Are Our Buildings making us sick?

All you need to know about the air in our work places

WEBINAR WHITEPAPER
FEBRUARY 2022

Keynote speakers

Professor Jason Monty
- Melbourne University

Associate professor Donna Green
- University of New South Wales

Distinguished Professor Lidia Morawska
- Queensland University of Technology

westlab santé NEXT-GENERATION SOURCING

Being the subject of a current paradigm shift, air quality is currently a key topic. Westlab and Santé Group hosted a webinar covering knowledge and insights from key specialists in facilities management and consultancy for Workplace Hygiene, Fluid Dynamics and tips on how to effectively manage air in a workplace environment.

Presented by 3 of the world's leading professors, passionate about keeping our air healthy.

Professor Jason Monty

One of the most influential characters of the Australian coronavirus narrative, and indeed globally influential. Jason has conducted studies alongside the Victorian Department of Health which led to ground-breaking discoveries that coronavirus is airborne, hence the highly enhanced risk of transmission in our workplaces.

Associate Professor Donna Green

A founding member of the Climate Change Research Centre, UNSW and is an Associate Investigator of the ARC Centre of Excellence for Climate Extremes. She leads a national researcher network, the Climate Health Network and a novel indoor air quality project. Donna was a contributing author in the UN World Energy Assessment and for the IPCC's Fourth and Fifth Assessment Reports. Her teaching focuses on linking energy policy, climate change and environmental impacts in Australia and internationally.

Distinguished Professor Lidia Morawska

A Polish-Australian physicist and distinguished Professor in the School of Earth and Atmospheric Sciences at the Queensland University of Technology in Brisbane, and a co-director for the Australia – China Centre for Air Quality Science and Management (ACC-AQSM). She is recognised as one of the world's foremost authorities on airborne particulate matter in the context of atmospheric pollution and its sources, as well as its impact upon human health and the environment.

MC

David Henderson
David has extensive experience in the healthcare industry, and heads up Santé global research team - collecting and collating best practise global trends & insights.

Q&A

Ted Fowler
Director Ted Fowler has worked closely with healthcare, corporate and education sectors to implement HEPA filtration for shared spaces. Ted will explore products available to keep air quality in the workplace healthy. Ted's extensive background in laboratory and scientific spaces has led to an in-depth knowledge in air movement and extraction, and the importance of clean air to maintain a healthy environment.

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Are our workplaces making us sick?

Wellness is one of the most important aspects to manage in workplaces and commercial buildings, and that the care of staff, ensuring safety, productivity and focus is maintained. Now with the present risk of a pandemic, we have been given the ultimate wellness challenge, which is to learn from key specialists in facilities management and consultancy for Workplace Hygiene, Fluid Dynamics on how to manage air quality.

Distinguished Professor
Lidia Morawska

- Distinguished Professor in the School of Earth and Atmospheric Sciences at the Queensland University of Technology.
- Co-director for the Australia – China Centre for Air Quality Science and Management (ACC-AQSM).
- Recognised as one of the Time magazine's Top 100 most influential people in the world as a result of her work around COVID-19 and airborne transmissibility.

Indoor air quality - A bigger picture

Distinguished Professor Lidia Morawska

Distinguished Professor Lidia Morawska discusses natural ventilation, mechanical ventilation and indoor air quality standards relating to home, schools, restaurants, shops and other social venues. Lidia was recognised as one of the Time magazine's Top 100 most influential people in the world as a result of her work around COVID-19 and airborne transmissibility. When circumstances permit i.e. when it is not too cold, not too hot or not too noisy; the usual advice is to open the window to improve air quality. In reality windows often remain closed for those very reasons, and there's no ventilation at all - which undermines the basic value of natural ventilation for better health.

Natural Ventilation

The actual reality of natural ventilation is that it often means no ventilation, or very minimal ventilation despite air being mechanically uploaded into enclosed spaces. Here air quality is compromised as there is inevitably leakage throughout any building envelope, so when ventilation is at a minimum, the question remains; how to improve indoor air quality without ventilation or with minimum ventilation when discussing the issue of infection transmission during the pandemic?

How to improve indoor air quality without ventilation

In this situation the accepted advice is to use filter-based air-cleaners, which do operate well if fitted properly and the size of the venue is considered in conjunction with the solution. Research papers have shown a significant reduction in transmission risk using this method, and it is evident that they are very effective in removing hazardous particles from the air. Benefits of filters in the management of outdoor air pollution, as with the series of bushfires that occurred prior to pandemic, have also proven to be effective. During this period, when overall air quality in some areas was overwhelmingly poor and causing serious issues relating to respiratory health, filter-based air-cleaners are a good option for improving air quality. Despite this recommendation there is genuine concern that the use of hundreds and thousands of HEPA filters used will become electronic waste, particularly after the pandemic.

Indoor gaseous pollutants: are they a problem?

The other issue related to minimal ventilation is the occurrence of gaseous pollutants, which accumulate when there's no natural ventilation. Some papers acknowledge that these pollutants cause problems with concentration and impact cognitive function. Children in classrooms for example, with inadequate ventilation will be affected by pollutants and other organic compounds in the air according to the PPM in each volume of air. In reality, if there's no ventilation at all - air cleaners will not solve the problem.

Mechanically ventilated interiors

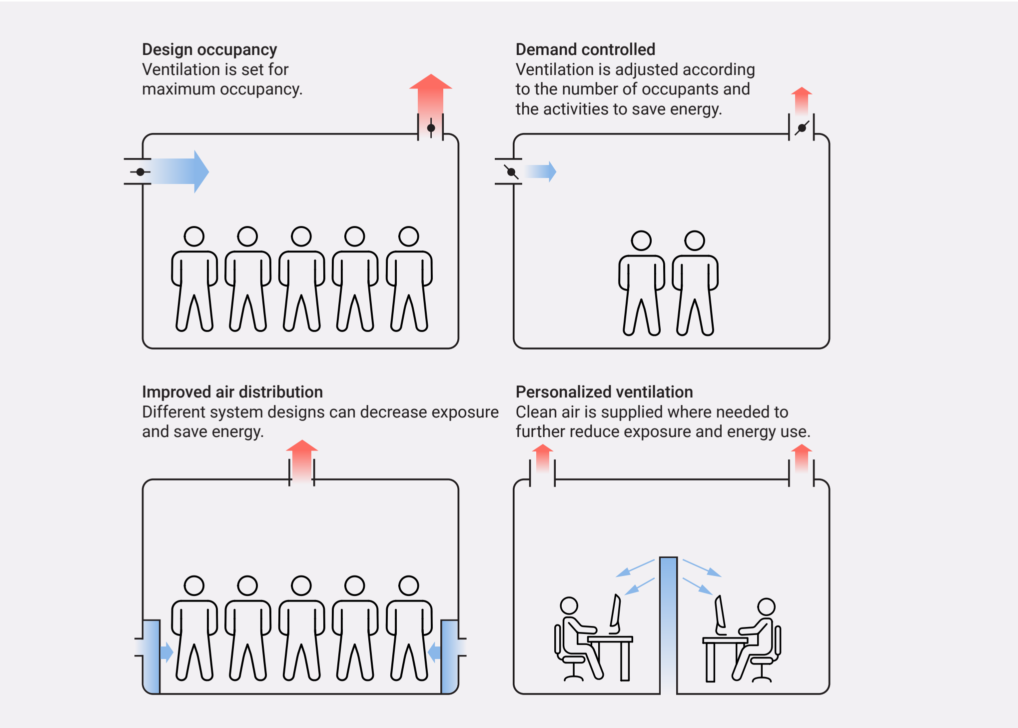
The next topic, mechanical ventilation is the intervention to low ventilation. This is where is enough ventilation to reduce infection risk. HEPA filtration can potentially remove particles that originate indoors or outdoors, and can be filtered out when there is insufficient outdoor air to remove indoor generated gases. When assessing indoor air quality, what is the minimum recommended ventilation rate? It's understood that in documented non-residential settings, the recommendation is 10 litres per-second per-person. This volume varies in differing settings.

How much ventilation is needed for good IAQ?

Whether in an art class or lecture hall, there can be a difference in volumes required. In an art class for example, additional pollutants are generated from paint materials and the recommendation differs. The main European recommendation is 9.5 and 4 litres per second per person independently. The question is, how does a building space assess the number of people inside and what are they doing? Whether they are working or quietly sitting? How do we know what particular level is enough to adequately cover the risk of infection?

The building and us

Further, for which pathogen or which variant? The pandemic so far has presented several variants each subsequently more infectious. From a paper published last year, a schematic diagram showed different ventilation scenarios with designated occupants as the main control. When looking at the main control and the related situation between, the design must meet the demanded control. The design must account for the amount of people who are actually in the room, if it is shown that there are more than the design accommodates, the space is under-ventilated. If the amount is less than the design amount, then valuable energy is wasted. The building cannot assess capacity or usage or the activities the rule was designed for, for example, working on the computer or other activities - even talking creates emissions. Localisation means lots of emissions by humans which means potentially a significantly higher concentration of pathogens. The risk of airborne transmission increases and tests the limits of adequate ventilation.



Ventilation and the risk of airborne transmission

A recently published a paper from the US and Italy looks at a number of different viruses or pathogens, and in particular very highly contagious pathogens including SAR'S, COVID 19 and Delta. This data shows that even high ventilation rates of over 14 litres per-second, per-person was not sufficient ventilation to keep the infection reproduction low; indicating that ventilation by itself will not do the job.

"This data shows that even high ventilation rates of over 14 litres per-second, per-person was not sufficient ventilation to keep the infection reproduction low; indicating that ventilation by itself will not do the job."

“Most infections occur in shared indoor spaces,”

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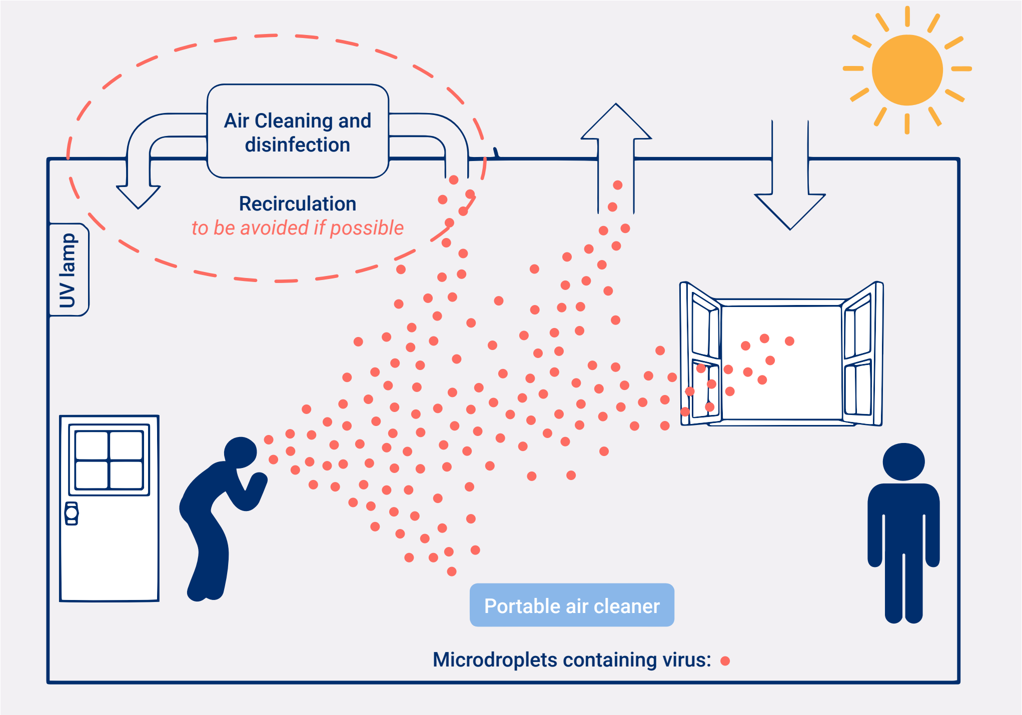
Distinguished Professor
Lidia Morawska

What can we do to control the risk of infection for such pathogens?

Air cleaners do work effectively for infection prevention but there's another solution which is continually under discussion - air disinfection. When utilising air purifiers pollutants are removed which is not disinfection as such, but the removal of particles. Infection of the air is not necessarily additional pollution generated indoors, but transmissible pathogens. To disinfect the air another approach is required, and one acknowledged method which has been used for some time is germicidal ultraviolet disinfection. It's a well-considered solution and an excellent way to decommission dangerous pathogens, and is safe for use around the average individual. Additional, this function has a low energy requirement, does not generate new pollutants, is silent, safer than other types of air disinfectant and indicators show a very low penetration into human tissue.

"In particular, we demonstrate that awareness of IAQ risks and availability of appropriate regulation are lagging behind the technologies."

Minimising airborne transmission of COVID-19 indoors



Clearly there are options for infection prevention in the air, ie. removal of pollutants, applied ventilation to improve air quality and UV methods. The difficulty in applying these measures, does relate to WHO quality guidelines, where values are now much lower than in the previous 2005 edition. The targets for sufficient benchmarks in air quality, indoor and outdoor have become unreachable. The guidelines, which once were related to outdoor air quality now both apply to outdoor and indoor air.

WHO global air quality guidelines

	Average time	2005 AQG level	2021 AQG level
$PM_{2.5}$,	Annual	10	5
μg/m³	24-hour	25	15
PM_{10},	Annual	20	15
μg/m³	24-hour	50	45
O_3,	Peak Season	–	60
μg/m³	8-hour	100	100
NO_2,	Annual	40	10
μg/m³	24-hour	–	25
SO_2,	24-hour	20	40
μg/m³			
CO,	24-hour	–	4
μg/m³			

Management of air quality

In general terms, the actual management of air quality is the standard which develops air quality health guidelines, and for most countries, serve to develop vital outdoor air quality legislation. Australia for example has good outdoor air quality standards, but the reality is that most countries do not have legislated indoor air quality standards. In regard to air quality standards there is only a handful of countries where a principal air quality standard exists. In none of these countries are they enforceable, which indicates that the entire field of indoor air quality is not regulated. In terms of monitoring and reliable data collection, the lack of enforcement undermines the process.

Monitoring – a key element of enforcement

Outdoor air monitoring is certainly current, and monitoring stations are located in every city and in remote areas around the world. But, there are challenges ahead in monitoring indoor environments. For a paper published several years ago, time sensors were installed to measure indoor air monitoring and deployed to urban buildings. The conclusion was that the problems with indoor air quality is the actual level of risk to individuals, and the availability of appropriate regulations which seriously lag behind new technologies.

IAQ Standards

Morawska's group intends to conduct extensive studies on local sensors for application in indoor and outdoor environments. Sensors are good research tools, but are not yet at the point where they could be used in every single venue. What is really needed, especially in light of the pandemic, is quality standards that can measure the concentration levels of selected pollutants. At this stage the idea that it would be possible to monitor all pollutants as is done outdoors is not quite achievable, although, selected pollutants can be measured in every indoor space.

This concludes a very complex, and big picture of indoor air where science, technology, awareness, politics are entangled.

Case Studies

Australia Post

Corporate Commercial Offices

Background	AusPost is the largest domestic postal service in Australia. With thousands of staff in both retail settings and distribution, AusPost required clean air to ensure Australians received timely postal services.
Challenge	Covid-19 was newly recognised as an aerosol-transmissible disease. Aside from healthcare-appropriate masks which are not entirely feasible in a distribution setting, what could be used to protect workers and prevent transmission?
Solution	The Aeris Aair 3-in-1 Pro HEPA purifier is ideal for removing nearly all of the risk of Covid-19 transmission. Westlab worked with global freight providers to airfreight hundreds of units for installation around Australia.
Result	AusPost's dedication to infection control brought a greater level of security and manageability to the HR table meaning they could stay a step ahead of the game with freight.

UNITS

3000

TIMEFRAMES

4-8 weeks

DELIVERY LOCATIONS

4-sites

Catholic Education Diocese of Parramatta

Delivery to multiple locations

Background	In the third quarter of 2021, recommendations came from several bodies for the need for clean air. Studies, e.g., from University of Melbourne, found HEPA air purifiers to be effective at cleaning 99.99% of harmful substances from the air, including Covid-19. The Diocese of Parramatta Catholic Education, following government activity, analysed the market for the best HEPA purifier to suit their needs.
Challenge	An air purifier is not an air purifier, in the sense that there are many different configurations and options with purifiers. The challenge was to find something that covered adequate amounts of floorspace, was immediately available for delivery, and was highly effective and fit for purpose.
Solution	With exclusive agency for the Aeris aair range, Westlab & Santé coordinated tight delivery of several thousand units for the Diocese of Parramatta. Working closely with our network of logistics partners and with the manufacturer, we were able to deliver in full within 4 weeks from order.
Result	Catholic Education Diocese of Parramatta were able to roll out the Aeris products quickly across sites due to the simplicity of setup. Currently, several thousand Aeris aair 3-in-1 Pro units operate in shared spaces to keep them safe and improve classroom wellness and outcomes. Thanks to their versatility and ease of use, nothing has hindered rolling out this program.

UNITS

10,000

TIMEFRAMES

4-6 weeks

DELIVERY LOCATIONS

91 Schools

NSW Education Department

Rapid Air Purification Roll Out

Background	The NSW Department of Education, since the beginning of 2020, has been implementing innovative programs to improve infection control indoors for schools. After recommendations from WHO and other independent bodies, it was proven that proper air filtration will dramatically reduce the risk of infection by removing foreign matter, including viral particles, from the air.
Challenge	With this new recommendation, the need for a purifier became a reality. However, in order to be a successful purchase, requirements such as effective clean air delivery rate (CADR), air changes per hour, filtration efficiency and digital intelligence were important. Firstly in order to manage properly, and secondly to ensure that the unit is effective and fit for purpose, delivering real value.
Solution	Westlab's Aeris product made a perfect fit for the requirements, and more. The Swiss design made it a highly simple yet effective unit which would prove crucial for success. Working through an extensive tender process, the Aeris Aair 3-in-1 Pro filtration unit was chosen for immediate rollout.
Result	Public schools throughout NSW are now successfully using the Aeris units, and now have access to a full suite of digital automation options, enabling smart fleet management. With units completely delivered within 1 week, infection risk has successfully been decreased for schools throughout NSW.

UNITS

5,000

TIMEFRAMES

6 weeks

DELIVERY LOCATIONS

1 Distribution Centre

Reducing airborne SARS-CoV-2 transmission risk indoors

Professor Jason Monty

Professor Jason Monty

- One of the most influential characters of the Australian coronavirus narrative, and indeed globally influential.
- Conducted studies alongside the Victorian Department of Health which led to ground-breaking discoveries that coronavirus is airborne

Professor Jason Monty from the University of Melbourne talks about method of transmission and the modes by which COVID-19 transmits and moves between people. These include aerosol transmission and surface transmission. To focus on aerosol transmission, we know that the virus itself is roughly 100 nanometres in size, or 0.1 Micra. Although small, it is important to note that the virus cannot live independently and to survive must attach to a carrier.

Typically, the virus attaches to human emissions in the form of coughs, sneezes (and touch), as aerosols leave the mouth or nose at an average of one Micron diameter. Viruses can vary in size but significantly, aerosols at that size faithfully follow airflow; therefore, wherever the air goes, particles will follow. This transmission can be seen as a mechanical problem as in fluid dynamics because the air moves mechanically. In a mechanical sense, COVID is transmitted when particle or aerosols move from one person to another. Fluid dynamics can be predicted with a simulator, as they must follow air movement. This can be complicated, as air moves around anything which means COVID transmission can occur in airflow both indoors and outdoors.

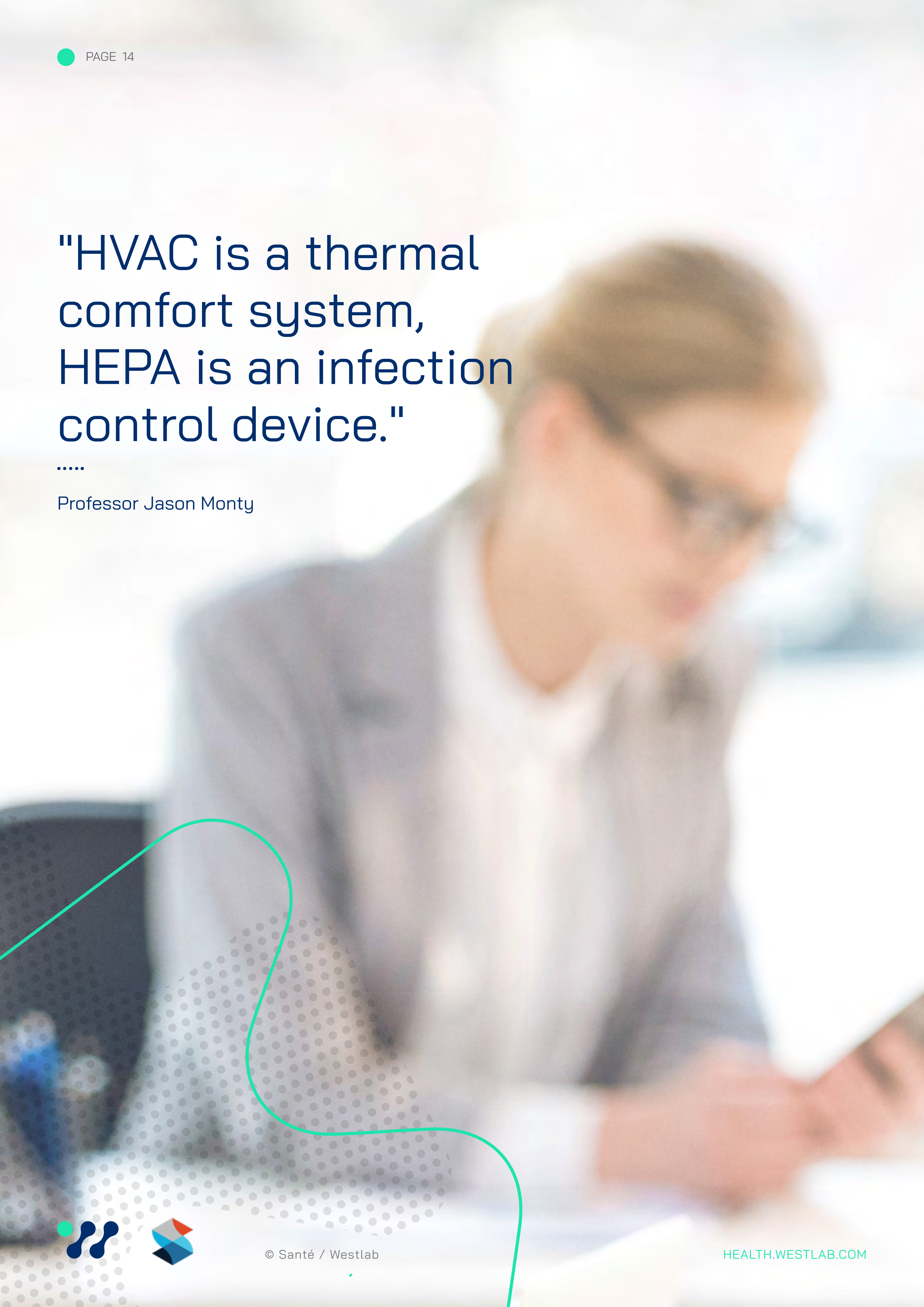
When do we worry about indoor transmission?

Circumstances must be very specific when transmission occurs outdoors, but indoor transmission requires two types of settings when referring to ventilation. Natural ventilation - by opening windows and if the windows are closed, no ventilation. In reference to split system air conditioning, typically heating or cooling, the introduction of fresh air into an enclosed space is almost negligible.

Natural Ventilation	Mechanical Ventilation
Opening windows	Maybe opening windows
Split system air conditioning	Circuit of ventilation ducts in ceiling

While natural ventilation is characterised by opening windows to allow the circulation of fresh air, mechanical ventilation indicates there are no open windows and consequently no fresh air. Mechanical ventilation is problematic in the pandemic era, as ventilation rates generally are quite low, which in the past has been the standard in most spaces that are frequented for work. This situation has occurred for the most part either by poor practice or poor design. Conversely, they can also be designed to facilitate mixed airing, once an exercise in ventilation efficiency; but now a serious a problem as the virus is actually being further distributed by moving contaminated air from one room to another space

Hotel quarantine is a prime example of this event, where air was being moving from one infected person's room to other peoples' rooms, an incidence also evident in hospitals. Mechanical ventilation presents a problem in air circulation when pathogens are present and transmissible. Change may be beneficial, but it's not cost effective and does not necessarily affect infection control. For example improving filtration in the HVAC system, unless it's a very short circuit, may not make much difference to infection control, but have other benefits, like reducing outdoor pollution when air is filtered into a space. In reference to Professor Lidia Morawska's previous assertion, there is no regulation or requirements in place to instigate a real change.



"HVAC is a thermal comfort system, HEPA is an infection control device."

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Professor Jason Monty

Building Ventilation	Vs	In-room Air Cleaning
Moving air through a space		Moving air **within** a space
Increased air flow dilutes aerosol-borne virus in a building		Increased air flow **removes** aerosol-borne from a **room**

How HEPA filtration works

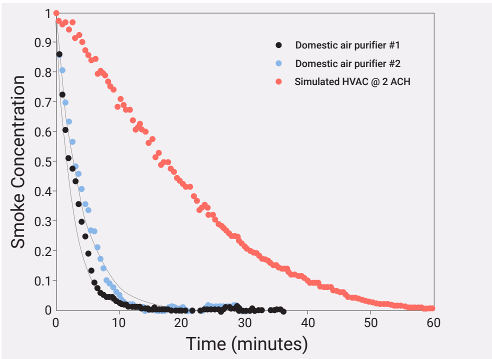
Two points should be considered here; building ventilation when air is moving through a space, which in fact dilutes the air to the point where infection risk is very low. The second point is in-room air cleaning in terms of HEPA filtration, air filtration or source control where air is moved within a space mechanically and the virus is then removed as the air moves.

An example of source control is a hood arrangement that was implemented in the ICU at Western Health Hospital in Footscray. This was a design by Professor Monty's team which is essentially a canopy with a duct and a HEPA filter at the bottom, and proved to be an ultimate source control. These measures proved to be a success and were commercialised for purchase.

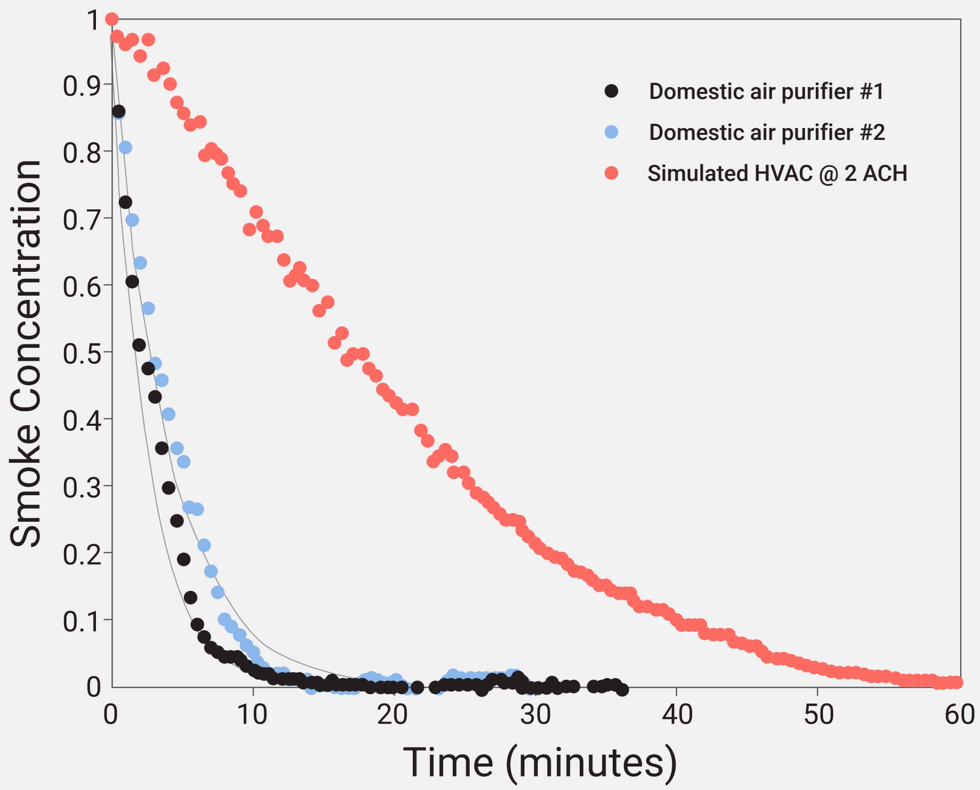
Are HEPA filters effective?

In a laboratory setting, a testing template was generated to examine the effectiveness of air purifiers. Conducted in a sealed room, varying HVAC settings were applied through a ceiling inlet which could also accommodate portable air purifiers. These function by drawing in 'unclean' air, and then emitting clean air. Unclean air is drawn in through a HEPA filter – typically an H13 which filters out 99.95% of particles. Although a simple device, these operate extremely well and are very effective.

The test involved a blackened room filled with smoke, and clearing timed after the air purifiers were switched on, or when the HVAC was used to clear the smoke. As the HVAC was doing its job, smoke particles were pulled out and smoke pollution decreased.



As the smoke decayed it took about sixty minutes for most of the room in the simulated HVAC case to clear. In this case with around two air changes per hour, this time period is typically found in most school environments and office buildings. Domestic air purifiers which operate at about 400 m³ per hour do work, so if you cough, airborne pathogens can dissipate in around ten minutes, but only in that test room. In order to check whether this was the case in the real world, the same test was conducted at the Royal Melbourne Hospital in an in an actual hospital room where the HVAC was much stronger. In that case the smoke was cleared much more quickly.



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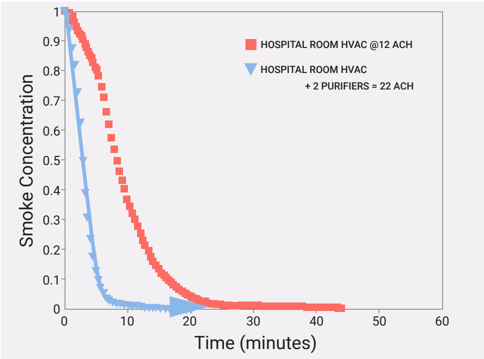


In a single room that doesn't have purifiers, a cough would be completely out of the room within 5 or 6 minutes. This proved that air purifiers are very effective for hospitals, which led to a large take up of the machines. It can be seen they're very effective at removing aerosols, but do they reduce COVID from a room?

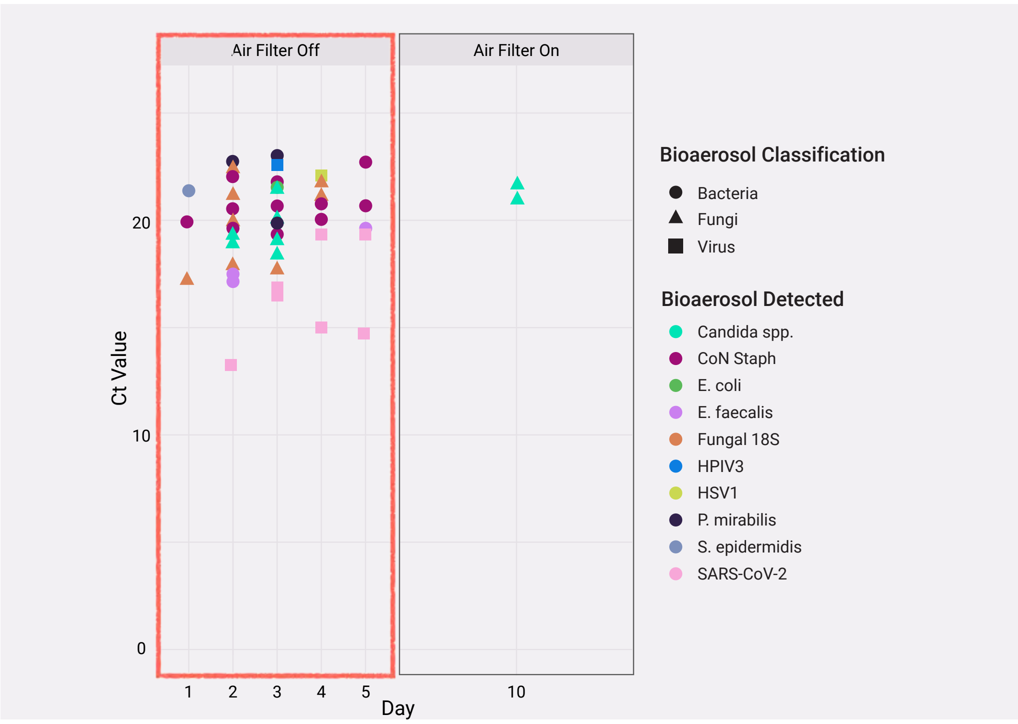
Do HEPA filters remove COVID from the air?

A large HEPA filter was installed in a real hospital room containing patients with COVID, emitting 1500 meters cubed air per hour, and it was shown that before installation that COVID was present in the room, accompanied by other viruses and bacteria.

Before the HEPA filter was turned on, it was evident that these pathogens were sitting in uncirculated air, after the HEPA filter was switched on, everything was almost eliminated excluding a small amount of Candida fungus. The other question is how long do HEPA filters actually last. The manufacturer will usually state that the filter lifespan is 6 to 12 months. To test these once more, a humidifier was placed in a room with a hood. The humidifier was filled with a known amount of aerosol, and then air generated outwardly in five mil doses.

Reducing airborne SARS-CoV-2 transmission risk indoors
Professor Jason Monty
continued

Purifier removing SARS-CoV-2 from a room

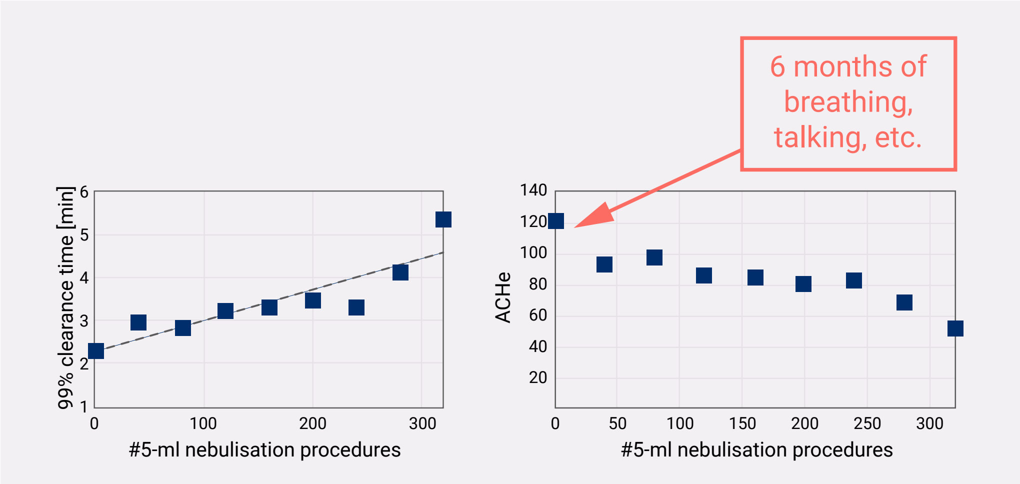


Reducing airborne SARS-CoV-2 transmission risk indoors
Professor Jason Monty
continued

How long do HEPA filters last?

Over time, with volume, it was shown that a filter can support around six months of daily nebulisation. According to clinical partners this is heavy use which correlates to about six months of breathing and talking. This is a conservative estimate and higher durations could probably be recommended. In the 300 nebulisation procedures observed in the hospital, clearance time showed that the same filter was being used and that air exchanges per hour dropped.

A similar test was conducted a real classroom in Victorian independent schools, with an aerosol concentration using smoke. In a naturally ventilated real classroom with the windows closed it took almost two hours to clear. If anyone had coughed, it would also take 2 hours to clear. When windows and doors are opened, the time taken to clear is reduced. If two air purifiers are placed in that particular classroom, the time to clear is around 20 minutes. This shows that windows work, but not well unless properly controlled, and poorly in winter when users close them.



The take away here is that air needs to be cleaned and not just ventilated.

Accelerated longer-term solutions to this problem need to happen in the future, and industrial solutions still need to be applied without having to rely on portable air purifiers which is unsustainable over long periods of time. Fluid dynamics experts should be consulted to show how air actually moves around, and to contribute to establishment of air regulation standards, in industry, schools, hospitals and office work spaces.

Associate Professor
Donna Green:

- A founding member of the Climate Change Research Centre, UNSW.
- Associate Investigator of the ARC Centre of Excellence for Climate Extremes.
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- Contributing author in the UN World Energy Assessment and for the IPCC's Fourth and Fifth Assessment Reports.

Looking to systemic change for air quality

Associate Professor Donna Green

Associate Professor Donna Green of University of New South Wales has an interdisciplinary background and is basically interested in fixing problems using a range of different tools. She has worked with Distinguished Professor Morawska on the project Clean Air schools, and has recognised that in Australia, and in many other places in the world there is generally a poor idea of indoor air pollution.

What does air quality mean for us?

It is assumed that the readings gathered around air quality concerns what is breathed in, but that is not the case. Mostly there is no idea as to what the air pollution is indoors and inside buildings. This is because air recording stations are taken outside and ambient background levels measured away from hot spots, which is unrealistic when most people spend about 80 to 90% of their time inside breathing indoor air. These measurement practices were pre-COVID as it was necessary to develop ways to understand how outside air pollution travels indoors, the recirculation of indoor air pollution and how indoor air is generated.

Current recommendations

The Clean Air Schools website was put together with low-cost sensor technology to try and understand the movement of air pollution from the outside to inside, and to look at particulate matter PM 2.5 which affects lung health and the incidence of respiratory and cardiovascular disease. With the advent of COVID questions began to arise, the main one was, how do we protect kids inside school buildings from COVID?

An easy fix

A band-aid solution is to put HEPA into classrooms and shared spaces in schools, other than more complicated designs which might include ionisation or germicidal treatments. By just putting a filter in the classroom and siting it properly, the question was whether or it would or would not reduce the particles in that room and lower the risk for the transmission between children and between children and staff. It was found to work, but how much they work depends on actually using the units.

Despite the fact it's a quick-fix solution, it is something that is highly effective and fit for purpose and can be implemented in the short term to reduce not only the impact of COVID but to reduce the risk to children and to staff. Furthermore, it adds a measure of mobility and flexibility not seen in HVAC and base build systems. The measure will also improve workers' health in office buildings and will benefit people more generally as a result of reduced indoor air pollution. There's a double benefit and a very clear financial benefit where workers are not having to look after sick children, who will experience less triggered asthma attacks. The added quality of life is that everyone is healthier, public health is improved.

Can we implement a more systemic approach?

Now the question is whether a more systemic approach can be implemented. Rather than placing a domestic sized or domestic grade HEPA filter into individual rooms or classrooms, a new more holistic way of managing new builds, where HEPA filters are automatically installed, and the issue also retrofitting individual buildings to improve air health is a good alternative.

The question now is if UV can be used as a more economic and resourceful way to disinfect air. Within an HVAC system or UV plus a HEPA within an HVAC system, or some other way of moving that new air into the rooms in order to reduce both COVID and other air pollution, the answer is expert guidance in air flow management.

People are looking for simple guidance on how to use HEPA.

A South Australia report recently stated that HEPA is unable to remove carbon dioxide from the air, which suggests a missing level of education because HEPA will never remove gases from the air, thus the attempt should never be made. Generally, people are currently attempting to skill up in the air purification sector and until recently, experts were not focusing overly on indoor settings, so information available now arises from steady ground work in information collection. Fact sheets and efforts in public awareness are not adequately addressing this problem not only in Australia, but worldwide.

Good guidance is available on the Victorian Government Schools website regarding HEPA, but at this stage more sophisticated information is required. For example, information around air flows should be available to the public at an international level or the Australian level. Australia is fast becoming a leading force in the air purification and it could be stated that due to ongoing investigation, good low results arising from COVID air purification measures, the hope is that the world will become a cleaner and safer place to live.

There is significant support for HEPA, but at present not many governments are actually mandating use.

"Australia is fast becoming a leading force in air purification and it could be stated that due to ongoing investigation, good low results arising from COVID air purification measures, the hope is that the world will become a cleaner and safer place to live."

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Donna Green

Distinguished Professor
Lidia Morawska

Professor Jason Monty

Associate Professor
Donna Green:

Q&A

Your HEPA questions answered by our expert panelists

Is there an indication to show where air purification mandates are heading? Will they become mandated?

HEPA units are currently in use especially in schools and high-risk areas, but mandating HEPA filters may not be possible. First the Government should put in place regulations regarding conditions, quality standards and quality recommendations to encourage the broad use of HEPA,and then enforce the regulations.

This also applies to the building industry. Spaces that already have good ventilation may not require a HEPA filtration. As mentioned before, adequate and natural indoor air quality regulation is a good starting point.

HEPA filters are a solution but not the only one, so regulation is the most appropriate step to meet the desired outcome, which is to have it's to have cleaner air. Realistically, to mandate HEPA filters in every building would take years.

If HEPA is a bandaid solution, should it still be used?

Presently HEPA units are a weak solution but as a quick solution they are incredibly useful and until such time that better technologies emerge, they should be used.

Is it possible to include UV in a stand-alone system?

Yes, it is possible to contain HEPA plus UV within one system, but not in a HVAC system. Air has a longer time to be exposed to UV placed in the ceiling, and possibly would not eliminate virus particles. As UV disinfectant systems are not well established, HEPA filtration is still the best choice. It may be decades before UV is an incoming solution.

Can HEPA filters be fitted into an a HVAC system?

The answer is almost no. Portable filters are particularly good to use in naturally ventilated spaces when no windows are open, and when done properly, nothing else is required.

What about the actual placement of portable units?

In a layout where there are well ventilated rooms and in some fairly highly populated areas that aren't well ventilated, it is recommended not to place units next to open windows. They should not block anybody, or be at risk of having cables compromised.

What is the wholesale general advice on the placement of portable units?

To get people back into workspaces, the advice is HEPA does work and they do need to be running ideally least half an hour before people come into the room, and turned off half an hour to an hour after leaving the room.

How do you identify the air purification pinch points?

The most effective way is to walk around a building. People in a building breathe out carbon dioxide, and a carbon dioxide monitor can identify where air isn't travelling around. Stale air automatically means carbon dioxide and is often in corridors, toilet areas and kitchen areas. These are ideal locations for HEPA's, when there may be COVID pathogens that need to be cleared. It's also a fairly cheap and effective just to get a sense of where the priority areas are.

How can larger higher risk in areas like medical centres, surgeries be addressed?

Fortunately, in healthcare settings rooms can be fairly small. This means that portable HEPA filters are ideally suited to small rooms, or even at 60 square meters. For ideal usage, hospital patient rooms are exactly that size or smaller, so evidence shows that they work very well.

Is there a whole building solution?

Not as yet, whole building solutions are a concept to keep pursuing. At this stage HEPA filters in each room is very effective. Depending on the setting every measure should be taken. If people are too close to each other in low ventilation, filtration does not really help immediate inhalation of the plume emitted by another person, and transmission is almost instantaneous.

Should we run HEPA filters all the time?

It depends where in a healthcare setting people are all the time, but yes. But in a school setting for instance, HEPA filters cannot be run all the time because of massive energy losses.

If HEPA filters are run whether they are needed or not, the increase in energy consumption would be phenomenal and unaffordable, so they must be used in an economical fashion.

In a mechanically ventilated space, does air quality change per hour, and does it have a relationship to the quality of outside air?

In terms of health recommendations the standards are listed by WHO. There is a shift towards 10 litres per second per person, and four to six changes per hour according to the number of people in the room. When talking about clean air coming in a mechanical ventilation system that's being adjusted to draw in fresh outside air, it means that air changes per hour will be higher.

But when referring to a HEPA filter, there is no outside air, just recirculated air within the building. It's clean in the sense that the infectious aerosols are being removed and potentially whatever else is in the room. That is particles which could be pollution as well as entering from outside, and being cleaned effectively by a HEPA filter.

What about the overall noise of HEPAs?

Generally it's just white noise that works quietly in the background, it is necessary to have them on full, but those noise levels won't increase if there a three or four in a room. The HEPA filtration will increase by having more than one in an indoor setting, but there is no recommended perfect number at present. It's important to size units correctly to the room space, but some HEPA is better than none. While extremely effective, it will not 100% guarantee absolute elimination of pathogens, so risk prevention and risk reduction is the main goal.

What about sort of manufacturing areas where you have quite a high population density?

In larger environments circulation of natural air is essential. To clear those big spaces air must be moved around, and work places with very high ceilings are very useful for that. But we don't recommend HEPA units for very large spaces, including high ceiling spaces, as they are not effective.

What would you term a high risk area?

Low ceiling areas, small unventilated rooms and offices, rooms with the window and the door are closed, crowded and poor ventilated areas.

What is the comparison between HEPA and MERV ratings?

They are definitely not the same thing. HEPA is a really tight filtration system so it's not possible to combine it with a HVAC system as there is not enough power to draw air through. MERV ratings indicate that HEPA units are the preferred option. The MERV rating is actually for different sizes of particles, whereas the HEPA is more applicable to worst case scenarios. The MERV rating is about 75% filtration whereas a HEPA filter is 99.95% (although there are differing grades of filters).

There seems to be some misconceptions about HEPA removing CO_2, why is this?

HEPA filters particles, but not gases, so will not fully stop the increase of CO_2 in a room.

Carbon dioxide build-up over time can affect mental capacity. But, the presence of carbon dioxide in a space is incredibly useful for identifying where there might be a problem in a room at that time.

By using a CO_2 monitor, gas levels can be easily measured and numbers above 600 are extremely unhealthy. Readings over 600 also help us understand transmission rates between people, so the monitor is useful to identify whether HEPA, or natural ventilation or any other product is required for that space. The carbon dioxide meter will allow you in real time to identify the problem, and take adequate steps in filtration systems to address it.

> "Presently HEPA units are a weak solution but as a quick solution they are incredibly useful and until such time that better technologies emerge, they should be used."

Is your workplace air quality putting your health at risk?

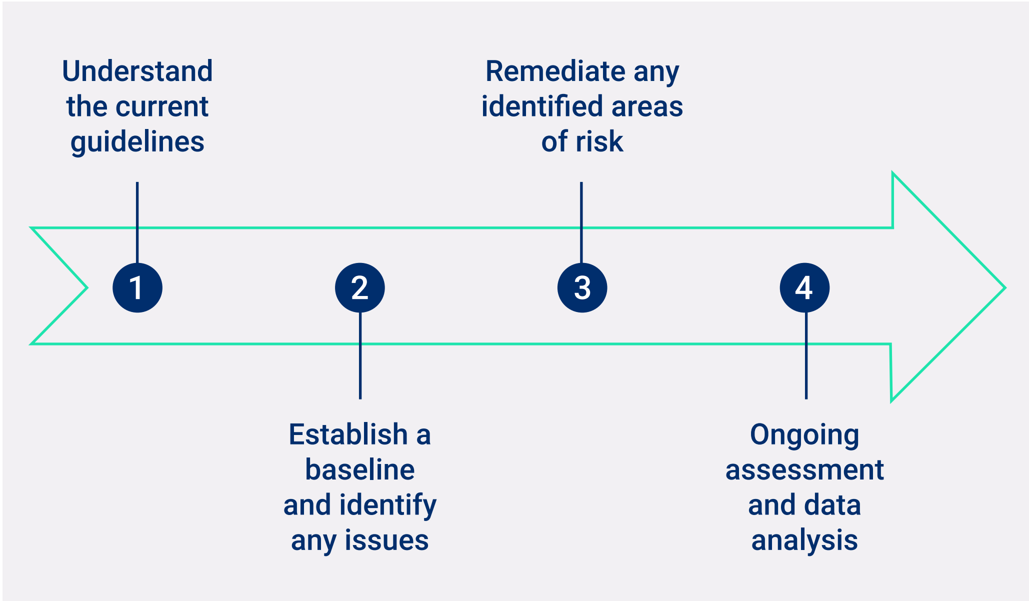
Recommendations

1. Understand the current guidelines
2. Understand your spatial requirements
3. Activate preventative measures with HEPA and CO_2 Monitors
4. Record data and review
5. Review and improve

Clare Walter

- Public health PhD candidate at the University of Queensland, researching the health impacts of air pollution in Australia.
- Previously based at the Peter Mac lung cancer clinics as a specialist pharmacist.
- Worked with Santé and Westlab to develop a 4-step process to best optimise ROI when making decision around HEPA filtrations and air purification in our buildings

The 4 Step Solution



Clare Walter is a public health PhD candidate at the University of Queensland, researching the health impacts of air pollution in Australia and the associated policies designed to mitigate the impacts. Previously based at the Peter Mac lung cancer clinics as a specialist pharmacist, Clare's advocacy work began in response to the growing number of lung cancer patients with no smoking history, and the categorisation of diesel exhaust as a group 1 carcinogen.

Clare has worked with Santé and Westlab to develop a 4-step process to best optimise ROI when making decision around HEPA filtrations and air purification in our buildings.

The COVID virus is predominantly spread via airborne transmission in indoor areas. Ventilation is therefore a critical concern for building managers attempting to reduce risk and provide confidence for employees to return to work. Best risk reduction practices utilise multiple strategies (e.g. mask wearing, vaccination, social distancing), however it's useful to note that ventilation is the only strategy that addresses the main route of transmission that does not rely on personal behaviours and compliance. There are four steps that should be followed to ensure indoor ventilation meets best practice guidelines.

Step 1. Understand the current guidelines

The wide variance in current guidelines (Table 1) reflects the involvement and varying focus of different industries and organisations primarily involving medical bodies, building and construction engineers and the HVAC industry (heating, ventilation, and air conditioning).

There are pros and cons associated with each unit of measurement:

Carbon dioxide (ppm). Carbon dioxide (CO_2) measurements are a practical and cost-effective way of measuring building ventilation. It is the most common metric used in current guidelines (Table 1). It is an inexpensive and easy method to get a proxy measurement of risk in buildings that rely on natural ventilation or fresh air intakes via the HVAC system. However, it is highly variable depending on the number of people in the building, air diffusion and placement of monitors. Ideally the building should be at maximum capacity and monitors should be placed in multiple areas, ensuring they accurately reflect where people are spending their time. CO_2 is not an appropriate measurement when HEPA filtration or fine grain filters in the HVAC system (MERV 13 or greater) are being used.

These units reduce COVID risk by filtering viral particles (> 99% with effective HEPA filtration and < 75% with MERV 13), but do not reduce CO_2 concentrations. In these instances, a high CO_2 concentration does not necessarily correlate to a high risk of COVID transmission.

Litres per second per person (L/s-1 person). This is the most common measurement used by engineering/building experts. It refers to the amount of fresh air provided to a building per person in the building. To reflect the varying occupancy of the building some HVAC systems have CO_2 sensors within their system that dictate the level of fresh air required. This method can fail to account for the significant variation across the workspace (or multi-level workspace using the same HVAC system) leading to 'hot spots' which remain unaddressed. For this reason, it's a useful standard for building guidelines, however it's not the standard used by most health and air quality experts to determine the risk of viral transmission.

Air Exchanges per hour (ACH). This measurement is the 'gold standard' of ventilation assessments. It can be measured several ways with varying accuracy. Blower door tests are an easy but not particularly accurate method. Tracer tests that measure the gas or particle decay rate in an empty building (therefore independent of occupancy) provide the most accurate result.

"The COVID virus is predominantly spread via airborne transmission in indoor areas."

Table 1. Selection of current domestic and international guidelines

Authority	Description
Victorian Department of Health and Human Services (DHHS)	CO_2 concentration levels exceeding 1,000ppm is an indication of insufficient ventilation.
Infection prevention control resources for healthcare facilities (2021)	Standard pressure hospital rooms should have a minimum of 6 ACH
OzSAGE. Safe indoor air for workspaces (2021)	Aim for an equivalent of minimum six air changes per hour (6ACH). "Low relative risk" = CO_2 concentrations below 800ppm "moderate relative risk" = CO_2 concentrations between 800 – 1500ppm. "High relative risk" = CO_2 concentrations above 1500ppm
New Zealand Ministry of Education Indoor Air Quality and Thermal Comfort Version 1.0 (2017)	"Well ventilated" = CO_2 between 600 – 800ppm and equates to between 5 – 10 ACHs
Harvard Healthy Buildings Program - Schools (2020)	Categories: Ideal (6 ACH) Excellent (5-6 ACH) Good (4-5 ACH) Bare minimum (3-4) and Low (<3 ACH)
American Society of Heating, Refrigeration and Air conditioning Engineers (ASHRAE)	10L/s-1 person 4 – 6 ACH per hour.

Step 2. Establish a baseline and identify any issues

Ambient CO_2 monitoring. CO_2 monitors that use non-dispersive infrared (NDIR) sensors are a cost effective and sensible starting position to estimate the baseline ventilation. It may be the initial measurements indicate existing ventilation is sufficient and there is no need to invest in further technologies.

When selecting ambient CO_2 monitors considerations should include:

- **Accuracy.** Are the monitors calibrated, if so against what and how?
- **Longevity.** There are some very cheap monitors currently available, however they often become inaccurate after 4 – 5 months. It's generally a more cost-effective option to purchase a monitor that is guaranteed to last in years rather than months.
- **Data logging.** Monitors that log data provide an opportunity to analyse patterns over time and varying locations, providing the ability to pinpoint specific areas of concern and provide ongoing assurance for building users.
- **Additional measurements.** Monitors that incorporate other parameters such as temperature and humidity can include these inputs to provide a more accurate overall COVID risk rating. Volatile organic compounds (VOCs) and fine particulate matter (PM2.5 and PM1) readings are useful to indicate the general indoor air quality and identify risks related to dust storms, bushfires, and thunderstorm asthma episodes. PM readings will also provide an indication of the efficacy of any existing HVAC filtration or HEPA filters.
- **Visibility of readings.** The monitor should provide a clearly displayed and easily interpreted reading. Traffic light systems related to risk provide a useful indication for when building occupants need to take further actions such as increasing natural ventilation, fresh air in HVAC systems or turning on HEPA filters

Consider air distribution. Baseline ventilation should also consider how the air may be distributed. Building occupants should not be downstream of any strong directional air flow such as generated by a fan blowing directly from one person to the next. Gentle diffusion is preferable. Ceiling fans should be set to the winter setting or if not possible then the lowest possible setting. Any pedestal fans should be situated near open windows or doors to encourage airflow in /out of the room. Blowing bubbles and watching the movement across the room is an inexpensive and easy way to observe the directional flow of air. Where the bubbles move is also the likely direction viral particles may take.

Measuring ACH

Gas tracer tests to measuring the ACH is a more technical and accurate method of obtaining baseline ventilation results. The added advantage is that should remediation be required, the baseline ACH can be used with the room volume to calculate the specific clean air delivery rate (CADR) that may be required from HEPA filters.

Step 3. Remediate any identified areas of risk

If CO_2 levels are reading above 800ppm and/or the ACH measurements are below 6ACH then further steps are required.

Options include:

1. **Improve natural ventilation.** If it is possible to open windows and doors and there is good cross ventilation, then this method may be sufficient to reduce risk. The key issue with relying solely on this approach is thermal comfort – it is impractical to do this in hot or cold conditions. Additional issues include safety concerns, noise, ingress of outdoor air pollution including dust, pollen, bushfire smoke and traffic particles.

   For some single level buildings there may be engineering solutions that can improve natural ventilation and additionally circumvent some of the issues mentioned above.

2. **HVAC alterations.** Some HVAC systems can be retrofitted to include filters that capture some of the viral particles. Unfortunately, with most current HVAC systems, installing finer filters leads to a build-up of pressure that compromises the system. An expensive option is to install a new HVAC system, ensuring it incorporates a sufficient proportion of fresh air.

3. **HEPA filters.** Portable HEPA filters provide a cost effective and practical option for many workplaces. Provided the required 'power' or 'CADR' has been calculated to meet the specific requirements of the space, they are a very effective way of reducing circulating viral particles. The CADR across filters is additive, which provides an option of adjusting or moving filters across spaces as required during the course of a workday e.g. moving them into meeting or conference rooms when needed. They can be turned off for periods of low office use and/or when CO2 levels are below 800ppm reducing the unnecessary use of power. An additional advantage of HEPA filters is an overall improvement to the indoor air quality by the simultaneous removal of all particulate matter. This includes bushfire smoke, traffic pollution and natural dust and pollens. Particulate matter is the air pollutant deemed most detrimental to human health and is associated with asthma, respiratory infections, heart disease, respiratory disease, and allergies. There is also a correlation between high particulate exposure and increased COVID mortality risk. Improving indoor air quality reduces the number of sick days required by staff and has also been shown to improve productivity in the workplace.

Key considerations when choosing HEPA filtration would include:

- Top-rated filtration efficiency and fidelity
- No system leakage = 0 count reading at air outlet
- Filter Anti-microbial coating inside and out
- Smart air quality monitor and AI
- WiFi connectivity, app and fleet control
- Silent fan engine
- Filter life 12 months and over
- Zero ozone or reactive oxygen species

Step 4. Ongoing assessment and data analysis

Data obtained from logging ambient CO_2 monitors (Step 2) should be periodically reviewed. Large offices may benefit from several monitors in different locations. These locations can be altered to provide a finer grain analysis across the workplace. Remember – when moving monitors be sure to record the date/time and location of movement. It may be useful to keep a logbook next to the monitor. Natural ventilation can alter in response to weather patterns such as wind speed and direction, barometric pressure, and temperature; therefore, it is useful to collect and review long-term data. Workplace staffing and staff habits may also alter over time, creating variations in CO_2 outputs. If there are COVID outbreaks within a workplace recording these and reviewing the timing and seating arrangements may provide an indication that ventilation strategies need further attention.

HEPA filters should be periodically reviewed to ensure they are being used correctly (turned on and working when CO_2 levels are exceeding 800 ppm). Filters should be replaced according to manufacturer specifications. Most monitors will have a visual display that prompts filter replacement

> "Portable HEPA filters provide a cost effective and practical option for many workplaces."

Aeris aair 3-in-1 Pro

HEPA Filtration units are designed to recirculate air and clean it from particles, sub-organic compounds and organisms such as mould and spores.

Literally cleaning the air of Covid-19 can dramatically reduce transmission rates, all while keeping the air breathable, and improving mental outcomes.

Westlab are the exclusive distributor for the Swiss-designed and engineered Aeris Aair range. Speak to one of our team today on 1800 358 101 to secure your allocation.

Product Specifications

- Anti-microbial filter treatment
- 3-in-1 Filter including:
- F7 Pre-filter
- Activated Carbon Filter
- H13/H14 HEPA Filter
- H13 Main HEPA Filter
- Artificial Intelligence Programs
- Fleet Management
- Automatic air speed
- Integrated Air Quality Meter
- Continuous AQI readout
- Wi-Fi Integration
- Mobile Control

Aeris aair Lite

Product Specifications

- Anti-microbial filter treatment
- F7 Pre-filter
- H13 Main HEPA Filter
- Artificial Intelligence Programs
- Fleet Management
- Automatic air speed
- Integrated Air Quality Meter
- Continuous AQI readout
- Wi-Fi Integration
- Mobile Control
- Extremely simple filter change
- 12 Month Filter Life

Zona 200

Zona 490

Product Specifications

- HEPA 13 with UVC optional
- 330m³/hr CADR
- 2.8kg – 295x295x455
- Pre-filter and Carbon 3in1
- Touch panel & Wi-Fi SMART
- OEM

Product Specifications

- HEPA 14 with UVC
- 7 Stage Purification
- 488m³/hr CADR
- Touch panel, remote & Wi-Fi
- Auto modes and sensors
- 8 grades wind speed

Zona 620

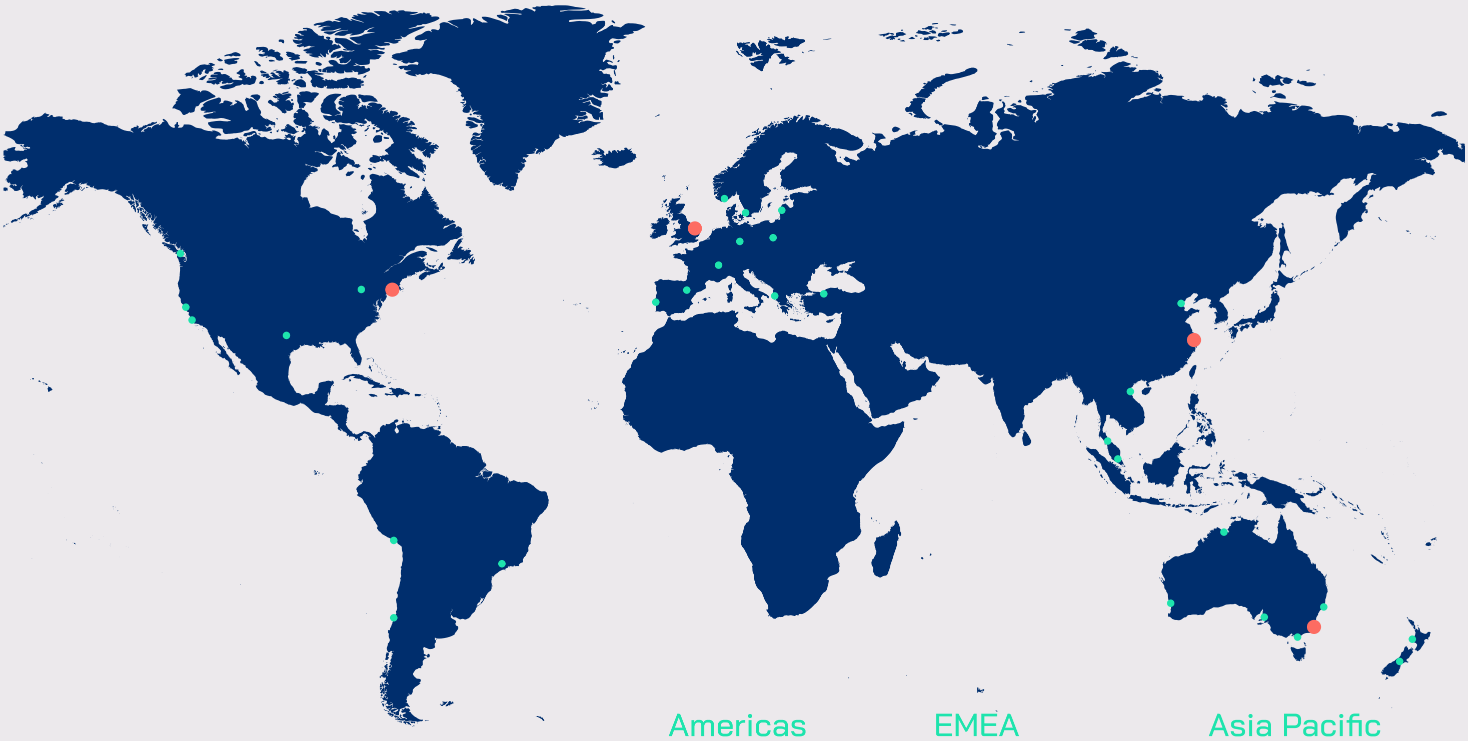
Combining the best HEPA filtration with Zonitise antimicrobial technology, these air purifiers not only filter the bad stuff out of the air but they can also eliminate harmful pathogens too.

Product Specifications

- HEPA 14
- Automatic sensors and AQI
- Touch panel, remote & Wi-Fi
- 620m^3/hr CADR
- 4 grades wind speed
- 4 stages of purification

Is clean air the missing piece to the employee wellbeing puzzle?

Our Locations



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