

The importance of ventilation in the post-pandemic workplace

A White Paper by:

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Contents

Executive summary	page 1
Background	page 1
Indoor environments under the microscope	page 2
Minimising the spread of viruses in the workplace	page 5
Ventilation trend - from comfort to wellbeing	page 7
Ventilation in the spotlight	page 7
The changing landscape of workplace wellbeing	page 8
The future: Lessons from a pandemic	page 9

Executive Summary

Covid-19 has intrinsically changed the way we view and manage workplace health and safety. Specifically, the government and scientific community has placed an emphasis on improving the quality of ventilation within indoor environments as a way to minimise the spread of Covid-19. Experts agree that the current rules on ventilation are failing to stop infections, including Covid-19. This development continues to turn health and safety regulation on its head, signalling the beginning of a new model of improved ventilation conditions in workplace environments even as we emerge out of the pandemic.

This white paper is a call to action for the change in regulation needed to ensure adequate ventilation within workplace and public indoor environments. Specifically, incorporating learnings from the pandemic following the devastating impact to wellbeing that poor ventilation can cause. This document provides insight into the importance of workplace ventilation systems in terms of employee wellbeing; the scientific case for good ventilation in minimising the spread of Covid-19 and other viruses; how mechanical ventilation systems work; ways to make the workplace a safer environment; a trend moving from comfort in the workplace to wellbeing within the workplace and concludes with a number of recommendations as we look to the future.

Background

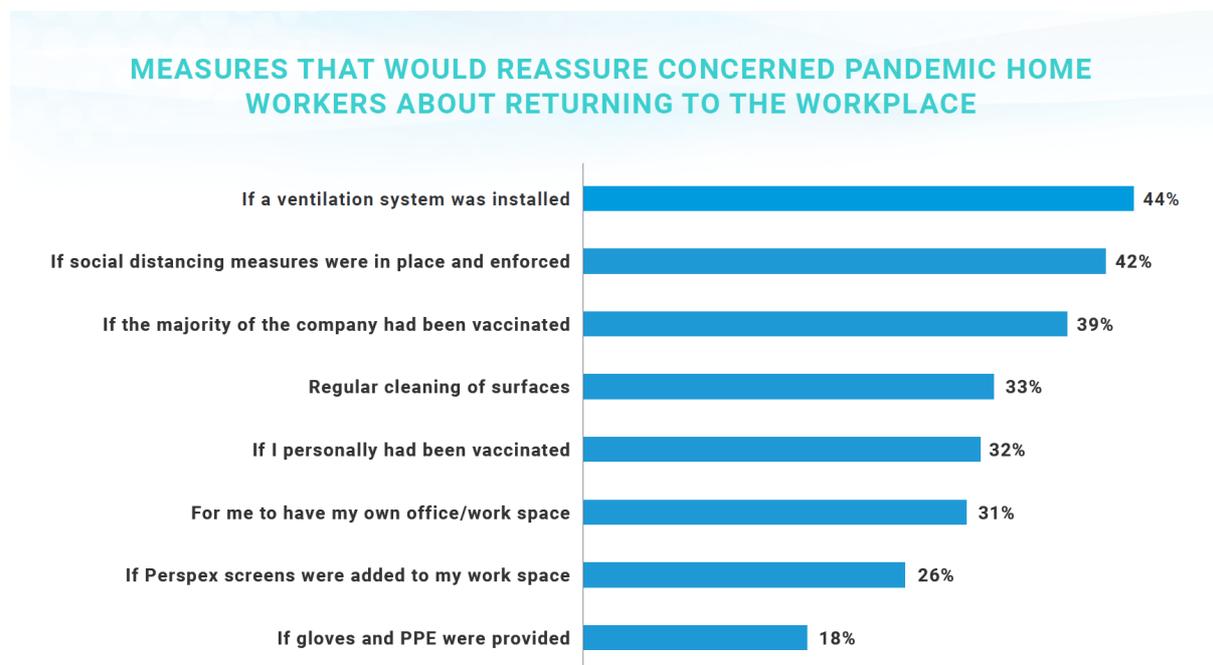
When the news first broke about Covid-19 at the end of 2019, nobody could have predicted the impact the pandemic would have on the way we work. Since then, millions of us have spent over a year working from home following government guidelines to minimise contact with others as a way to keep ourselves safe and our businesses on track as best we can. Now, as restrictions ease and companies across the country return to the workplace, the concept of health and safety at work has never been more front of mind for business owners, their employees and the construction and design industry at large.

The problem is likened to the health crisis caused by contaminated water in Britain's cities in the 1800s. Scientists and engineers alike say that while governments have regulations on the safety of sanitation, food and drinking water, there's far less emphasis on pathogens in the air. In the scientific paper, '*A paradigm shift to combat indoor respiratory infection*' published by Morawska et al (2021), Dr Catherine Noakes, Professor of Environmental Engineering for Buildings at Leeds University said that a "revolution" is needed in how governments regulate indoor air quality and in how the issue is handled in degree and apprentice courses. According to Noakes, an investment in good ventilation is "likely to lead to fewer people being off sick".

This white paper highlights the importance of good ventilation in the workplace to protect employees against the threat of Covid-19 and other airborne viruses and diseases. The future of Covid-19, its mutations and other similar diseases is uncertain, but one thing is for sure, the pandemic has placed 'health and safety in the workplace' firmly in the spotlight, making the importance of employee wellbeing paramount, and the need for adequate ventilation solutions, essential.

Indoor environments under the microscope

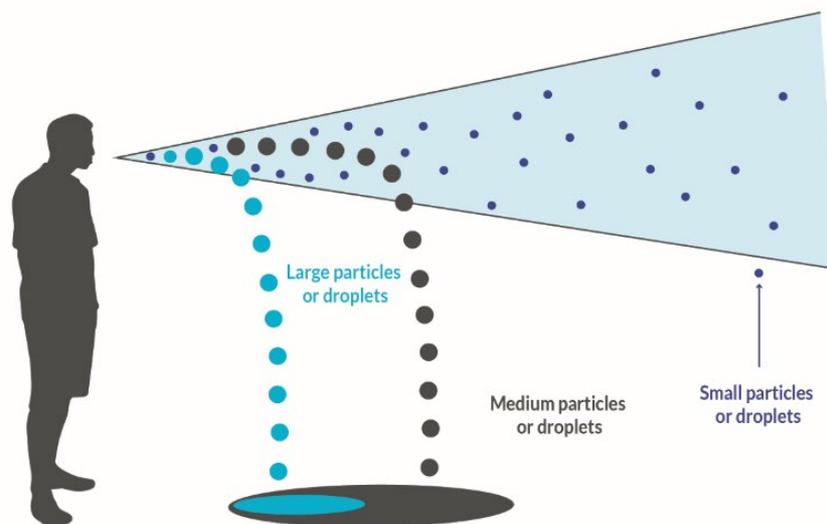
In May 2021, JD Cooling Group™ commissioned an independent survey with Opinium Research using a sample of 1,000 UK employees working from home during the pandemic. The survey concluded that seven out of ten people are worried about going back to their workplace after restrictions are lifted and two-thirds of employees (68 per cent) cited contracting Covid-19 at their place of work as their biggest concern. The survey found that despite the extensive vaccine roll out, many people remain cautious about the prospect of a return to the office.



Source: JD Cooling Group™ conducted with Opinium Research (2021).

Are people right to be concerned? Since the pandemic, one thing the global population is clear about is that indoor environments increase the chance of spreading Covid-19. So why are we more likely to catch Covid-19 and other viruses within an indoor environment?

Covid-19 can be transferred between humans through airborne transmission in aerosol. This means that if an individual has tested positive for Covid-19, virus particles like small droplets are expelled through breathing, coughing, and sneezing. Larger droplets will fall onto surfaces within two metres, and the smaller droplets travel in the air and can remain airborne indefinitely within indoor environments.

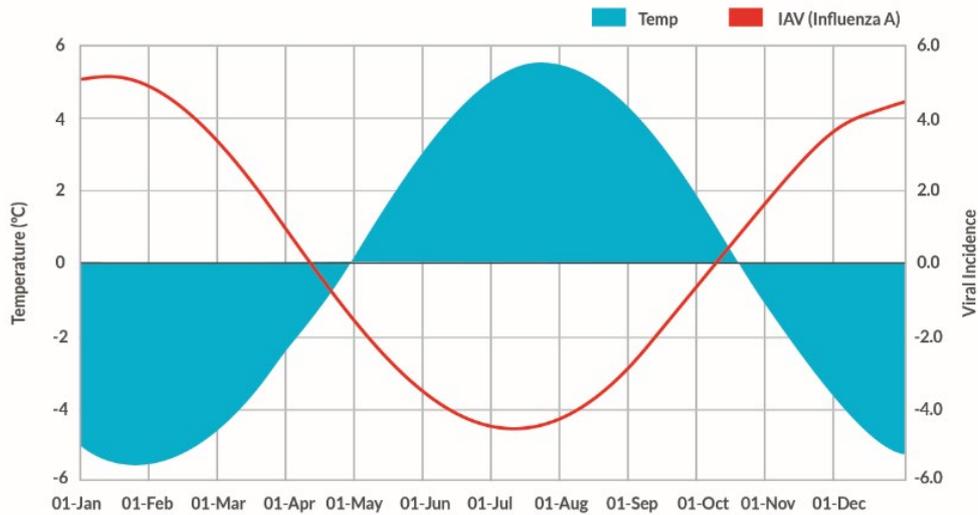


Source: JD Cooling Group™
Graphic inspired by Wei J, et al. Building and Environment 93 (2015) 86-96.

It is therefore widely accepted that spaces need ventilation to replace this stale air. In addition, in a journal, '*Is there an airborne component to the transmission of COVID-19?*' (Beggs, 2020), we know that transmission is five times more likely to occur from talking compared to regular breathing, and 30 times more likely to be found in the air from singing when compared to breathing within indoor environments.

Ventilation, whatever the weather

When it comes to indoor environments, a key factor identified as high-risk is related to the moisture content of the air and the seasonality of cases. In the UK, we know that Covid-19 cases rise during our winter conditions and fall in our summer conditions.



The SARS-CoV-2 virus also appears to exhibit seasonality.

Source: JD Cooling Group™

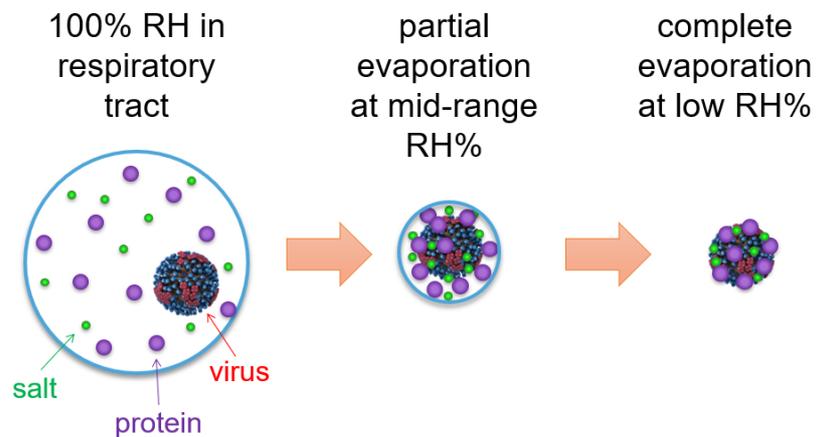
Graphic inspired by Price, R. H. M., et al, Association between viral seasonality and meteorological factors, Sci Rep 9, 929 (2019).

The transmission distance (how far and long a particle or virus can travel and stay airborne) is directly correlated to quality and moisture content of the air we breathe. Effectively, the higher the moisture content, the lower the case levels.

In addition, the decay time of the virus is also affected - this is the time that the virus survives. This can be as much as seven times longer in low-moisture environments.

Although relative humidity (RH) in moisture content is relative to temperature, there has been widespread research with findings concluding that the ideal environment for us to work in is between 40% & 60% relative humidity (RH) and at a typical room temperature.

Water Evaporates, Solutes Don't



SOURCE: Marr, L.C., 2021.

As our working spaces have evolved over the last couple of decades and technology has improved, we surround ourselves with equipment which generates heat, and as a by-product of this and other mechanisms such as air-conditioning, which provides comfort, we unwittingly dry the air we live in.

However, RH alone does not give a true representation of the actual moisture content of air; it is a percentage content of moisture relative to the air temperature. This is why it's important to have ventilation all year round, and especially in the winter months when viruses are more likely to spread.

In fact, there is evidence to show that the moisture content of the air has a direct relationship with Covid-19, SARS and many other viral survival rates. During winter, conditions where temperatures are around 0°C/ 90%RH, there is little if any impact on the virus decay, this means the virus is more likely to remain active and airborne for longer (Beggs, 2020).

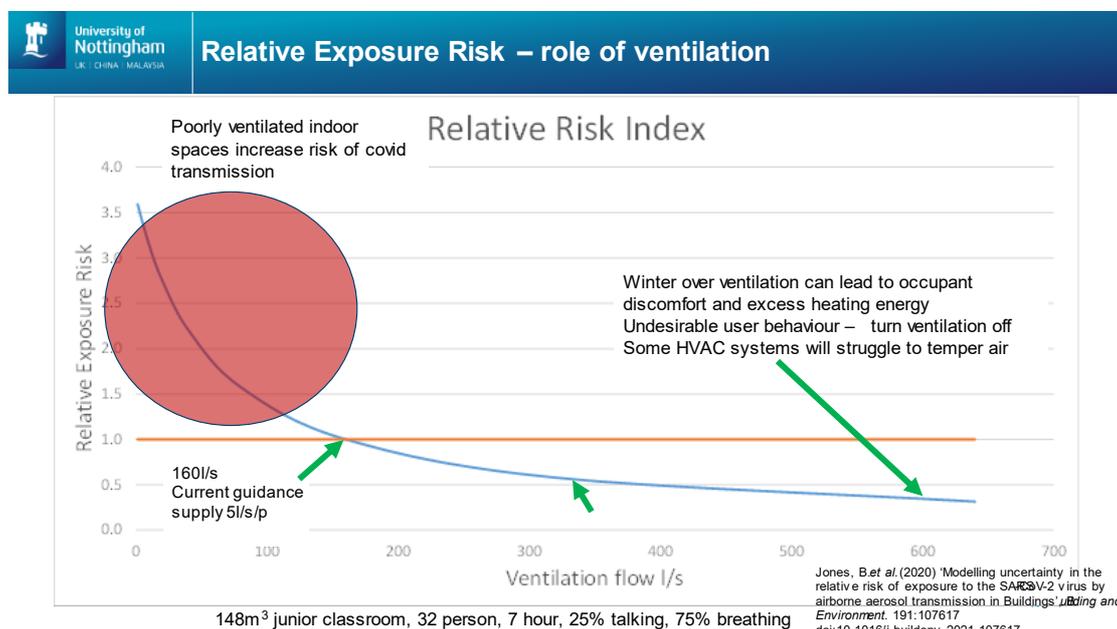
Whereas in summer conditions, with temperatures around 21°C/65%RH, the viral decay is 40 minutes, which means that the virus will decay within 40 minutes and is therefore less likely to be transmitted. In even warmer environments, around 25°C/60%RH, the virus will decay within just 26 minutes. This evidence is backed up by the high numbers of reported respiratory and flu viruses within the month of December (Beggs, 2020).

Minimising the spread of viruses in the workplace

Implementing social distancing, supplying appropriate PPE, and providing hygienic hand-washing areas are of course all measures that can be employed to minimise spread. Dilution and minimising the spread of airborne particles is another important consideration. Good ventilation reduces the concentration of the virus in the air and therefore reduces the risk from airborne transmission. Therefore, by improving air quality, this can help to protect employees within indoor environments.

However, not every working environment has windows and even those that do will be reliant on the outdoor temperature, a breeze and the mild climates that permit open windows. Sometimes a mechanical ventilation system is essential.

There is evidence to suggest that a ventilation system will minimise the spread of germs and viruses like Covid-19. Firstly, there is a correlation between the risk of catching viruses like Covid-19 within poorly ventilated indoor environments. To back this up, there is a recent scientific study from Jones et al. (2020): *'Modelling uncertainty in the relative risk of exposure to the SARS-CoV-2 virus by airborne aerosol transmission in well mixed air in Buildings'*. The research, which examined school environments, shows that poorly ventilated indoor spaces increase the risk of viral transmission. The study found that as the ventilation flow increased, the exposure risk decreases.



SOURCE: Jones, B., et al, 2020.

How mechanical ventilation works

A mechanical ventilation system improves the indoor air we breathe by removing stale or contaminated air and replacing it with filtered fresh air from outside.

Modern ventilation systems comprise of much more than a fan to bring in fresh air, they have developed to become very energy efficient systems, by transferring the thermal energy in the building to the incoming fresh air the system can operate all year to deliver a comfortable temperature to the occupants.

A mechanical ventilation system improves air flow, removes exhaled stale air, and brings in fresh air from outside. By increasing the level of fresh air and air change rate we can reduce the risk of spreading germs through dilution or displacement.

Ventilation trend - from comfort to wellbeing

Over the last couple of decades there has been a noticeable change to workplace environments across the UK. Increasingly more and more organisations, factories, offices and educational settings have prioritised the installation of air conditioning as a way to ensure comfort levels within their spaces.

An air conditioning system is an energy efficient way to cool down or heat up an environment and it is often essential for work environments with lots of electrical equipment such as computers, printers and other equipment.

However, an air conditioning unit does not do the same thing as a mechanical ventilation system. Air conditioning systems, without a ventilation system, circulate the same air, cooling and heating it to a different temperature and controlling the temperature of the room. This is often essential to ensure comfort levels.

A mechanical ventilation system provides a two-way flow of air. It expels air from an indoor environment - the air we breathe in and out as well as stale or contaminated air - and supplies fresh air from outdoors, back into the indoor environment.

An air conditioning system with a ventilation system works two-fold: It controls the temperature of an environment, while providing ventilation at the same time - expelling air from indoors to outdoors, and then circulating fresh, temperature-controlled air from outside into the indoor environment.

During the months following the pandemic, and as we spend increasingly more time back in the workplace, we predict a fundamental change in behaviour, whereby organisations and other work environments may start seeking solutions to help minimise the spread of viruses through a mechanical ventilation system.

Many may consider a mechanical ventilation system installed as a stand-alone piece of equipment but most environments may also require the option of climate control through the installation of air conditioning. A sensible option is to install mechanical ventilation to a new or an existing air conditioning system providing temperature control and fresh air flow to ensure comfort levels, while also minimising the risk of spreading viruses.

Ventilation in the spotlight

Wellbeing has become a hot topic and understanding how good ventilation can minimise not only the spread of Covid-19, but other viruses such as common colds, flu and other diseases, feels important now more than ever. General health and wellbeing is therefore becoming an increasingly important consideration and responsibility for employers as well as those working within the design and construction industries. With a greater emphasis on safety and wellbeing in workplace environments, ensuring adequate ventilation within indoor environments will not only help to minimise the spread of Covid-19 but there are many other intrinsic benefits that are starting to become more apparent to many.

What are the benefits to the employer?

Improving air quality in buildings brings a host of benefits beyond reducing just sickness levels due to respiratory infections. It is likely to reduce allergens and the number of people who experience "sick building syndrome".

So although good ventilation indoors can have a tangible impact on minimising the spread of Covid-19, it can also improve comfort levels and general wellbeing and health too. Good ventilation can:

- Improve your overall wellbeing
- Minimise the spread of other viruses and germs
- Increase overall comfort levels
- Improve mental clarity and concentration
- Offer a better environment for the workplace

Comfort Levels

Specifically, an indoor environment with good ventilation will contain healthy levels of oxygen, which in turn, allows people to feel comfortable, experience better clarity and focus, and generally higher levels of comfort in a working environment.

Mental Clarity and Concentration

When there is a lack of oxygen due to poor ventilation people feel tired, sluggish and uncomfortable, sometimes triggering headaches and other symptoms. Often what follows is discomfort, a lack of concentration and reduced productivity.

For working environments, and seasons, where natural air flow isn't possible, a ventilation system is essential. A mechanical ventilation system will expel used air and send in fresh oxygenated air from outdoors. This replenishes the oxygen levels and increases comfort levels, allowing for better mental clarity, concentration and productivity, while also helping to minimise the risk of spreading harmful viruses.

The changing landscape of workplace wellbeing

It's clear that we're entering a new and different way of working, one perhaps where more consideration is given to wellbeing and health. The survey JD Cooling Group™ commissioned in May 2021 highlighted the concerns among workers where almost half (47 per cent) of those surveyed cited the possibility of catching Covid-19 through airborne transmission indoors as their biggest concern, followed by 40 per cent who said poor air quality is a worry for them about returning to their workplace.

Despite these worries, there were a number of solutions that would help reassure employees about returning to work, with three in five (62 per cent) saying they would like a ventilation system installed to improve air quality, circulation and flow.

This data clearly shows that while there are measures in place, such as face masks and social distancing, people remain concerned when it comes to the next stage of

restrictions lifting, and it won't be enough to simply open doors and windows to put their minds at rest.

Even with the vaccine roll out, proper ventilation is coming out as the top way to help employees feel comfortable about returning to the office. As people are still clearly concerned about catching the virus at work, it's important that employers do what they can in order to protect, reassure and ultimately keep their workforce safe.

Beyond this, the pandemic will undoubtedly have far-reaching long-term impacts on workers' attitudes, as a third (35 per cent) say that they will be more concerned about catching common colds and flu viruses at work than they were before the pandemic, even after the vaccination programme has been fully rolled out.

The future: Lessons from a pandemic

Following any major global event there are often many lessons to be learnt. After a big upheaval such as a world war, catastrophe or pandemic, there often follows a period of re-evaluation, growth, advances in technology, progressive attitudes or preventative measures to avoid or minimise similar situations in the future. It's time to re-evaluate how we view and address the transmission of respiratory infections to protect against unnecessary suffering and economic losses; a time to reflect on what lessons we will take with us into a better future.

We want to be confident that the air in the offices and public buildings we visit is clean. In terms of managing health and wellbeing in the workplace, there is growing pressure and evidence for the regulations and standards for ventilation to be revised. It's not just the industry and scientists calling for it - employees want to be safe and employers want to know what to do. With 22 years in the HVAC industry, I would like to see greater emphasis on regulation and testing in the workplace. This includes:

1. Fresh air rates to be revised and increased.
2. Moisture level standards to be implemented and monitored.
3. World Health Organisation to extend indoor air-quality guidelines to include airborne pathogens.
4. Carbon dioxide levels to be monitored.
5. Regulatory commissioning of ventilation systems.
6. Filtration levels and air sanitisation to be improved.
7. Building certification to reflect the standard of ventilation provided.

Experts continue to challenge the argument that costs of air quality control in buildings would be prohibitive. In fact, the scientists say that the monthly cost of Covid-19 is conservatively estimated at £1 trillion. Yet installing ventilation and air-quality systems designed to remove airborne pathogens would only add about 1% to the construction bill of a typical building, according to the paper published by Morawska et al (2021).

These changes need to be supported, implemented and regulated through governing bodies such as the Health & Safety Executive (HSE), The Chartered Institution of Building Services Engineers (CIBSE) and American Society of Heating and Air-Conditioning Engineers (ASHRAE) – to ensure these new ways of working are fully embraced to improve health and safety conditions, and wellbeing for all.

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Pictorial references

Marr, L., C., Transmission of viruses in droplets, Seminar in Department of Chemistry, University of Toronto

Image courtesy of Dr Chris Iddon, University of Nottingham.

About the Author Mike Gould

Mike Gould has 22 years' experience working in the HVAC industry. An IOR Member, he currently works as an air conditioning and ventilation contractor and pharmaceutical HVAC designer. In 2019 he led the team responsible for winning "Best Clean Room Facility" awarded by Cleanroom Technology. He holds a Bsc in Biomedical science from Anglia Ruskin University.

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It is the UK's leading independent supplier of temperature control systems and specialists in cooling, industrial refrigeration, heating, electrical, automation control and facilities support services. People are central to JD Cooling Group's success including their employees, their customers, and their supply chain.

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