided by Rensair units.







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– APPENDIX A: HEPA FILTER AND UVC LIGHT TECHNOLOGY

HEPA Filter

HEPA filters are most efficient - almost 100% at 0.01 micron - at capturing ultrafine particles below the 0.3-micron HEPA test standard (NASA)

A High-Efficiency Particulate Air (HEPA) Filter is composed of a mat of randomly arranged fibres, with diameters between 0.5 and 2.0 microns (μm)

Must satisfy certain levels of filtration efficiency.

Common standards require that a HEPA H13 air filter must remove (from the air that passes through it) at least 99.95% of particles whose diameter are equal to 0.3 micron.

Filtration efficiency increase for particle diameters both less than and greater than 0.3 microns.

HEPA captures pollen, dirt, dust, moisture, bacteria (0.2-2.0 micron), virus (0.02-0.3 micron), and submicron liquid aerosol (0.02-0.5 microns).

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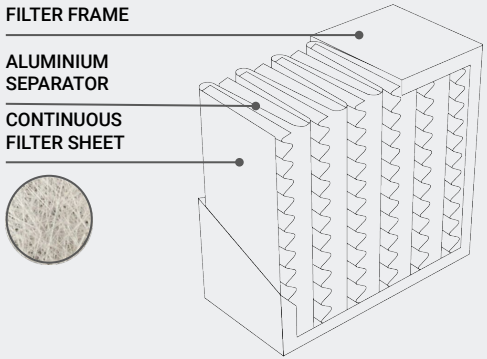


UVC

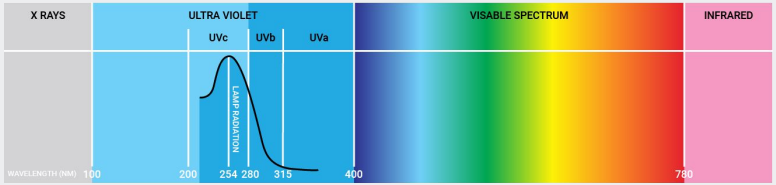
UV-C light is effective for killing COVID-19 on N95s (Henry Ford Health System).

UV is divided into three types with reducing wavelengths and increasing energy. They are UVA, UVB and UVC. For UV sterilization, only UVC (200-280nm) has high enough energy to effectively kill microorganisms. Germicidal UVC is UVC at 254nm.

Short- wavelength ultraviolet (or UVC) light is used to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA.

This leaves microorganisms unable to perform vital cellular functions.

UVC is used in a variety of applications, such as food, air, and water purification.



NASA

Henry Ford Health System

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GLOSSARY

Aerosol
A suspension of fine solid or liquid particles in air. An aerosol particle has a diameter typically less than 1 Micron.

Air Changes per Hour (ACH)
The amount of air that is purified in a room relative to the room's total volume. For example, if 3 ACH are achieved by a Rensair unit in a room which has a volume of 100m^3, then the Rensair unit will be purifying 300m^3 volume of air in 1 hour.

Fomite
Objects, materials or surfaces which are likely to carry infection, such as clothes, utensils, and furniture.

HEPA Filter
High-Efficiency Particulate Air Filter that must satisfy certain levels of filtration efficiency. Common standards require that a HEPA air filter must remove (from the air that passes through it) at least 99.95% of particles whose diameter are equal to 0.3 µm, with the filtration efficiency increasing for particle diameters both less than and greater than 0.3 µm. HEPA captures pollen, dirt, dust, moisture, bacteria (0.2-2.0 micron), virus (0.02-0.3 micron), and submicron liquid aerosol (0.02-0.5 µm).

HSE
The Health and Safety Executive is a UK government agency responsible for the encouragement, regulation and enforcement of workplace health, safety and welfare, and for research into occupational risks in Great Britain.

Micron (symbol: µm)
One thousandth of a millimetre (0.001 mm)

UVC
Short- wavelength ultraviolet (or UVC) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. UVC is used in a variety of applications, such as food, air, and water purification.

Adequate Ventilation
The WHO, SAGE committee and UK Building regulations recommend 10 litres per second per person is provided in a room (equivalent to 36m^3/person/hour).

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