AIR QUALITY AND VENTILATION

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EazySAFE is a leading provider of building and workplace health and safety services. Our mission is to create cultures of wellness in your organisation. We provide occupant centric sensing and software solutions to manage and monitor building and occupant health.

Introduction

This article introduces the important role air quality monitoring can play in mitigating the transmission of airborne viruses, and how simple actions such as opening windows and doors can help us safely return to schools and workplaces.

Increasing evidence suggests the SARS-CoV-2 virus can be transmitted through aerosols, the very fine droplets that we expel when speaking, breathing and doing other normal activities that occur in classrooms and offices throughout the country. Therefore the dilution of contaminated air with fresh air becomes critical to limit the spread of disease. Expert guidance advises that air quality monitoring is the best way to measure ventilation levels in buildings to ensure a healthy and safe environment is maintained.

This article discusses how smart, low cost internet enabled sensors can continuously measure air quality and comfort levels in meeting rooms, classrooms and offices. Real time notifications will alert occupants when air quality becomes poor or unsafe, ensuring action can be taken to improve ventilation.

How does ventilation reduce the risk of airborne transmission?

Ventilation reduces the risk of airborne transmission by diluting contaminated indoor air with fresh outdoor air. This article focuses on buildings with natural ventilation.
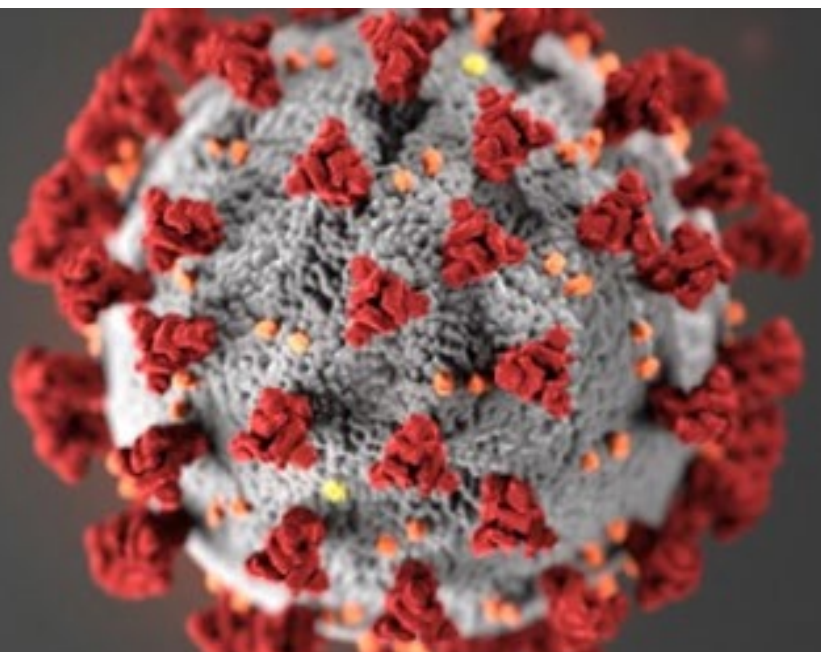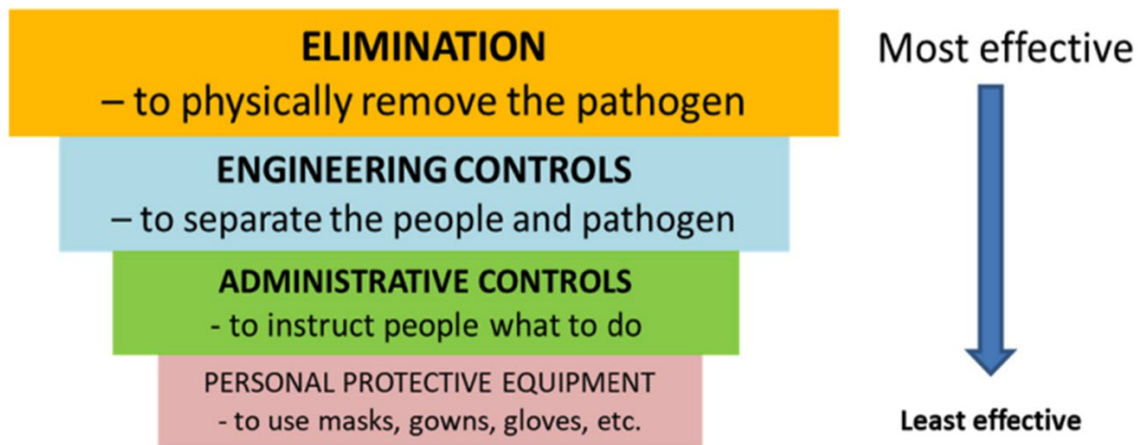
Airborne Transmission

New evidence on SARS-CoV-2 (COVID-19) suggests airborne transmission can occur when people with the virus expel microdroplets while speaking, exhaling or coughing[1] . The particles containing the virus are so small that they can become suspended in the air for long periods of time and potentially travel much further than the 2.0m recommended by the HSE for social distancing. Therefore, as we return to schools, offices and public spaces; good ventilation has become one of the most important control measures required to help fight the spread of this disease.

What is Ventilation?

Ventilation is the process of supplying fresh outdoor air into our rooms and buildings and removing the stale indoor air, by natural (vents, windows and doors) or mechanical means (air-conditioning)[2] . The rate of ventilation is

1. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-how-is-covid-19-transmitted?

ELIMINATION
– to physically remove the pathogen

ENGINEERING CONTROLS
– to separate the people and pathogen

ADMINISTRATIVE CONTROLS
- to instruct people what to do

PERSONAL PROTECTIVE EQUIPMENT
- to use masks, gowns, gloves, etc.

Most effective

Least effective

determined by the volume and velocity of air flow in and out of the room, thus controlling how quickly the exchange process occurs between fresh and stale air.

How Important is Ventilation?

Ventilation as an "engineering control" ranks highly in the hierarchy of controls[3] , as shown in the diagram above. Social distance, cough and sneeze etiquette, hand washing and wearing PPE are very important control measures, however ventilation is considered more effective.

How does dilution help?

Ventilation helps to reduce the risk of airborne transmission of viruses in two ways; supply of fresh air and extraction of stale air. Both processes have the effect of diluting the overall concentration of exhaled virus-laden air and therefore any subsequent dose inhaled by the occupants.

For dilution to occur it is critical that the ventilation rate is sufficient to match the number of people occupying the space and size of the room. With mechanical ventilation, such as air-conditioning systems, this process can be managed. With natural ventilation, such as windows, doors and vents, it becomes much more difficult to manage due to variances in wind direction and differences in indoor and outdoor temperature.

WHO Guidance for Ventilation[4]

Ventilation is an important factor in preventing spread of the virus that causes COVID-19.

- *Consider using **natural ventilation** (i.e., opening windows if possible and if it is safe to do so) to increase dilution of indoor air by outdoor air when environmental conditions and building requirements allow.*

- *Consider **monitoring carbon dioxide (CO2)** levels according to national regulation, because CO2 level is a rough indicator of the effectiveness of ventilation and overcrowding."*

REHVA Guidance for Ventilation in Workplaces[5]

- *It is recommended to install CO2 sensors at the occupied zone that warn against underventilation especially in spaces that are often used for one hour or more by groups of people, such as classrooms, meeting rooms, restaurants*

How do you measure ventilation?

Expert guidance advises that measurement of CO2 in a space is the best way to monitor ventilation levels[6] .

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2. ISO 17772-1: 2017. Energy performance of buildings. Indoor environmental quality. Indoor environmental input parameters for the design and assessment of energy performance of buildings.
3. Hierarchy of Controls, 2015. Centers for Disease Control and Prevention.

4. WHO, 2020. COVID-19 management in schools and other commercial buildings.
5. REHVA, 2020. How to operate HVAC and other building service systems to prevent the spread of the coronavirus (SARS-CoV-2) disease (COVID-19) in workplaces
6. REHVA, 2020: Guidance for School Buildings. Federation of European Heating, Ventilation and Air Conditioning Association (REHVA).

CO2 as a proxy for ventilation.

Carbon Dioxide (CO2) is directly emitted by people as they breathe. The more people that occupy a space or the longer you spend in a space without adequate ventilation will result in a continuous increase in CO2 levels. It is therefore an ideal proxy for ventilation levels, since it is strictly related to the amount of fresh air entering the room, the size of a room and the amount of people occupying the space.

The WHO and other expert bodies are recommending the installation of CO2 monitoring sensors in locations where people will spend long periods of time or where large numbers of people gather.

Can we leave the windows open?

Unfortunately leaving the window open does not guarantee good ventilation when you are relying only on natural ingress of fresh air. Wind direction, internal and external obstructions and the difference in indoor and outdoor temperature all play a significant role in determining how much ventilation can take place.

What do we do in winter?

There will be periods of the year when it will not be possible to keep the windows open all day long and still achieve comfortable conditions inside the building. Not to mention the excess energy and environmental cost of heating a room that is open to the elements.

CO2 sensors can help occupants to manage the ventilation levels in order to maintain a healthy and comfortable environment.

CO2 Measuring Sensors

In rooms and buildings that rely solely on natural ventilation the recommendation is to install sensors with traffic light indicators mounted on the sensor and internet connectivity.

1. Traffic Light Indicators: Sensors with in built traffic light indicators provide a simple and real time indication of air quality levels for occupants. The orange and red lights indicate when air quality is becoming unhealthy or unsafe.

2. Internet connectivity: Ideally smart internet connected sensors should be installed. This enables capture of the air quality data to ensure compliance with guidelines and to identify rooms where existing ventilation is not sufficient.

CO2 (PPM)	Air Quality	Action
> 1,700	Bad	Ventilation required - open all windows, doors and vents
< 1,700	Poor	Ventilation recommended - open windows
< 1,000	Fair	Adequate ventilation - No action required
< 600	Excellent	No action required
< 400	Outdoor	No action required

Take action to improve natural ventilation:

1. Open windows and ventilations' grids as much as possible during occupied hours.

2. Ensure regular airing with windows during breaks (also in mechanically ventilated buildings).

3. Make sure that ventilation facilities are not obstructed or blocked by curtains or furniture.

4. Keep an eye on any installed CO_2 monitors (ask other occupants to assist).

Conclusion

- The WHO states the COVID-19 virus is transmissible by air.
- High levels of ventilation are essential where people are required to spend a lot of time together, such as in classrooms, meeting rooms and offices, to reduce risk of transmission.
- CO_2 monitoring sensors are the best way to measure ventilation levels.
- The sensors should have traffic light indicators for real time alerting when air quality deteriorates.
- The sensors should have internet connectivity to track compliance and ensure ventilation is adequate.

Smart Low Cost Sensors

Smart, internet of things, CO_2 sensors are now widely available at low cost making them accessible to all organisations. Innovative service models remove the barriers of capital expenditure and instead provide data and insight from the sensor and software on an ongoing operational basis.

Benefits offered by Smart Sensors:

- Low Cost - accessible to almost all budgets

- Wireless - making installation very fast and easy

- Internet Connected - No additional costs or infrastructure required

- Simple setup - Plug and Play features

- Software - access to the sensor data via supporting software

- Any device - access your data using any laptop, phone or tablet device

- Reporting - receive regular automated reports about your building or facility.

Contact us for more information.