Winter is coming

The importance of clean air in educational settings.

WEBINAR WHITEPAPER
MARCH 2022

Keynote speaker

Clare Walter
Clare Walter, a specialist in the field of lung health, air quality and air pollution studies, works extensively in this field to assess indoor air ventilation and implement strategies to control air quality.

westlab

santé
NEXT-GENERATION SOURCING

Index

Lung health is critically important in children and pollution is known to have negative effects on lung growth and development and has been thought to be linked to negative effects on cognitive function.

Clare Walter

Clare Walter, a specialist in the field of lung health, air quality and air pollution studies, works extensively in this field to assess indoor air ventilation and implement strategies to control air quality.

How to Tackle Air Quality

Discussion and Questions by Clare Walter

Select your guideline

In regard to HVAC systems and building code guidelines there are a variety of differing guidelines available. The correct reference depends on the guideline designed for building codes or for risk assessment. There is a distinct difference to validity when aiming to reduce environmental COVID risk when using a HVAC systems; generally the core consistency across most guidelines is carbon dioxide.

CO_2 As an Indicator of Ventilation Efficiency

The main question is: what are the main metrics we use to measure ventilation and what does measuring carbon dioxide or air exchange rate mean? We know that when a carbon dioxide reading returns at less than 800 parts per million, or if the exchange has been calculated and it's less than 600 parts per million, the risk for COVID transmission or effects from carbon dioxide accumulation is low. To elaborate, essentially carbon dioxide is the main gas that we exhale; and outdoors exhalation comes in at 400 parts per million. By contrast, breathing indoors causes the gas to accumulate which at a certain point - over 800 parts per million, which means that ideal ventilation is no longer viable for healthy inhalation.

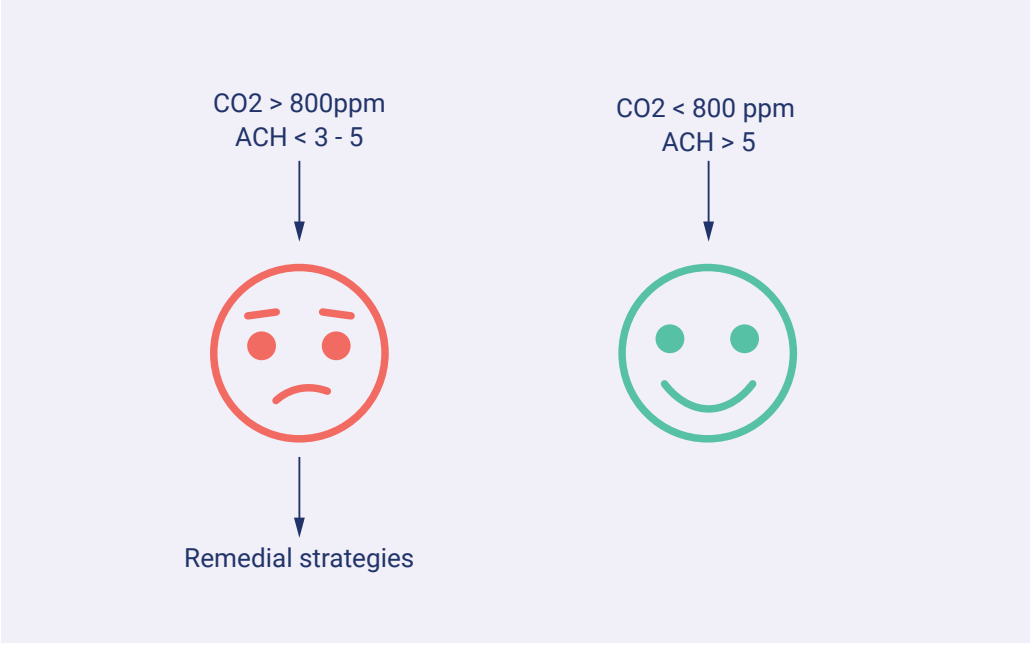
Ventilation metrics

Carbon Dioxide (CO_2)	Shows accumulation of exhaled breath Proxy measurement for virus risk
Air Flow or CFM (L/s^{-1} person)	Cubic feet per minute (US). Litres per second per person Fresh air supply to a building
Air Exchange per Hour (ACH)	How often the air is 'refreshed' or changed per hour. Most accurate measurement of risk

These measures show that as carbon dioxide accumulates in an enclosed and poorly ventilated space, viral particles will accumulate. A person who is COVID positive will expel viral particles in an enclosed space and it will accumulate. Measuring carbon dioxide accumulation is a simple process and very cost-effective, but accuracy in measurement can be very highly variable in certain conditions. The accepted Australian airflow measurement is litres per-second-per-person, and the current recommendation related to a low COVID risk is 10 litres per-second-per-person. This assessment relates solely to the level of fresh air supply that reaches and circulates inside a building. This is a very useful code that dictates how much fresh air supply should be streamed into a building, and when estimating the impact HVAC system installation and air conditioning systems have on air circulation.

"A person who is COVID positive will expel viral particles in an enclosed space and it will accumulate."

Establishing a baseline



On a positive note, measurement shows capacity and how much is required to accommodate the number of people in a building. In practice however, ventilation assessments can return as somewhat flawed. When applying the metric, it doesn't always uniformly represent risk across an enclosed space and is not necessarily reflective of the breathing zone where people are. An additional variable is the air exchange rate per hour, and how often air is refreshed in a room per hour.

How to Tackle Air Quality continued

To date this method is the most accurate measurement of COVID risk, however, the method can be challenging when testing gas or particle decay. In this instance a room is permeated with gas and then allowed to empty. Gathered measures include the time it takes for the gas to decay and then using that calculation the exchange rate in a room is recorded. In order to reach an accurate measure, a baseline must be established which can be done easily with carbon dioxide. Caveat paradigms remain in place when measuring air exchange rates. When carbon dioxide is over 800 parts per million or air exchange rate is less than five, then remedial strategies are needed. There are three main types:

1. Increase natural ventilation

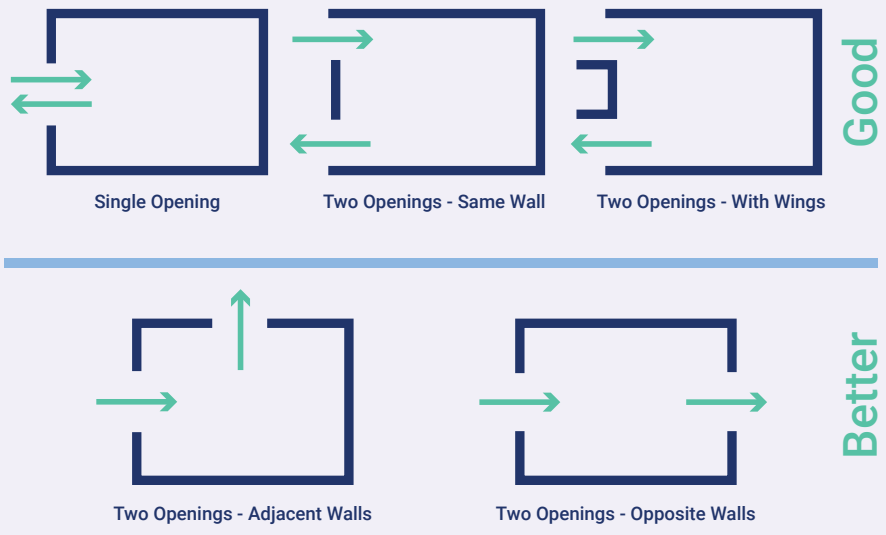
2. HVAC modifications

3. Air Purifiers

1. Increasing Natural Ventilation.

To increase natural ventilation opening doors or windows will boost cross ventilation which makes a huge difference to efficient air circulation. This means that open ventilation at a 45 or 180 degree angle will lead to fresh air within a room. If this is not a viable solution, other methods to increase natural ventilation - depending on the type of building for example whirly gigs on roofs, must be employed. These are efficient and effective, and provide thermal comfort in winter or very hot days in summer and also ingress fresh outdoor air which mitigate pollutants and particles.

Increase natural ventilation



Source: Harvard T.H. School of Public Helath

2. HVAC System Modifications.

HVAC system modifications can ensure the highest fresh air supply possible. If an air conditioning system is not providing fresh air and is simply reticulating, there is an increased risk of COVID transmission within a room. To avoid this, it's essential that an HVAC system brings in fresh air supply. Additionally, some HVAC systems are fitted with filters as with a Merv 13, which has a good rating and filters some particles out. Unfortunately, in practice most or many of the existing HVAC systems in buildings do not supply sufficient fresh air, and is often not enough to ensure six exchanges per hour within an enclosed space. Also, most current systems don't have the fine-grain filters that are attributed the Merv 13 or preferably even higher. Retrofitting can be quite problematic, as instigating pressure build-up within these systems can cause them to cease functioning entirely.

"There is a clear distinction between HEPA filters and other air purifiers where HEPA filters are preferable due to efficacy."

3. Air Purifiers.

There is a clear distinction between HEPA filters and other air purifiers where HEPA filters are preferable due to efficacy. As they have been under use for an extended time period, evidence shows that they work and that they're safe. Other types of air purifiers have been shown to produce free radical gases and volatile organic compounds (VOC's), which can be harmful to health particularly for children whose lungs are still developing.

How is the amount of required HEPA filters calculated?

The best and most accurate way is to take the existing air exchange rate of a room along with the room volume to calculate the clean air delivery rate. This indicates the measurement of power that's supplied by the HEPA filter. The next consideration is where to place the units – which is always in relation to the location of electric sockets and trip hazards. Placement must also take into account air distribution to ensure that it is relatively even; where there is a reasonable mix of fresh air and reticulated air, placement of an HEPA filter is indiscriminate as they will still function well.

That said, if after catering for trip hazards and electric sockets and there are still options to improve air quality, the next thing to consider is the likely transmission pathway. Air distribution flows can be identified the simply by blowing bubbles and watching where they travel around the room - and then considering where people can be seated. Prior to the Omicron it was found that the main transmission pathway in a classroom was from teacher to child. At that point, the filter should have been placed between the teacher and the speaking airflow to the children. With the advent of the Omicron variant it is now known that this is only one kind of transmission, which has now ascended to generalised transmission between each and every one of us.

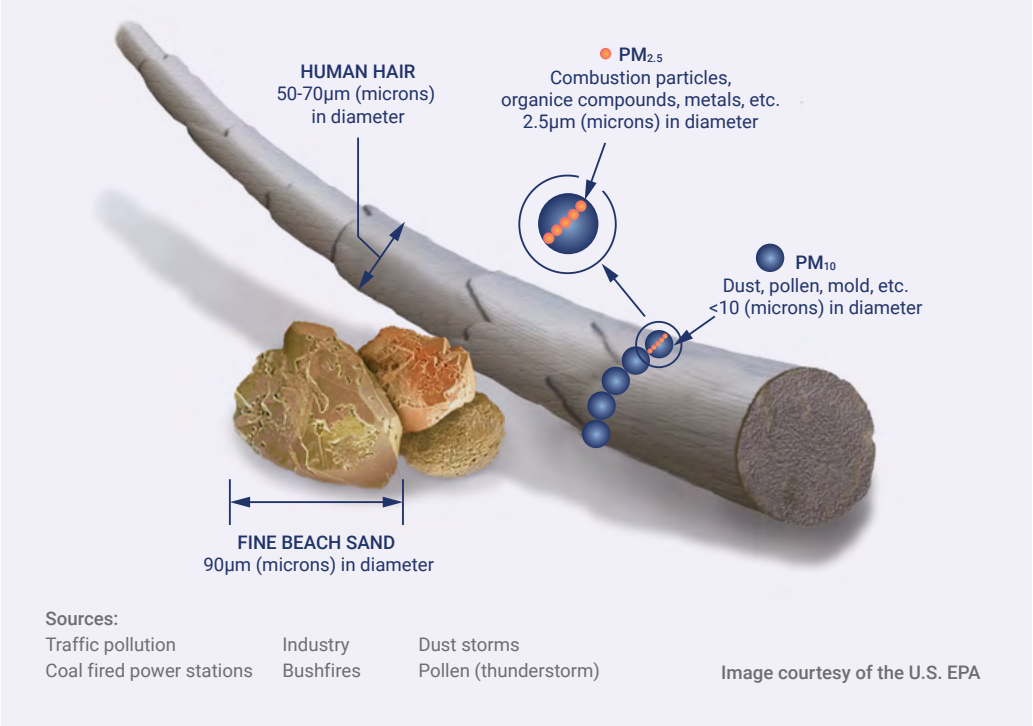
Essentially the breathing zone and transmission air distribution around a room does assist in calculating the ideal placement of air purifying units. These units can also be utilised to match filtration needs after a volume assessment. For example, at 700 parts per million (which hits the limit of carbon dioxide weight in the air) two HEPA filters at 350 density each placed in different areas across the room will facilitate adequate distribution of filtered air. Importantly, HEPA filters trap particles - not gases. But when measuring carbon dioxide it is a useful proxy measurement for COVID risk when there is no filtration existing in an HVAC system or a unit.

HEPA filters will reduce accumulating viral particles, but they have no impact on the carbon dioxide levels in an enclosed space. The recommendation is to wait until the carbon dioxide rises to 800 parts per million, which is a clear indicator to turn on the HEPA filters. At 800 parts per million HEPA filters will address the COVID risk, but carbon dioxide accumulation will still continue to increase. Clearly pre-filters filter VOC's as well as viral particles, and it is this airborne particulate matter that is estimated to contribute to over two and a half thousand premature deaths a year.

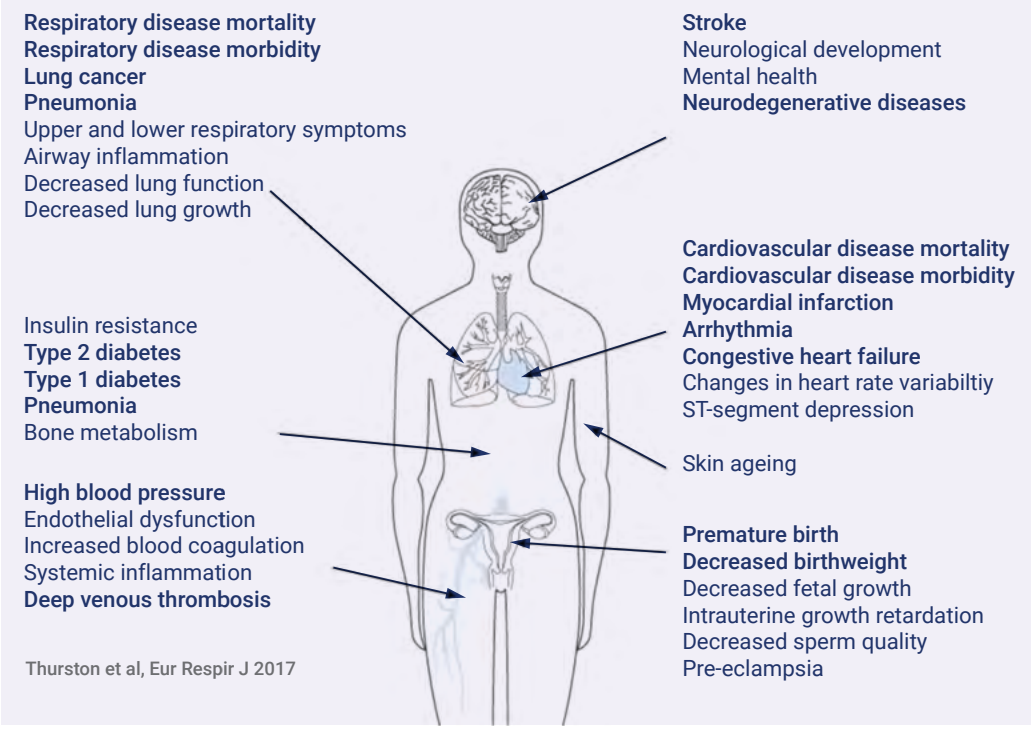
How to Tackle Air Quality continued

In Australia air pollution causes the most harm to population health, particularly toxic particles that are usually formed from combustion processes, for example, traffic emissions and bushfires. Combustion emission particles are so small that when breathed in they adeptly cross into the bloodstream from the lungs, travelling throughout the body and impacting every organ along the way. Children are the most vulnerable to the health impacts of particulate matter, as they have a high metabolic rate which in turn produces an increased respiratory rate. Their inhalation capacity carries a higher load and their lungs have a higher surface area compared to the rest of their bodies. This serves as a greater area for deposition particles and absorption into the body, and affects the immune system and developing lungs (still in a growth phase until 15 years) and diminishes natural health defence systems.

Particulate Matter



The Australian Child Health and Air Pollution Study or HF study looks at children's exposure to combustion emission particles in twelve cities across Australia. Exposures in school classrooms, residences and homes were also taken into account during the study. It was found that even a very small increase in traffic emissions was associated with a 24% increase in the risk of developing asthma. A surrogate meter where nitrogen dioxide is used to measure traffic emissions shows that at 4 parts per billion, this smallish increase in nitrogen dioxide was significant enough to affect the quality of lung health among children under 15. In Australia policies exist that actually encourage child carers, child care centres and schools to be located near major roads. For example, inner-city Melbourne locates 10% of child care centres within 60 meters of a major road, which shows that generally, nitrogen dioxide levels rise to at least 4 parts per billion or higher in an area that's closer to arterial roads.



"Over 2,500 pre-mature deaths per year in Australia"

Over twenty years ago In California results like these were deemed a public health hazard and as a part of public health policy, the EPA insisted on 150-meter buffer zone between schools and major roads. In the 20 years since the implementation of this policy and through regular testing of thousands of Californian children, these policies have been associated with the growth of significantly larger and healthier lungs in children. The point being made here is that by utilising HEPA filters there are numerous health and quality of life benefits, and that recent and current policy discussions, inquiries and royal commissions related to the health impacts of air pollution led to this conclusion.

Again, locating child care centres and schools near major roads makes them vulnerable to the impacts of the bushfire season. In 2019-2020 the Victorian response to these and to thunderstorm asthma events have identified the use of filters as a potential mitigation strategy, as well as addressing the risk of COVID transmission.

"If using HEPA filters have the CADR calculated for you using ACH and room volume."

Recommendations

1	**Use ambient CO_2 Monitoring**	The end recommendation is that when using an ambient carbon dioxide monitor, logic suggests that a data logging unit with a display screen is incredibly useful when interpreting levels over 800 parts per billion, the level at which remediation strategies are immediately needed.
2	**If using HEPA filters have the CADR calculated for you using ACH and room volume**	When applying HEPA filters, the most beneficial approach for good air quality is to access the results for the existing air exchange rate in a room along with the room volume to calculate the clean air delivery rate.
3	**CADRS are additive and filters portable so you can move around according to need.**	The units and filters are portable and can be moved around according to need. For example, in a meeting where there will be additional people in a room, extra filters can be employed and transferred elsewhere later on.
4	**Consider carbon emissions. Can be turned off when risk is low.**	In reference to carbon emissions, clearly HEPA filters do use electricity, and the recommendation is that they be switched off when risk is low and avoid running them overnight.
5	**Ongoing monitoring with logging CO_2 Monitor**	Ongoing carbon dioxide monitoring with a logging function is a useful practice, as the regulated data can indicate long term trends in levels. Workplaces are everchanging and seasonally affected, and efficient cross-ventilation is dependent on window placement and wind direction. External changes such as these can affect carbon dioxide level as a risk barometer, therefore ongoing monitoring with logging carbon dioxide monitors ensures a more reliable prediction of levels. Noting down where the units have been kept, and on what date can identify hotspots when looking back over the collected data, and locate temporal trends.

The Aeris 3-IN-1 Pro Purifier

HEPA Unit

The Aeris unit is Swiss engineered and designed, and the three-in-one switch is our flagship product.

The Aeris draws in air at 360 degrees and then pulls it up through a three-stage prefilter, a carbon filter and a true H 13 HEPA filter. The key difference is the antimicrobial coating on the filter itself. Westlab has commissioned studies that endorse this function and has conducted local studies to prove that this coating actually kills microbes.

Not only does this addition allow the user to replace a cartridge safely, it also means medical waste is a non-issue. The filter unit has an inbuilt air quality monitor, a PM 2.5. that adjusts fan speed when using the automatic mode, and can be operated remotely using an app. Another key point is there's no system leakage, and every particle that enters the system is filtered. There is a long-life filter that gives 12 months' service (under normal operation) from one filter cartridge, which is simple to replace. There are two models available in the Aeris range. One is the Aair Light, typically used in smaller spaces the next one is the Aair 3-IN-1.

The Aair 3-IN-1 gives around four air changes per hour in either a 30 square meter or 70 square metre space. A typically sized classroom would require at least three Aair 3-IN-1 units. The unit comes with a variety of functions, the start and stop time can be set; and a purge cycle can be set at the start of a day where the fan speed can be accelerated. The units are extremely quiet and under normal operation will sit at 50 decibels, so it can be used quite easily in a classroom setting. Westlab has also introduced another brand called Zonitise which meets a lower budget and is a slightly smaller yet effective unit. It contains a number of speed settings, with noise levels varying between about 30 to 50 decibels, and supports air flow at around the 600 to 620 mark. The University of Melbourne has independently tested both Aeris units and the results can be shared to any interested parties.

Aeris 3-IN-1 Pro

Aeris aair Lite

Zona 620

Q & A

Answers by Clare Walter

In our previous webinar, we alluded to the fact that WHO has officially recognised aerosols as being a major cause of COVID infections. Do you have any comments on that?

Clare Walter WHO has stated that about 95% of the transmission route is airborne indoors, so at the beginning of the pandemic it was apparent nothing was being done about air ventilation which was particularly frustrating. Part of my PhD looks at the transition of scientific evidence into policy related to public health - specifically pollution. We know Professor Lidia Morawska in Queensland, who is a phenomenal resource for Australia, was trying to inform the World Health Organisation and policymakers around the world from the very outset that COVID was an airborne virus. At different conferences over the years she has talked about her research with the MERS and SARS viruses and the transmission of viruses indoors. When she said from the outset that this was an indoor airborne disease, and that predominantly that was the route,you knew straight away she would be right. But to watch how many months it took to convince the policymakers that this was the case is rather frustrating, and an interesting exercise in the transition of evidence through to policy in itself.

How do we know this is actually working?

Well, we know HEPA filters particles down to 0.3 microns and they may even be smaller than that to begin with, but what happens then? Is there coalesce in the air or agglomeration? We know they filter viral particles as there's been plenty of studies in the past on other viruses and Lidia's work in her Queensland lab shows they are effective. In terms of COVID specifically, I understand there's some work being conducted in the UK. There was a study being undertaken and I was very much looking forward to seeing the results, comparing UBC to HEPA filters. I haven't seen the published results yet, and I don't know that there's any specific evidence in the current context - but we do know with previous viruses that it works. There's no reason to suggest the COVID virus is the exact same size as other respiratory viruses. If you do have a carbon dioxide monitor that also measures particulate matter, some of them do measure both these parameters and will show that HEPA filters are working.

Any recommendations for CO_2 monitoring?

Make sure you get one that's NDIR – non-dispersive infrared. We can get cheap units but I have found after about four or five months they are no longer very effective, so I would get one that logs the data. I use a couple of the high-tech calibrated loggers that log every 30 seconds and they've been measuring very well.

Q & A
continued

Q & A

Frequently asked HEPA questions

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."

Disclaimer

This document is a technical whitepaper setting out the current and future developments of Westlab Pty. Ltd ("Westlab"). The Whitepaper does not does not constitute an offer to sell, a solicitation of an offer to buy any of the products, services or tokens that are mentioned in this document. Westlab does not perform Initial Coin Offering (also known as Initial Token Offering or Token Sale) and this paper is for information purposes only and is not a statement of future intent. Unless expressly specified otherwise, the products and innovations set out in this paper are currently under development and are not currently in deployment. Westlab makes no warranties or representations as to the successful development or implementation of such technologies and innovations, or achievement of any other activities noted in the paper, and disclaims any warranties implied by law or otherwise, to the extent permitted by law. No person is entitled to rely on the contents of this paper or any inferences drawn from it, including in relation to any interactions with Westlab or the technologies mentioned in this paper. Westlab disclaims all liability for any loss or damage of whatsoever kind (whether foreseeable or not) which may arise from any person acting on any information and opinions relating to Westlab or the Westlab Platform contained in this paper or any information which is made available in connection with any further enquiries, notwithstanding any negligence, default or lack of care. The information contained in this publication is derived from data obtained from sources believed by Westlab to be reliable and is given in good faith, but no warranties or guarantees, representations are made by Westlab with regard to the accuracy, completeness or suitability of the information presented. It should not be relied upon, and shall not confer rights or remedies upon, you or any of your employees, creditors, holders of securities or other equity holders or any other person. Any opinions expressed reflect the current judgment of the authors of this paper and do not necessarily represent the opinion of Westlab. The opinions reflected herein may change without notice and the opinions do not necessarily correspond to the opinions of Westlab. Westlab does not have an obligation to amend, modify or update this paper or to otherwise notify a reader or recipient thereof in the event that any matter stated herein, or any opinion, projection, forecast or estimate set forth herein, changes or subsequently becomes inaccurate. Westlab, its directors, employees, contractors and representatives do not have any responsibility or liability to any person or recipient (whether by reason of negligence, negligent misstatement or otherwise) arising from any statement, opinion or information, expressed or implied, arising out of, contained in or derived from or omission from this paper. Neither Westlab nor its advisors has independently verified any of the information, including the forecasts, prospects and projections contained in this paper. Each recipient is to rely solely on its own knowledge, investigation, judgment and assessment of the matters which are the subject of this report and any information which is made available in connection with any further enquiries and to satisfy itself as to the accuracy and completeness of such matters. Whilst every effort is made to ensure that statements of facts made in this paper are accurate, all estimates, projections, forecasts, prospects, expressions of opinion and other subjective judgments contained in this paper are based on assumptions considered to be reasonable as of the date of the document in which they are contained and must not be construed as a representation that the matters referred to therein will occur. Any plans, projections or forecasts mentioned in this paper may not be achieved due to multiple risk factors including without limitation defects in technology developments, legal or regulatory exposure, market volatility, sector volatility, corporate actions, or the unavailability of complete and accurate information. Westlab may provide hyperlinks to websites of entities mentioned in this paper, however the inclusion of a link does not imply that Westlab endorses, recommends or approves any material on the linked page or accessible from it. Such linked websites are accessed entirely at your own risk. Westlab does not accept responsibility whatsoever for any such material, nor for consequences of its use. This paper is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation. This paper may not be redistributed, reproduced or passed on to any other person or published, in part or in whole, for any purpose, without the prior, written consent of Westlab. The manner of distributing this paper may be restricted by law or regulation in certain countries. Persons into whose possession this paper may come are required to inform themselves about and to observe such restrictions. By accessing this paper, a recipient hereof agrees to be bound by the foregoing limitations. Planned features may change based on the competitive landscape and go-to-market strategy.