



THE
Safer Air
PROJECT

Safer shared air

A critical accessibility
and inclusion issue



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Contents

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Foreword

A little boy walks into his classroom. Instantly his face lights up when he sees his classmates running and playing with a paper airplane. I'll join in, I'll do the same! And then a realisation: he cannot be "free" like his friends!

A young woman enters the open-plan office where she works. Friendly faces, smiles, and chats before the morning briefing. She enjoys this small community and feels part of it in every way: intellectually and socially. In a moment she will be immersed in the bustle of the morning. And then the reality sets in: "I cannot do everything like they can".

The air in the classroom and in the office, as in many Australian public spaces, is polluted. Nobody checks what is in the air; nobody ensures that the amount of fresh air that reaches the space is adequate in relation to the number of people in the space. Nobody knows if the air delivered is indeed "fresh", or if occupants' respiratory emissions into the space are quickly removed from it. What are these emissions? Everything we emit during the processes of breathing, speaking, and laughing. All of what we emit because we are alive. But the emitted plume also contains microbes from our respiratory tract: viruses and bacteria. Some of them are pathogenic and make people sick or even kill them if inhaled.

The little boy and the young woman are among millions of Australians with chronic health conditions who are more susceptible to infections if they inhale these airborne pathogens. These infections could

be extremely threatening to their health, and they cannot afford to get infected. Therefore, when entering the classroom or the office, they cannot feel "free" like other people. Right now, people with chronic health conditions must protect themselves from others and the risk of infection in our shared indoor spaces, and they must take responsibility for this because no one else does.

Our Australian community prides itself on being inclusive and supportive, and indeed much has been done to make buildings accessible and safer in many ways. But inclusiveness does not extend to support for clean indoor air; thus, those who are most threatened by air pollution and especially airborne pathogens are excluded from enjoying the most basic freedom of the physiological function of breathing.

But it should not be like this. No one should have to worry about breathing air in public spaces. Indoor air pollution affects us all, and we all have the right to clean air indoors, where we spend more than 90% of our time breathing 12 times per minute. All of us – regardless of whether we have a disability or a chronic condition.

Is it possible to guarantee clean indoor air in all public spaces? The science of indoor air is advanced, and we have sophisticated engineering and building design technologies to achieve this goal. What is missing is the will to implement this knowledge and know-how, and the understanding of how important it is for us all.

The Safer Air Project and its leader, Plum Stone, are doing an extraordinary job of fostering an understanding of the critical role of clean air for the health of our communities and working tirelessly to make clean air the norm. I congratulate the Safer Air Project on this noble pursuit and acknowledge it as an important step towards clean indoor air for all Australians.

Distinguished Professor Lidia Morawska
Australian Laureate Fellow
Centre Director for THRIVE, QUT



Founder's foreword

At the start of the pandemic, I was living in the UK with my young family. Before the country went into lockdown, we all became sick, and I lost my sense of taste and smell for two weeks. Ten days after our symptoms began, my three-and-a-half-year-old daughter suffered a prolonged status epilepticus seizure and was hospitalised. It was several hours before she woke up from the medication that eventually stopped the seizure, the longest hours of my life. Over the next fortnight, she continued to be very unwell, with a range of other challenging symptoms and required several additional trips to the hospital.

Unfortunately, by April 2020, I began developing neurological and cardiovascular symptoms that we now know to be symptoms of long COVID, and which sadly persist today. Both my daughter and I were 'previously healthy' and had no known risk factors for serious illness. Yet, we still suffered poor health outcomes from that initial, acute infection. Adding to our family risk, my husband has an auto-immune disease, which means he is severely immunocompromised and, therefore, remains at significantly increased risk from any infection.

As a result of my family's experience and my almost 20-year history working in healthcare policy and advocacy, I have spent the last few years focusing on the solutions to create safer and more inclusive environments for families like mine, because we are not alone in our experience. People living with high-risk conditions like cancer, diabetes, auto-immune diseases, cardiovascular disease, asthma and many more, are not rare and we are not isolated. People living with these conditions are in every workplace, in every school, in every community. 'They' are all of us: our families, our friends, our neighbours, our co-workers, and we should all be safe to breathe without risk of harm.



So, what's the answer? Many viruses are airborne, and transmission is ultimately fuelled by infections occurring in inadequately ventilated buildings with poor indoor air quality. Improving indoor air quality is, therefore, the obvious solution to making our shared indoor air safer for everyone to breathe, because the burden of responsibility for staying safe shouldn't rest on the immunocompromised or high-risk person, especially when that person is a child.

It's time to recognise that people living with high-risk conditions need safe access to public spaces without risking their health due to airborne infections and make indoor air safe for everyone to breathe. To do so, we need to set and implement indoor air quality performance standards that effectively lower the risk of infection from airborne pathogens, and the health impacts of other pollutants, to achieve accessible public spaces for everyone. I appreciate your support as we seek to create a world where we can all breathe safely indoors.

Plum Stone
CEO and Founder

Executive summary

In late 2019, a novel coronavirus (SARS-CoV-2) emerged, and within months, the World Health Organization (WHO) declared the pandemic a public health emergency of international concern. In the months that followed, public health measures aimed at reducing the transmission of SARS-CoV-2 also reduced the transmission of other viruses, such as influenza.¹ However, since relaxing public health measures, we have seen a significant increase in the transmission of SARS-CoV-2 and other airborne pathogens, including influenza, measles, respiratory syncytial virus (RSV), pertussis and others.^{2,3} Unfortunately, the increased risk of transmission of airborne pathogens is an ongoing problem that disproportionately affects people living with chronic health conditions and other predispositions because they are at significantly increased risk of poor health outcomes from infection.⁴

It is not a small minority of the population who face increased risks from poor health outcomes from airborne infections. While public health messaging has repeatedly focused on ‘protecting the vulnerable’, it may have led to a skewed perception that people with chronic illnesses are the minority, thus ‘othering’ people with high-risk conditions.⁵ However, according to the Australian Bureau of Statistics, one in two (49.9% or 12.6 million) people had at least one chronic health condition, and women are more likely to have at least one chronic condition than men (52.3% compared to 47.4%).⁶ “They” are all of us.

We spend 90% of our time indoors, and everyone needs safe access to indoor environments without the risk of poor health outcomes from infection by airborne pathogens and other pollutants, especially people living with chronic health conditions. However, there is a widespread lack of recognition that poor indoor air quality (IAQ) reduces accessibility to

indoor spaces for people with risk factors for poor health outcomes from airborne infection and other pollutants. As a result of the invisible nature of the problem and the lack of public awareness or public health campaigns to educate the community, many people are unknowingly putting themselves at risk of poor health outcomes. This is a solvable problem.

The importance of IAQ in health has been recognised for some time and was highlighted in the very first chapter of Florence Nightingale’s seminal book, *Notes on Nursing*, in 1859.⁷ More than 160 years later, the evidence continues to mount, showing that improving IAQ and committing to safer indoor air environments,

“The very first cannon of nursing... To keep the air he breathes as pure as the external air, without chilling him.”

– Florence Nightingale,
*Notes on Nursing*⁷

can both substantially reduce the risk of airborne infection,^{8,9} and lower the risk of poor health outcomes from other conditions such as asthma and allergies.^{10,11} In doing so, we can increase the safety and accessibility of indoor environments for everyone, protecting health now and into the future.

To date, advocates for equity, diversity, inclusion, and belonging have focused on accessibility for people of different races, ethnicity, age, gender, religion, sexual orientation, disability, economic

status, and other diverse backgrounds. For example, the Australian Disability Discrimination Act 1992¹² makes it necessary for every area and facility open to the public to be safely accessible for people with a disability. The Premises Standards define the accessibility features as ‘necessary’. Another example is the Children’s Services Regulation, which puts restrictions on the built environment to ensure the health and safety of children in those environments.¹³

Now we need to expand our thinking on accessibility to include people with chronic health conditions that cause invisible disabilities and clinical vulnerabilities. We also need to recognise that people without known risk factors are also at risk of developing health complications from airborne infections and exposure to other pollutants, such as damp buildings or during vegetation fires, and that these health risks may significantly impact society.¹⁴

Recognising that many viruses are airborne and transmitted primarily indoors where spaces are inadequately or inappropriately ventilated and that they cause disproportionate harm to people living with high-risk conditions, underscores the vital need to prioritise accessible IAQ in all public spaces. Improving IAQ will address the risks associated with

airborne pathogens and reduce the poor health outcomes that arise from other airborne pollutants. Creating safer indoor air environments can be achieved, and we already have the tools to make safer indoor air in all public spaces a reality.⁹ We have identified four priority areas where the urgent implementation of IAQ performance standards is critical to reduce infection risks from airborne pathogens, as well as the health impacts of other airborne pollutants. These priority areas are:

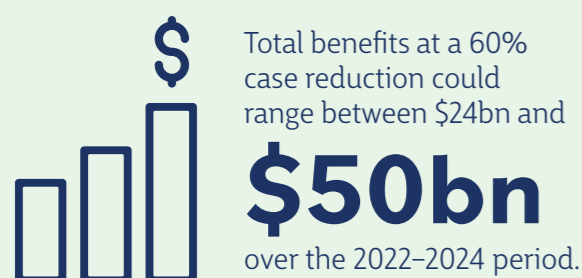
- 1. Child education settings** – All children deserve a safe learning environment that minimises the risk of infections from airborne pathogens
- 2. Healthcare** – Healthcare environments must protect patients from healthcare-acquired infections, especially those that may worsen pre-existing conditions
- 3. Disability, aged-care, and residential care settings** – Residents have the right to a safe living space, free from infection risks
- 4. Workplaces** – Employees, particularly in the high-risk sectors above, deserve safe working conditions, including protection from airborne pathogens.



The right to safe access for employees and other users of each of these settings are already covered by existing workplace health and safety standards and regulations,¹⁵ and these rights need to be reconsidered in the context of preventing serious harm that may occur due to airborne infections and exacerbating existing health inequalities.

Improving IAQ for accessibility and reducing the risk of airborne infection in shared indoor environments, with a focus on people living with high-risk conditions, makes indoor air safer and healthier for everyone. Businesses that invest in

Financial benefits of improved IAQ



improving their IAQ can achieve a social return on their investment through increased accessibility and inclusion, and a financial return as they realise other benefits such as improved cognitive functioning, increased productivity, satisfaction and creativity and reduced sickness costs.¹⁶⁻¹⁸

A preliminary economic analysis, conducted for this report, on the benefits of improved indoor air quality, which is based solely on reduced sickness, through the avoided costs of COVID-19 and long COVID cases that would not occur due to enhanced air quality in public spaces, indicates that a significant return on investment is achievable. The analysis shows that the benefits of improved indoor air quality in public spaces, assuming a 60% reduction in cases, could range between \$24 billion and \$50 billion over the 2022-2024 period and achieve a benefit-to-cost ratio (BCR) for Australia, of between 1.5 to 3.1. While there is uncertainty around the precise scale of the benefits and costs of improving indoor air quality in public spaces, there is a high level of confidence that the BCR in Australia exceeds 1.0, meaning the benefits are likely to outweigh the costs. A more detailed study by the Productivity Commission, or a similar agency, is recommended to determine the precise BCR for Australia.

It is time to recognise IAQ as a critical accessibility and inclusion issue for people living with chronic health conditions. The provision of safe air for all should be considered an urgent priority to prevent and control the transmission of infectious diseases and reduce the disproportionate harm they cause to people living with high-risk conditions.

Recommendations

Over the next year, we call on the Government to action six priority recommendations:

1. Acknowledge IAQ as an accessibility issue that must be addressed to deliver the accessibility theme within the Australian Disability Strategy. In addition, note that a lack of access to safe air spaces represents a potential breach of the Disability Discrimination Act 1992
2. Set IAQ performance standards, that effectively lower the risk of poor health outcomes from infection by airborne pathogens and other airborne pollutants, for all public spaces as covered by the Disability Discrimination Act, and update the Premises Standards to include IAQ as an accessibility feature
3. Address the gaps in the implementation and enforcement of existing workplace health and safety laws and ensure that appropriate steps are taken to prevent infection risks from airborne pathogens
4. Prioritise implementation of IAQ performance standards in four key settings
 - a. Education (including early years, primary and high schools)
 - b. Healthcare (including hospitals, primary health, allied health, pharmacies etc.)
 - c. Disability, aged care and other residential settings
 - d. Workplaces
5. Recognise that infection prevention control (IPC) is a shared, whole of community issue, not just a healthcare setting issue, and direct the newly established Australian Centre for

Disease Control (CDC) to include IPC in its remit

- a. Direct the Australian CDC to update IPC guidance, for all settings, to include appropriate mitigations for the prevention of transmission of airborne pathogens

6. Direct the Productivity Commission to conduct a benefit-cost analysis for investments required to meet IAQ performance standards in all public spaces

Over the next year, we call on employers to action two priority recommendations:

1. Adopt and demonstrate compliance with IAQ performance standards for all business premises
2. Acknowledge IAQ as an accessibility and inclusion issue and incorporate it into existing equity, diversity, inclusion, and belonging policies

Improving IAQ for accessibility and reducing the risk of airborne infection in shared indoor environments, with a focus on people living with high-risk conditions, makes indoor air safer and healthier for everyone.

Introduction

In late 2019, a novel coronavirus (SARS-CoV-2) emerged, and within months, the World Health Organization (WHO) declared the COVID-19 pandemic as a public health emergency of international concern. In the months that followed, public health measures aimed at reducing the transmission of SARS-CoV-2 also reduced the transmission of other viruses, such as influenza.¹ However, since relaxing public health measures, we have seen a significant increase in the transmission of SARS-CoV-2 and other airborne pathogens, including influenza, measles, respiratory syncytial virus (RSV), pertussis and others.^{2,3} Unfortunately, the increased risk of transmission of airborne pathogens is an ongoing problem that disproportionately affects people living with chronic health conditions and other risk factors because they are at significantly increased risk of poor health outcomes from infection.⁴

It is not a small minority of the population who face increased risks from poor health outcomes from airborne infections. While public health messaging has repeatedly focused on ‘protecting the vulnerable’, it may have led to a skewed perception that people with chronic illnesses are the minority, thus ‘othering’ people with high-risk conditions.⁵ However, according to the Australian Bureau of Statistics, one in two (49.9% or 12.6 million) people have at least one chronic condition, and women are more likely to have at least one chronic condition than men (52.3% compared to 47.4%).⁶ Some of the most prevalent chronic health conditions in Australia include cancer, kidney disease, lung disease including chronic obstructive pulmonary disease (COPD), heart, stroke and vascular disease, diabetes, and asthma (see *Figure 1*).^{6,19}

Additionally, many people without known risk factors for poor outcomes from viral infection develop post-

It is not a small minority of the population who face increased risks from poor health outcomes from airborne infections.

acute infection syndromes, such as long COVID and Myalgic Encephalomyelitis (ME).^{14,30} Long COVID and ME can affect people of any age (including children and elderly),^{31–35} people of different race and ethnicities, sex and gender, and irrespective of baseline health status.^{36,37} Therefore, compounding the high levels of people living with pre-existing health conditions, with the ongoing transmission of SARS-CoV-2 and other airborne pathogens, more people will become newly vulnerable to poor health outcomes.³⁶

Even before the COVID-19 pandemic, acute respiratory illnesses were the leading infectious cause of death, responsible for more than 2.74 million deaths globally.³⁸ The economic cost of these infections has been, and remains, high. For example, Australia’s economic burden from lower respiratory infections exceeded \$1.6 billion in 2018–19.^{39,40} Yet, for several reasons, the risks and our ability to prevent the significant social and economic costs were largely ignored until the pandemic brought them into focus.

Many have described the pandemic as a pandemic of buildings because transmission predominantly occurs indoors, in inadequately or inappropriately ventilated spaces.⁴¹ In finally acknowledging that respiratory illnesses are predominantly spread through the air, we can understand the drivers of transmission and, importantly, how to prevent airborne infections

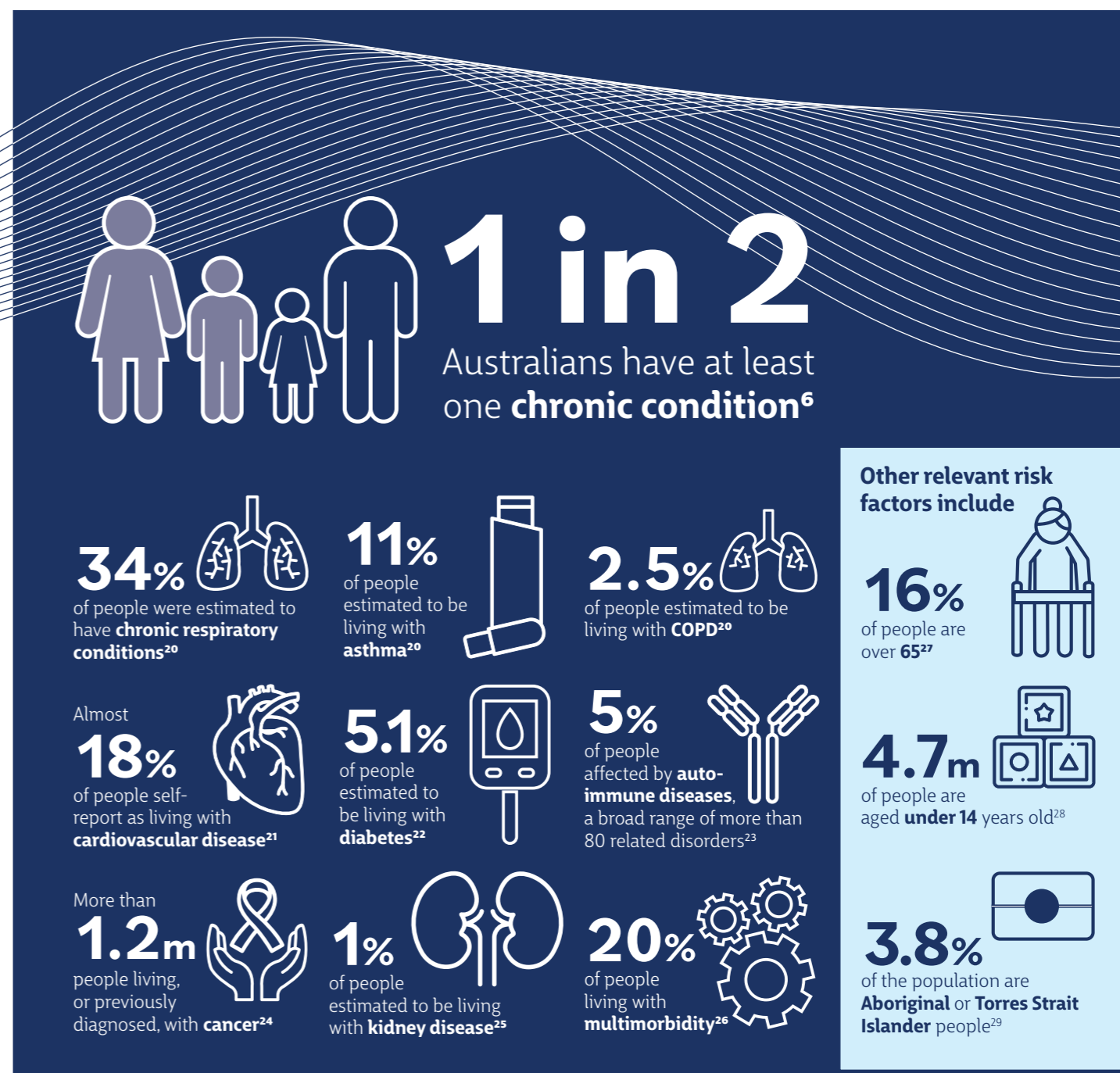


FIGURE 1 ‘They’ are all of us

from occurring by improving indoor air quality (IAQ).^{42,43} The pandemic has also shown that we have been paying insufficient attention to the design of buildings and ventilation and filtration systems to achieve healthy indoor environments, including safe workplaces, schools, and public transport.⁴⁴ We need this to change, for everyone’s benefit.

Improving IAQ and committing to safer indoor air environments can substantially reduce the risk of airborne infection and lower the risk of poor health outcomes for everyone, especially for people living with chronic health conditions and other risk factors. Improving IAQ through ventilation, air filtration and air cleaning will also address other airborne contaminants, such as fine particulate matter (PM_{2.5}), that are hazardous to health.^{45–47}

Although we may not be able to eliminate respiratory infections by controlling airborne transmission in shared indoor spaces, especially due to the nature of close-range transmission, we can substantially reduce them.³⁹ In Australia alone, if hospital admissions caused by airborne respiratory viruses could be halved by reducing transmission, it would save hundreds of millions of dollars each year.³⁹ And it follows that the same measures would reduce hospitalisations for millions of people, saving billions of dollars globally.

This is a solvable problem; it’s time to make indoor air safer for everyone to breathe.

The role of indoor air quality in accessibility

For a long time, we have known that people living with chronic health conditions are at increased risk from poor health outcomes from many viral infections. People living with a wide variety of chronic health conditions, including transplants, cystic fibrosis, cancer, auto-immune diseases (such as IgA nephritis and Crohn's disease), the very young, and the elderly, have routinely been told to avoid infections by their clinicians. This advice could include things like avoiding public transport, types of careers to avoid, changes to duties at work, forms of childcare to enrol children in – or even considering not having children at all. However, there has been a widespread lack of recognition that poor IAQ increases the risk of airborne pathogen transmission and, in turn, reduces accessibility to indoor spaces for people with risk factors for poor health outcomes from infection and other airborne pollutants.

As a result of the increased risks people living with chronic health conditions face, they need safe access to indoor environments without the risk of poor health outcomes from airborne pathogens or pollutants. By recognising that safe IAQ is critical to protecting the health and safety of people with chronic health conditions and choosing to act, we can ensure that the air we share indoors is safer for everyone to breathe.

Equity, diversity, inclusion, and belonging and people with chronic health conditions

Until now, advocates for equity, diversity, inclusion, and belonging (EDIB) have focused on accessibility for people of different ethnicity, age, gender, religion, sexual orientation, disability, and other diverse backgrounds. Yet, despite the high numbers of

people living with chronic health conditions, they are rarely considered in diversity and inclusion policies and procedures. At best, people with chronic illnesses may be incorporated under umbrella disability policies, but this is problematic because people with chronic illnesses do not necessarily identify themselves as living with a disability.

The needs of many people living with chronic health conditions go unnoticed due to the often invisible nature of chronic illness. Yet, they remain at increased risk of exacerbating their illness, or even death, when exposed to unsafe conditions. Meanwhile, the needs of people living with disability to avoid airborne infections through safe IAQ have also not been recognised in policy.

Now it is time to expand our thinking on EDIB to include accessibility for people with chronic health conditions that cause invisible disabilities and clinical risk. We also need to recognise that even people without known risk factors are at risk of developing health complications from airborne infections and other pollutants, such as damp buildings or during vegetation fires, and that these health risks may significantly impact organisations and society more broadly.¹⁴

The right to safe and universal access to public spaces

Public places play an important role in communities, and they should be able to accommodate persons of all ages and abilities.⁴⁸ Around the world, we have laws governing safe and universal access to public spaces for people with disabilities. While the laws that govern safe and universal access to public spaces for people with disabilities vary by country, several key standards for accessibility are commonly

recognised around the world, such as the Americans with Disabilities Act in the US and the European Accessibility Act in the EU.

In Australia, the Disability Discrimination Act 1992 (DDA) makes it unlawful to discriminate against people with disabilities and includes provisions for ensuring accessibility in public spaces and services.⁴⁹ The Disability (Access to Premises – Buildings) Standards 2010 also provide detailed requirements for building design and construction of ramps and stairways, accessible entrances and bathrooms, hearing augmentation systems, tactile surfaces and others, to ensure that public buildings are accessible for everyone.^{50,51}

The DDA states that a person's disability may be temporary or permanent; a physical, intellectual, sensory, neurological, learning, or psychosocial disability; a disease or illness; physical disfigurement; or a medical condition or work-related injury.⁵¹ As such, many chronic health conditions, including temporary illnesses, are already considered a disability under the DDA. If a person's illness falls under this definition, their employer must

make reasonable adjustments, including building modifications, to ensure they can continue working.⁵²

We can no longer ignore the connection between IAQ in public spaces and the accessibility challenges it presents for people with chronic health conditions and other risk factors; we need to mandate safe IAQ performance standards for all public spaces.⁵³

Given the legal provisions that already exist governing universal safe access to public spaces for people with disabilities, including for people living with chronic diseases, or invisible disabilities, it is time that the DDA and the Premises Standards are adapted to make indoor air safer for everyone to breathe.

People living with chronic health conditions need safe access to indoor environments without risk of poor health outcomes from airborne pathogens or pollutants.



Craig

Life during COVID – a throwback to an alienating and inaccessible era

While many in the community recall the restrictions and isolation of the lockdown period as a thing of the past, the reality for some people with disabilities and health conditions is that this has become the way we live now.

My small family, which includes my 89-year-old mother and brother, have now spent almost half a decade shielding in a state of perpetual lockdown based on medical advice and direct experience of SARS-CoV-2.

All of us have significant disabilities and risk factors. My brother and I have a rare disability called central core disease, which is a neuromuscular condition that leaves us highly vulnerable to respiratory illness. At the same time, my brother also has Myasthenia Gravis and Asthma. Mum is 89 with smoker's bronchitis after picking up the habit in the 1950s.

Respiratory infections for us were always to be avoided; however, the risk of COVID tips the scale to unacceptable. We've all been vaccinated and had years of boosters, but my brother contracted COVID last year in a health setting, spent 10 days on a ventilator and nearly died. When I asked a doctor about my risks, he shook his head and said, 'Look, you don't want to get COVID as a long-term wheelchair user'. We don't know how Mum would fare, but we're not keen to find out.

We all make risk calculations every time we cross the street, but not with the level of plausible risk that now confronts my small family. Every visit to an indoor setting is a game of Russian roulette, which requires us to ask, 'Is this worth the risk of possibly killing our whole family?'

As a result, our world is much smaller. With a few exceptions, none of us has gone to a friend's home, a cinema, an indoor restaurant, a hotel, a library, a theatre, a gallery, a sporting match, a café or another venue since September 2021 when the virus began circulating again here in the ACT. We have not travelled on planes, trains or buses or connected with relatives outside of immediate family in years.

When my previous workplace began going back to the office, they said the right things, but it became clear pretty quickly that being the one home-based staff member simply wasn't going to work. I was forced to make the difficult but necessary decision to leave my job of seven years, followed by the strange, sad experience of going into the office on a weekend when no one was there to pack up my personal effects and slowly drag my boxes out the door. Enjoyable clubs and volunteer groups I was a part of also fell away with no online options.

Canberra is a lovely city but very cold in winter. While most people are able to get to the theatre or the cinema or restaurants in the cold months, this is now closed off for me, meaning that winter days are very much eat, sleep, screen, repeat. That hamster wheel drove many people to distraction during the 2020 – 2022 lockdowns – but we've been living like that for years, along with chronic pain and other issues associated with inactivity. Spring and summer are the saving grace as I can go on long wheels around the bike paths around my home.

Being a vulnerable person in COVID-19 feels like a cross between being some kind of high-risk offender on never-ending home detention and a ghost in the movie *The Sixth Sense*. Confined to home most of the time and then able to go out for contactless wanders through the spaces and places where you once interacted with real people.

It's a grim old life, but it also feels a bit familiar.



As a fifty-something with a lifelong disability, life in 2024 feels like growing up in the closed world in the 1970s before disability rights and accessibility were commonplace.

A lack of accessible buildings, transport and facilities, along with community attitudes, meant it was pretty rare for people with a disability like mine to go anywhere outside the family home. We just never went anywhere.

Governments and advocates like me may talk about progress, the 'social model of disability' and 'inclusion', but to be honest, none of it feels real anymore.

In one important way, 2024 feels much worse than fifty years ago because those brief excursions into the outside world now feel risky, stressful, and dangerous.

For instance, health facilities are places where there is increased COVID risk, but we have also seen the gradual disappearance of masks, air filters, and other precautions.

I only visit a GP when absolutely necessary, while visits to the emergency department now involve a terrifying risk weighting. "Are these chest and shoulder pains really bad enough to risk being exposed to COVID?" Dropping dead of a heart attack versus having my whole family contract a virus and suffocate aren't calculations any of us should be making, but here we are.

The last few years have been strange, stressful, solitary, and sad for some of us, but there are things governments and health authorities can realistically do.

Firstly, they should acknowledge some of us have been left behind. This requires an admission that current layers of vaccination and treatment are not

enough to protect everyone from serious illness, so there are now some people who are marooned and isolated.

Gaslighting or ignoring people who have made a rational decision to shield themselves from COVID is not humane or respectful. It's incredibly frustrating and enables vilification.

While we live in hope, I know that Governments are not going to suddenly decide to eliminate community transmission of COVID any time soon. Failing a medical breakthrough to strengthen vaccines and/or treatments this is a situation we are stuck in for some time.

So, let's admit the mess we're in and make the best of it by taking some sensible steps to adjust the risk rating for people like me, making life more tolerable and the world more visitable.

Clean air, masking and sensible precautions in key settings would make decisions about accessing health and dental care and key services a bit less fraught and stressful.

Community development work and outreach to people who are isolated would also make a difference, as would enshrining rights to work and study.

An acknowledgement that some people need to shield themselves might prompt innovative and accessible responses. Holding more outdoor events and options, providing quiet or by-appointment options at venues and ensuring that more face-to-face events are mirrored online would be a start.

Craig Wallace is the Head of Policy at Advocacy for Inclusion. You can read their White Paper on COVID here and you can also follow Craig @CraigWtweets



Studies have shown that classrooms equipped with properly designed and maintained mechanical ventilation systems can reduce the relative risk of infection for students by at least 80%.⁶⁰

FOUR PRIORITY AREAS FOR ACTION

1. Children have a right to access a safe learning environment

Many legal frameworks and international agreements enshrine every child's right to a safe learning environment. Internationally, these rights are supported by the United Nations Convention on the Rights of the Child (CRC), domestic laws such as the Education Act 2002 in the United Kingdom, and Human Rights Law. These frameworks collectively ensure that children have access to a safe learning environment that is not harmful to their health.⁵⁴

In Australia, several entities and frameworks work together to ensure that children are safe in education, including the Federal Government, the Australian Human Rights Commission, State and Territory Governments, and schools and education providers. Schools also have a duty of care for students while they are involved in school activities, which extends to situations where students are at the school outside normal school hours or engaging in off-site activities.⁵⁵ Additionally, the Children's Services Regulation puts restrictions on the built environment to ensure the health and safety of children in those premises and includes specific guidelines for ventilation and other safety measures.¹³ However, in the absence of standards for safer indoor air quality, many children with chronic health conditions are at risk of poor health outcomes from viral infections acquired in the classroom.

In addition to the health risks faced by children with pre-existing conditions, many viruses circulating in schools, including SARS-CoV-2, influenza, RSV, measles, and bacteria such as mycoplasma pneumonia, pose a significant risk to all children. With each new wave, the number of people, including children, experiencing reinfections with SARS-CoV-2 increases, adding to the cumulative risk of children developing long COVID, as well as sub-clinical organ damage, type 1 diabetes, and other post-acute

sequelae.⁵⁶⁻⁵⁸ In the United States, COVID-19 is also a leading cause of death in children and adolescents.⁵⁹

Without mandated performance IAQ standards that effectively lower the risk of infection from airborne pathogens and the health impacts of other airborne pollutants in schools, many high-risk children (and the children of high-risk families) are put in the position of having to protect themselves from harm. Studies have shown that classrooms equipped with properly designed and maintained mechanical ventilation systems can reduce the relative risk of infection for students by at least 80%, where ventilation rates exceed 10Ls⁻¹ student⁻¹, compared with a classroom with only natural ventilation.⁶⁰ Meanwhile, other studies have shown that the use of portable air purifiers can deliver a 30% reduction in infections in daycare settings,⁶¹ (see *We have the tools to deliver safer indoor environments, now we need indoor air quality performance standards*).

However, in Australia, many schools are naturally ventilated. While some States in Australia acted to ensure air purifiers were placed in every classroom to protect children from infection when schools returned following the lockdowns,⁶² the majority relied solely on natural ventilation or hybrid systems.

The challenge with relying on natural ventilation is that it depends on teachers remembering to open the windows and doors which may not happen due to noise, the weather being too hot, too cold, or poor outdoor air quality due to bushfire smoke. For example, the SAMHE study in the UK measured ventilation rates in schools and found that the overall mean ventilation rates were well below these rates at 5.3Ls⁻¹ person⁻¹, rising to 6.8Ls⁻¹ person⁻¹ in warmer weather and falling to 3.8Ls⁻¹ person⁻¹ in colder weather.⁶³ The number exceeding the 1500ppm CO₂ threshold rose



to approximately 20% when the daily mean outdoor temperature fell to around 5°C, indicating that thermal comfort will be prioritised over IAQ.⁶³ Notably, these rates are well below the 10Ls⁻¹ student⁻¹ in the classroom study above,⁶⁰ and significantly below the 20Ls⁻¹ student⁻¹ recommended for classrooms the ASHRAE Standard 241 (ASHRAE 241) for the control of infectious aerosols,⁶⁴ (see *We have the tools to deliver safer indoor environments, now we need indoor air quality performance standards*).

The same human challenges also exist for ensuring the proper use of air purifiers, with teachers needing to switch them on, position them properly, and ensure they are running at the right speed, adding to the existing workload. Parent groups and individual families have become responsible for advocating for the use of air purifiers and carbon dioxide (CO₂) monitors on an *ad hoc* basis with varying degrees of success. In the meantime, high-risk children continue to wear respirator masks to protect their health and

The same human challenges also exist for ensuring the proper use of air purifiers, with teachers needing to switch them on, position them properly, and ensure they are running at the right speed, adding to the existing workload.

because of the burden of responsibility for doing so, we shouldn't expect them to protect themselves from the air they breathe. Yet without mandated indoor air quality standards in schools (and other public spaces), that's what we've ended up with when it comes to air quality.

We have heard from many teachers and parents that schools are no longer taking steps to prevent the spread of airborne pathogens. Examples include schools allowing teachers and children to come to work while knowingly sick, leading to infection of other staff and students, and refusing to notify families of confirmed cases, preventing high-risk families from making an informed risk assessment. These actions are placing high-risk families in the untenable position of having to balance the need for their children to receive an education with their family's need to protect themselves from potentially catastrophic health outcomes following an infection, which is at odds with the school's duty of care to each child.

It's time to ensure every classroom in Australia is safe for every child. We need to set IAQ performance standards that can reduce the transmission of airborne infections to the lowest practicable level, monitor indoor air quality in real time and mechanically ventilate schools to ensure classrooms meet these accessible standards consistently.

the health of their families, with limited support and often while experiencing bullying and exclusion.

The wearing of respirators should be a last resort because people living with chronic health conditions shouldn't be the only ones responsible for protecting their health from unsafe air, particularly children. It's a huge responsibility for young children to have to wear respirators to protect themselves and their families from poor health outcomes because the air they breathe at school, and other public spaces, is not safe for their health. In the same way that we wouldn't expect children to have to boil water to make it safe to drink, not just because they could get burnt but



Kate for Emily



In March last year, my four-year-old niece Emily was diagnosed with neuroblastoma, a rare and aggressive childhood cancer that started as a single immature cell and quietly grew into a tumour the size of a grapefruit.

Oncologists call neuroblastoma “a silent monster” because by the time it is found and finally diagnosed, it has usually spread. In the space of a month, Emily’s cancer spread to her skull, her spine, her arms and legs, her optical nerve, and her bone marrow. During this time, her only symptom was a sore tummy and an occasional fever.

For this reason, neuroblastoma is also known as “the kitchen sink” of childhood cancers. Oncologists must throw everything at it: chemotherapy, surgery, high-dose chemotherapy with stem cell rescue, radiation, and immunotherapy. Neuroblastoma has one of the longest, most aggressive, and most toxic treatment protocols of any paediatric cancer.

In fact, one of the chemotherapies that Emily received is so toxic that we had to bathe her every four hours, day and night, so that her skin didn’t burn when the toxins left her body.

Like most kids, however, Emily rolled with the punches. Despite the pain she endured, she never complained. The hospital was her new home, and she named her IV pole Bobby. Naturally, Bobby was to blame for the fake spiders that taunted the night nurses, and the super soaker that drenched unsuspecting visitors. After a dressing change or a blood transfusion, Emily coaxed the doctor on call to fetch her a toy from the Bravery Box. As a family, we often joked that she was dancing while cankering because even at her sickest, she would still sing and dance.

There was always hope.

After five rounds of chemo and a high-risk surgery to remove her primary tumour, that hope was amplified. The frontline treatment worked better than expected. Her PET scan revealed she was cancer-free. She had a perfect response to treatment.

However, because of the high chance of relapse – a threat that hangs over every family with neuroblastoma – we had to proceed with a bone marrow transplant. At this point, Emily’s immune system would be destroyed past the point of recovery and rebuilt with her own stem cells. The transplant team assured us that Emily was in safe hands. “Transplant works best when there’s no evidence of disease,” they said. “Emily is in the best position possible.”

For the second time since Emily’s diagnosis, we allowed ourselves to feel hope. Cautious hope.

During transplant, while Emily was in protective isolation, she entertained herself by opening a coffee shop – Emily’s Unicorn and Rainbow Cafe. There were three menus to choose from: First Dessert, Second Dessert, and Snacks. If there was an item on the menu that Emily didn’t feel like making, she would simply say, “Sorry, we’re closed.”

When the high-dose chemotherapy obliterated her immune system, her coffee shop closed for good. At times, the pain was so severe she fainted. Thumbs up and thumbs down became her only way of communicating due to the mucositis in her mouth. Because she couldn’t eat or drink, she received a nutritional formula intravenously through a special pump. She suffered greatly, and there was nothing we could do.

Naïvely, we thought the worst was over when Emily’s stem cells engrafted, and her neutrophils started to rise. But that’s the thing about hope: it conspires against you.

At some point during her transplant, Emily contracted a fungal infection called *Lomentospora prolificans*. The fungus, which has been isolated from hospital soils and plants, occurs in urban environments and is typically found in arid climates. While the infection can affect the immunocompetent, it is especially dangerous for the immunocompromised, particularly those with cancer. When we asked Emily’s oncologist how she encountered the fungus, he said, “she probably breathed it in”.

Two days later, the fungal infection travelled to Emily’s brain and caused six mycotic aneurysms. When the first aneurysm ruptured, she was left with permanent brain damage. She lost her movement, her vision, and her complex reasoning. A shunt was implanted in her brain to drain the excess blood and fluid, and she was put on a ventilator to help her breathe.

After a week in the ICU, an Infectious Disease specialist finally agreed to meet with us. She explained that Emily’s best chance was the antifungal regime; however, Emily’s particular infection was resistant to most antifungal treatments. In the next breath, she informed us that the most promising drug available, Olorofim, was not an option for Emily because it had not yet been approved for use in children. “Even if they released the drug,” she said, “I wouldn’t know how to dose her.”

Emily died three days later, with her mum and dad holding her, and our family gathered around her bed. She was wearing her *Bluey* pyjamas and holding her stuffed puppy. Her Make-A-Wish was granted the next day.

One year on, we still have questions. How did Emily contract a fungal infection during her bone marrow transplant? Why did the hospital’s infection prevention and control measures fail? Why wasn’t Emily safe? Was the airlock system working? Why weren’t we told how serious the infection was, so that we could say goodbye to Emily before she had a stroke and was no longer conscious?

The only explanation we’ve been given is that “Emily was just very unlucky”.

Luck shouldn’t control a child’s life. Luck shouldn’t determine your health or your happiness or your future. Luck is a gambling term. Why are we rolling the dice with the most vulnerable members of our community – our children?

Like other kids with neuroblastoma, Emily was diagnosed with one of the most devastating cancers. But in the end, it wasn’t the cancer that took her life. It was the air she breathed. At least with the cancer, it was a fair fight. With the infection, and with no immune system to fight it, she never had a chance.

Kate Cantrell is a communications advisor at Neuroblastoma Australia and serves on consumer advisory bodies at Redkite and Cancer Council Queensland. She shares Emily’s story on Instagram at @all.4.emily



FOUR PRIORITY AREAS FOR ACTION

2. Patients have a right to access healthcare safely

Every person has a right to safe healthcare, governed by a range of laws and regulations internationally. In Australia, the Australian Commission on Safety and Quality in Healthcare (ACSQHC) sets benchmarks for safety and quality in healthcare services and is responsible for the Charter of Healthcare Rights.⁶⁵

The Charter describes seven rights that people and their carers can expect when accessing healthcare. These rights apply to all healthcare providers in Australia (see *Figure 2*). Of the seven rights, a person can expect to have access to care that meets their needs, safe care that meets national standards and makes them feel safe, and treatment with respect and dignity.⁶⁵

Unfortunately, in the absence of the safest possible indoor air quality standards and appropriate airborne IPC policies, many people with chronic health conditions, and other risk factors like age and disability, do not have these rights fulfilled because of the risk of healthcare acquired infection (HAI) from airborne pathogens. Data from Victorian hospitals in 2022 show a mortality rate of >10% in patients who acquired COVID-19 while in hospital.⁶⁶ While data from NSW show that 14% of all COVID-19 deaths in 2023 were due to infections acquired in healthcare settings.⁶⁷ Similarly alarming mortality rates from healthcare-acquired COVID-19 infections have been reported overseas.⁶⁸ Because of these increased risks, many people with chronic health conditions are making decisions about whether they *really need* to access healthcare, or not (see *Personal perspective – Craig*). Indeed, a recent Australian study showed that, because of the increased risks of infection occurring in healthcare settings, many people with chronic health conditions are avoiding going to the doctor or hospitals for their own healthcare needs.⁵

The process of assessing the risk of SARS-CoV-2 transmission and other airborne pathogens in healthcare facilities needs an urgent paradigm shift. SARS-CoV-2 is airborne and constantly present in the community, and approximately 60% of infections are the result of presymptomatic transmission.⁶⁹ Additionally, it is widely recognised that COVID-19 is frequently asymptomatic,⁷⁰ that some infected people have non-respiratory symptoms and that many people are infectious for well beyond the minimum isolation requirements. All hospital patients should be regarded as ‘high risk’ given their current medical problems. In many cases, patients are unable to wear respirators due to young or advanced age, confusion, or during surgery, imaging, or other treatments. Thus, they rely entirely on the facility to provide a safe environment.



FIGURE 2 The Australian Charter of Healthcare Rights⁶⁵



Respiratory protection plays an important role in employee safety in many sectors and should be integrated into healthcare occupational health and safety protocols.

Therefore, in addition to providing the safest possible IAQ standards to reduce the potential for airborne HAIs, it is also necessary to address source control via other measures such as universal respiratory personal protective equipment (PPE), including the use of N95 respirators, testing, and isolation. The use of N95 masking is widely recognised as both source control and PPE control in the risk reduction of airborne pathogens – with source control being the more effective risk reduction measure (i.e. everyone masking versus one-way masking).⁷¹ Education about proper use of PPE, and why it's important to wear respirators can help overcome potential resistance to their use.

The current recommendations that leave PPE decisions to individuals fail to acknowledge that one-way masking is insufficient protection: hospital stays involve many moments where masks must be removed (eating, taking medications, treatments, etc) and masking is impractical for infirm, elderly or confused patients. High-risk patients also need to be able to attend healthcare facilities while caring for their family members, as carers themselves.

One Australian study found staff N95 mask use and admission screening testing of patients can

reduce hospital-acquired COVID-19 infections and COVID-19 deaths.⁷² The same study also found that these two interventions can save the health system potentially hundreds of millions of dollars in the long term, and many thousands of lives.⁷²

Meanwhile, another study found masking among healthcare workers can reduce HAI respiratory viral infections by ~60%.⁷³ The authors also note that it would be a mistake to ignore the SARS-CoV-2 threat and that *“healthcare facilities could reimagine masking policies to protect patients from the full array of nosocomial respiratory viral infections, using masking to protect all patients from all viruses when viral activity is elevated and the most vulnerable patients year-round”*.⁷³

Respiratory protection plays an important role in employee safety in many sectors and should be integrated into healthcare occupational health and safety protocols. Employee training, education, and mask fit-testing should now be routine to protect patients, visitors, and staff, noting particularly that the provision of a safe work environment is also a basic employee right.

Ultimately, patients shouldn't need to self-advocate for basic airborne infection control procedures; providing a safe healthcare facility is the responsibility of the facility and cannot be transferred to patients. As part of good governance and optimising patient outcomes, healthcare facilities should explicitly prioritise protecting patients from contracting SARS-CoV-2 or any other communicable disease when in their care. Health service organisations accredited to the National Safety and Quality Health Service Standards⁷⁴ must comply with the Preventing and Controlling Infections Standard, which requires environmental control measures, such as effective ventilation systems, to be in place to reduce the risk of infection transmission.⁷⁵

Guidance for IPC, including optimising ventilation, should be updated to include mitigations for airborne diseases that:

- appropriately recognise asymptomatic and presymptomatic transmission
- acknowledge that high-risk patients are not confined to clinically high-risk areas, and may be attending as carers
- recognise that airborne transmission occurs through breathing and talking and isn't confined to 'aerosol-generating procedures'
- recognise that even where IAQ is optimised, respiratory protection is required to prevent the risks of near-field transmission occurring.

In addition to updating IPC guidance and improving IAQ in all healthcare facilities, the HAI committee of ACSQHC, which has been responsible for the National Hand Hygiene Initiative for many years, should implement a *'National Airborne Infection Prevention Initiative'*. Promoting the prevention of airborne transmission in the same way that the ACSQHC promotes the prevention of other HAIs will help educate and raise awareness among healthcare workers and patients of the risks of airborne transmission and how to prevent it from occurring. It will also ensure that patients are protected from all modes of transmission that cause healthcare-acquired infections.

Additionally, given that infections are transmitted outside of the healthcare settings, the newly formed Australian Centre for Disease Control (CDC) must include infection prevention and control in its remit. Leaving infection prevention and control solely under the remit of ACSQHC ignores the fact that IAQ is a shared, whole of community issue and not just a healthcare setting issue.

Robyn

I'm an atmospheric chemist and an aerosol scientist. I worked with colleagues from the Royal Melbourne Hospital in late 2020 to characterise the ventilation within a COVID ward. We examined how air cleaners could reduce infectious aerosol loads in a hospital setting⁷⁶ – showing that we could reduce aerosol by 99% in 5 and half minutes within a patient room with two small domestic air cleaners. I also pulled together a website Air Cleaner Guide⁷⁷ to help the public and wider community navigate the air cleaning technologies available on the market – and to ensure that people were able to make informed purchasing decisions when it came to cleaning their indoor environments.

It is with this expertise that in March 2023 I sat opposite an unmasked surgeon, in a small, sterile, clinical, room, with a dear friend beside me taking immaculate notes, and I was told that I had breast cancer. In this moment, you are suddenly trying to navigate a complex public / private health system for cancer treatment, understand what ER, PR, HER-2 and Ki-67 numbers mean; what tumour grades (as opposed to stages – who knew?) all mean. You don't want to (and most people just don't!) think about the quality of the air you are breathing – you expect it to be safe. This situation is scary, it is emotional, and all you want to have is a treatment team who you can trust to 'get this damn cancer out' of you, and stop it coming back. You want them to be the best in their field, to keep up with the latest science, to be – basically – the superstars who are going to save your life. You want them to be working in a hospital with infection control leaders and boards who equally have patient safety at the centre of their ethos.

I did have a superstar team that looked after me, and when I finished my treatment on Halloween

last year, bald, tired and battered – I can say that I had done everything I could to improve my odds of survivorship. I should qualify this that in Australia: 1 in 7 women get breast cancer, and the survivorship at 5 years is 92% (up from 78% in the early 1990s) – so the odds are in my favour. The surgery gives you about a 75% survivorship, radiotherapy about 15%, and chemotherapy (for my tumour) 6%. It is the chemotherapy that is really playing with the smallest odds, and causing the most impact (3 months I will not get back, my finger and toe-nails lifted off their beds and I'm still coming to terms with my new curls!). While undergoing chemotherapy you need blood tests to check your white blood cell counts, you need to sit for 4-6 hours in a chair receiving the chemotherapy, and you are extremely immunocompromised. All this for a 6% chance of survival over the next 5 years – you certainly don't want to be contracting a respiratory virus like COVID-19 while in hospital, which, as a cancer patient in Victoria, presented a 25.6% all-cause 100-day mortality in 2020 to 8.1% in 2022.⁷⁸ A cancer hospital is the one place where you will find vulnerable patients and visitors will do all they can to enhance the outcomes of their loved ones.

Disappointingly and fundamentally, we won't see a change in the management of the air even in our most vulnerable spaces without indoor air quality standards.

It was with dismay that as I was undergoing radiotherapy that masking mandates were lifted in our 'world-leading' cancer hospital. This prompted me to write to the board and management of the hospital. If you visit now you won't see many staff, volunteers, doctors or visitors masks. It is hard to find a quality mask (they're still there – hidden and tokenistic). Disappointingly and fundamentally, we won't see a change in the management of the air even in our most vulnerable spaces without indoor air quality standards.

The science is clear,⁷⁹ the health economics is clear,⁷² but the public health messaging and environmental health policies that make clean indoor air a reality are not where they need to be to protect us all.



When any infectious disease spreads in residential care facilities, it risks the health and safety of residents and can exacerbate health inequalities.



FOUR PRIORITY AREAS FOR ACTION

3. People in living residential care facilities have a right to access safe living environments

As with healthcare settings, preventing the transmission of airborne infections in residential care facilities is fundamental to ensuring safe and accessible living environments for all. Residential care facilities are designed to offer supportive and secure environments for people who are living with disabilities, people who are elderly and people with other high-risk conditions, including frailty, immunocompromise, or living with comorbidities. High rates of comorbidities amongst the elderly increase the risk of mortality,⁹ and therefore must offer additional prevention and control measures to keep residents safe from harm.

Residential settings cover a wide variety of facilities, including prisons, where the consequences of an outbreak would be devastating. People in prison are at great risk of poor health outcomes from infection, with almost one-third of people entering prison having at least one chronic health condition, like asthma, cancer, cardiovascular disease, diabetes, or living with a disability.⁸⁰

In addition to the increased risks of the people living in residential care facilities, these facilities are

environments where the rapid spread of airborne pathogens can occur.^{9,81,82} For example, an Australian study found the risk of SARS-CoV-2 infection within Australian aged care homes was 27% higher than compared with the general population.⁸³

New guidelines for infection prevention and control for Australian residential aged care facilities were published in August 2024. The guidelines note that ‘effective infection prevention and control is central to providing high-quality aged care for all older people and a safe working environment for those that work in aged care settings’.⁸⁴

However, as one of the guidelines’ authors noted, the new guidelines were developed with the intention of providing a risk-based approach that balances the social and emotional needs of those in aged care, while attempting to lower the risk of infection for all, but ‘remaining practical’.⁸⁵

Balancing the social and emotional needs of residents, with effective infection prevention control and the need to protect highly vulnerable residents from poor health outcomes and death, has many challenges. When any infectious disease spreads in residential care facilities, it risks the health and safety of residents and can exacerbate health inequalities.

It is necessary to implement active IAQ controls to effectively mitigate all airborne infection transmission to the lowest practicable level, such as proper ventilation systems and IAQ monitoring, air purification, routine screening of staff, residents and visitors, to deliver equitable access to a safe living environment for all residents.

An Australian study found the risk of SARS-CoV-2 infection within Australian aged care homes was 27% higher than compared with the general population⁸³

Lyn

Dad grew up on the land, staying active throughout his life, with an enduring love for sports. He avidly supported the Broncos (NRL) and enjoyed watching the State of Origin. Despite his Parkinson's diagnosis, Dad maintained a determined and optimistic outlook on life. He had a remarkable memory and excelled at trivia, often winning trivia competitions at his aged care facility.

Dad volunteered for many years with the local Rural Fire Brigade, responding to fires and accidents. He was extremely proud of receiving both *The National Medal for Service* and the *QFRS Diligent and Ethical Service Medal* for his dedication. Dad was deeply religious, praying every day and following Jesus' teachings on not judging others. He was humble, kind, diplomatic, and young at heart. His playful spirit, intelligence, loyalty, and love for his family and community made him a beloved figure among everyone who knew him. His attention to detail was notable – even insisting on combing his hair before meals or photos, even if he was only in the background.

Dad was 73 when he moved into a residential aged care facility in early 2020, just before the pandemic started. In December 2021, I raised concerns regarding the facility's approach to protecting residents from the pandemic, as the planned onsite vaccination clinic was not conducted, and guardians were not advised of this. An outbreak followed in January 2022 without the vaccination clinic being held. Nearly all residents in the wing, including Dad, were infected with COVID-19.

Dad was so severely ill that end-of-life medications were prepared. While residents were eventually quarantined, the precautions taken were inadequate. When I took the risk to visit Dad because of his

deteriorating health during the outbreak, I found the door to his room wide open, with no signage on the door about the infectious resident, the need for respiratory PPE, and the resident's continued communal dining for days. It was not surprising, therefore, when infections continued to occur, which sadly resulted in the deaths of two residents.

Unfortunately, the facility had poor ventilation, with CO₂ levels reaching unsafe levels (over 1000ppm). This was only reduced when we ran the bathroom exhaust fan, which interfered with communication. Advocacy for air purifiers was met with resistance and we personally provided them, and even after installation, staff would often turn them off despite clear signage.

After that outbreak, I continued to raise concerns over infection control, but despite repeated outbreaks, the facility refused to enforce consistent mask-wearing, even in high-risk areas. 'Staff morale' was prioritised over residents' safety, with masks being removed during times of rising community transmission. This led to further resident infections, even as community COVID-19 cases surged in Queensland and changes that should have been implemented never came.

It was extremely disappointing to see the refusal to put simple, airborne infection control measures in place, such as N95 respirators, to reduce the risk to residents despite this risk being clearly demonstrated. There are other ways to boost staff morale and address any potential communication issues without jeopardising the health and safety of residents. COVID-19 can lead to a devastating death, and those who survive often do not return to their previous level of health, with substantial evidence of long-term impacts.



My efforts to advocate for better safety protocols, including improved ventilation, air filtration and masking, were met with dismissal from regulators and the facility itself. The ongoing lack of proper precautions made it impossible for me, as an immunocompromised person, to visit my dad safely. The situation created considerable frustration and tension within my family as we watched the facility's repeated outbreaks without substantial improvement.

Knowing the increased risks of infection for people with Parkinson's, my dad didn't want to catch COVID-19 or any other virus, but the facility made it clear that it was his choice to be isolated as a result of that decision. I feel that the new guidelines are discriminatory toward those who wish to avoid COVID-19, as they allow close contacts to mingle

with others while offering no safe options for those trying to avoid infection (who have isolated). There was no way to opt out – close contacts and residents 5 days post testing positive (no clearance needed) were prioritised to mix freely (resulting in lengthy outbreaks – often 4-8 weeks due to ongoing transmission), disregarding the rights of others who did not want to be exposed.

It was such an impossible situation. I am devastated that I couldn't visit Dad as much as I wanted to in his final months and wish that we could go back and put measures in place to properly protect everyone in aged care. Improving indoor air quality and reducing the risk of transmission through the proper application of airborne infection control measures could have made such a huge difference for everyone in the facility, and still could.



Companies, and facilities managers, must ensure that their employees are safe in the workplace.

FOUR PRIORITY AREAS FOR ACTION

4. Employees have a right to access safe working conditions

Workplace health and safety (WHS) laws vary significantly around the world, but there are some common frameworks and standards that influence a country's WHS regulations. In Australia, WHS laws are governed by a combination of national regulations, the Work Health and Safety Act 2011 and the Work Health and Safety Regulations 2011,⁸⁶ and State and Territory specific legislation. There are also national guidelines, provided by Safe Work Australia,⁸⁷ and State and Territory specific guidelines.

Traditionally, the WHS Act and Regulations have focused on mitigating physical hazards, ensuring that employees work in environments free from risks such as machinery accidents, hazardous chemicals, etc. For ventilation, Regulation 40, requires the duty holder (e.g. employer, building owner), to so far as reasonably practicable provide ventilation that enables workers to work without risk to health and safety, but it's very general. However, the pandemic has exposed the critical gap in these regulations – that is, the need to address the risk of infection from airborne pathogens, particularly for people who are at increased risk of poor outcomes from infection. Extending WHS laws to include protections against the transmission of infectious diseases is fundamental to the right of workers to a safe working environment and, given people work in all public spaces, should apply universally.

For example, in addition to the high-risk settings discussed in previous sections, public transport should be considered another priority setting for improving IAQ standards, for reducing airborne pathogen transmission and exposure to other airborne pollutants, for workers and the public. Ventilation in public transport, particularly buses, can be extremely poor,⁸⁸ with CO₂ levels frequently exceeding safe limits for cognition,⁸⁹ and increasing

the risk of airborne disease transmission.⁹⁰ Even before the pandemic, the occupational risks for people working in the public transport sector as a result of poor IAQ were known, with research showing that workers' exposure to bioaerosols was a significant risk.⁹⁰ However, the risk of transmission and therefore the occupational risks for public transport workers, can be reduced by increasing ventilation rates into vehicles.^{88,91}

Workers spend a significant portion of their lives at work, and their health and safety should be safeguarded by comprehensive legal standards that



Workers spend a significant portion of their lives at work, and their health and safety should be safeguarded by comprehensive legal standards that address both traditional and emerging risk.

address both traditional and emerging risks. Under existing workplace health and safety laws businesses must do everything reasonably practicable to ensure the health and safety of workers and others.⁹² Just as laws have evolved to address new safety challenges in physical environments, they must now evolve to include the risks associated with airborne diseases.

Companies, and facilities managers, must ensure that their employees are safe in the workplace, and need to recognise their responsibilities with respect to IAQ and health. Reducing infections in the workplace isn't just necessary from a health perspective; infections can lead to significant economic consequences, including increased sick leave, reduced productivity, and higher healthcare costs. By incorporating infection control measures into workplace safety regulations, employers can minimise these disruptions and contribute to a more resilient economy.

To effectively address the risk of airborne pathogens, workplace safety laws should include:

- IAQ performance standards, that effectively lower the risk of infection from airborne pathogens for accessibility,
- guidelines for the use of PPE, such as respirator masks, especially in high-risk environments (see *Patients have a right to safe healthcare*), and
- systems, policies and data for monitoring and reporting health conditions related to airborne infections to ensure timely responses and interventions.

It's time to address the gaps in our existing WHS laws and ensure that appropriate steps are taken to address infection risks from airborne pathogens as a necessary progression in protecting workers, especially those who are at increased risk from infection. By adapting legal standards to the current realities of increased airborne infection, we protect individual employee health, help prevent businesses from being disrupted and secure economic stability.

PERSONAL PERSPECTIVE

Phil

Growing up with the inherited lung disease Cystic Fibrosis in the 1980s, I wasn't concerned about airborne viruses. I mean, my doctors didn't expect me to live beyond my 30s, and that aside, like many kids I was focused on shorter-term things. My doctors would have been proven right if it weren't for the incredible gift of a double-lung transplant when I was 22. However, despite a rapid and successful recovery, I still lived with the knowledge that my extended life was likely temporary. After all, my older brother had tragically died just 1 year after his own double-lung transplant, the year before I received my own! I knew many others like him. But, thankfully I lived, and lived, and I continued growing up. One year turned into 2, 2 into 5, then 10, 20 and now, 28 years post-transplant, my life has proven itself anything but temporary. I've built a rewarding and enriching career. I'm raising two amazing children alongside an inspiring and hardworking woman I'm privileged to call my wife. I'm 50 years old. I now dare to make long-term plans.

If I'm to see these long-term plans come to fruition, now I really do need to exercise a healthy degree of caution about airborne viruses. Still on medication that suppresses my immune system to protect my transplanted lungs, I'm far more susceptible than the average person to contracting an illness if I'm exposed. On top of this, my now not-so-new lungs are unfortunately scarred from many battles with viral, bacterial and even fungal infections over the last 28 years, meaning that respiratory viruses are more challenging than ever; I get sicker, and

recovery takes more effort and time. Right now, of all the airborne viruses I could be exposed to, none are more challenging than COVID. I've caught it only once so far, and I was lucky: it was a mild case, no doubt helped by being able to start antivirals the same day I tested positive. But my doctors caution me that this doesn't predict how my body will respond if it happens again. The statistics are pretty confronting – I'm still at much, much higher risk of getting very sick and dying from COVID than the average person, even though I didn't get sick the first time, and I've had multiple booster vaccines. So really, it's a gamble. The thing is, I don't want to gamble with my life every time I walk into a crowded room. I shouldn't have to, especially not when there are things we can do that will make it safer for me, and the many like me facing similar challenges.

As a society, we already recognise the importance, and value, of supporting people whose health or physical limitations impact their lives. We pay our Medicare levies so that everyone has access to quality healthcare when they need it. We support the NDIS so people with disabilities can improve their quality of life, including returning to work. We enact legislation to prevent discrimination on the basis of health status or physical disability. We build ramps, elevators and escalators so people who have difficulty climbing stairs or accessing public transport can enjoy public spaces. We implement and adopt policies about nut-free foods so that kids with allergies can learn, play, and eat safely at school. We've proven time and time again that we care enough to improve our systems so that people experiencing disadvantage can live fuller lives.

Now we need to improve our policies, our procedures and our practice around the prevention of airborne virus transmission indoors. Not just

for people like me, but for everyone who would rather not catch the flu or COVID at work, at a party, in hospital or at a restaurant.

If I'm to see these long-term plans come to fruition, now I really do need to exercise a healthy degree of caution about airborne viruses.

“While there is a cost in the short term, the social and economic benefits to public health, wellbeing and productivity will likely far outweigh the investment in cost to achieve clean indoor air.”

– Distinguished Professor Lidia Morawska,
QUT News¹⁰⁰



INVESTING IN A HEALTHIER AND MORE PRODUCTIVE FUTURE

The additional benefits of investing in safer indoor air

Improving IAQ for accessibility and reducing the risk of airborne infection in shared indoor environments, with a focus on people living with high-risk conditions, makes indoor air safer and healthier for everyone. Businesses that invest in improving their IAQ, can achieve a social return on their investment through increased accessibility and inclusion. They can also gain a financial return as they realise other benefits such as improved cognitive functioning, increased productivity and reduced costs.^{16,17}

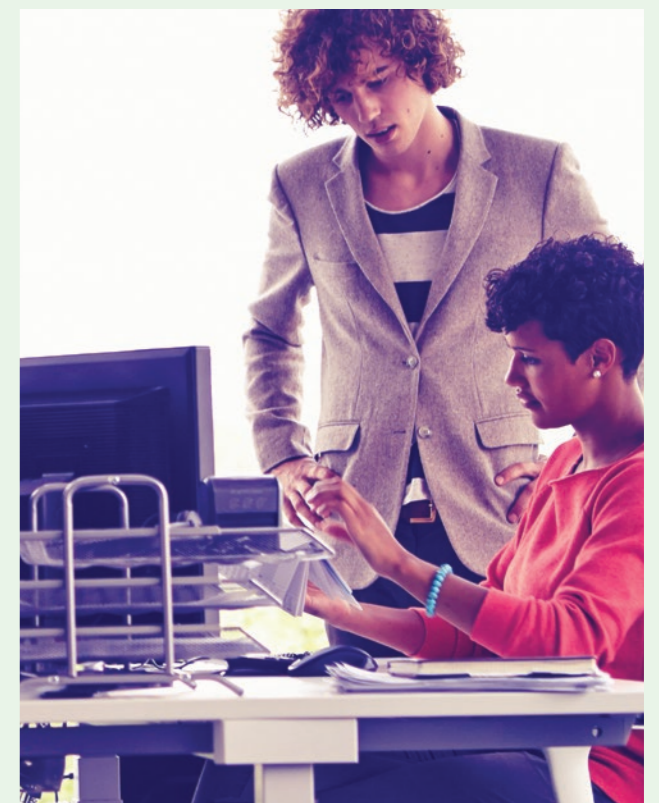
IAQ monitoring, for example, can have many benefits including improving employee satisfaction, creativity, safety and presence, increasing productivity and optimising health and climate goals.^{18,41} Many studies have shown that workers or students in well-ventilated buildings are healthier and more productive than those in poorly ventilated buildings.⁹³⁻⁹⁵ For instance, testing of office workers in the USA at different ventilation rates has also shown that better ventilation improves cognitive performance.⁸⁹ They also found significant declines in cognitive scores when CO₂ concentrations were increased to levels common in indoor spaces (about 950ppm). Meanwhile, another US study found that school students were more attentive and calmer in well-ventilated classrooms.⁹⁶

The health benefits associated with enhanced ventilation rates far exceed the per-person energy costs relative to salary costs.⁹⁷ The improved work performance associated with better ventilation has been estimated to produce a \$6,500 (USD) increase in worker productivity, with only an increase in energy

cost of \$40 (USD) per person, per year, and as low as \$1 if energy-efficient systems are used.⁹⁷ Other research has estimated that improving air quality at work in the U.S. in 1997 would save \$6–19 billion from fewer respiratory diseases, \$1–4 billion from fewer allergies and asthma, \$10–20 billion from fewer sick building syndromes, and \$12–125 billion from better productivity.⁹⁸ Other research found similar savings.⁹⁹

Environmental impacts from additional energy required to handle greater volumes of air in our mechanical systems, or where natural ventilation is increased, can be mitigated at regional, building, and individual-level scales. This can be achieved through the transition to renewable energy sources, the adoption of energy-efficient systems and ventilation strategies, and the promotion of other sustainable policies.⁹⁷

Businesses that invest in improving their IAQ, can achieve a social return on their investment through increased accessibility and inclusion.



Improving accessibility for people with chronic health conditions



Recognising the health and productivity gains achievable, many global companies are already investing in improving their indoor air quality, including Amazon and JP Morgan Chase.¹⁰¹

In addition to the financial and environmental return on investment that companies are realising, there is also a social return on investment that is yet to be realised – that of the increased accessibility and inclusion created for employees and customers with high-risk conditions.

Most organisations desire inclusion, and many already participate in membership programs to strengthen their commitments to be accessible and inclusive employers and service providers.

Therefore, organisations must understand that IAQ is a critical accessibility and inclusion issue, ensure their IAQ is accessible and address the inclusion of their high-risk employees and customers through existing EDIB pathways.

“Amazon is using an algorithm my company developed called HEAAL, which stands for Health-Optimized, Excellent, Action, Alert, Limit. When a measure of air quality is at “Action” level it’s not immediately dangerous and should be looked at by facilities within the month. At “Alert” level, the situation should be evaluated within two weeks. “Limit” means you are potentially endangering worker health, so the issue should be escalated to an environmental health and safety team and acted on within a day or two.”

– Associate Professor Joe Allen,
Harvard Business Review⁴¹

Lewis

From my late teens, I began to understand that good health can be temporary or even impossible for many people. I had asthma as a child, and although I maintained a healthy lifestyle as a young adult – staying active, eating well, and getting enough sleep – I learned that these behaviours aren’t always enough to prevent illness. In my late teens, I developed bronchitis, and in my early 20s, I became seriously ill with pneumonia. After first hearing that COVID was a respiratory illness, I knew I needed to take precautions due to my asthma.

The health problems I developed in my early 20s worsened over time. I’d had pelvic pain for years and finally was diagnosed with endometriosis in 2021. Not long after, I began feeling faint. I would often feel dizzy, have a racing heart rate and struggle to concentrate after standing up for hours during my Patisserie training classes. My symptoms were worse when the kitchen was hot, especially



in summer. My doctor at the time said my blood pressure was fine after I reported how I often felt dizzy if I stood up too quickly. However, a second opinion led me to a cardiologist, who diagnosed me with postural orthostatic tachycardia syndrome (POTS) in 2022.

I initially assumed most people understood that anyone, regardless of age, could develop chronic conditions. However, the pandemic highlighted that many see illness as something that can be avoided if people living with disabilities only tried harder. I had thought that there was a better understanding of chronic illness and disability within the queer community. My generation of queer people heard all the time about the importance of safe sex and STI prevention. Older queer people knew from the HIV/AIDS crisis that public health responses can often come too late, yet many queer people trusted the government and queer health organisations that COVID wasn’t a problem for them.

I was disappointed to see that many queer spaces began to stop encouraging masking from 2022 onwards. I used to attend markets regularly and shows for the queer community but stopped after hearing that someone else in the venue tested positive for COVID the next day.

As masks have become less common, so too has the broader understanding that diseases spread from person to person, or that some people are at significantly increased risks of poor outcomes from infection. Without isolation requirements, it’s clear that public spaces often contain people who may be contagious for any airborne disease, which puts people like me at increased risk of being infected.

There seems to be a lack of understanding about how our health is connected to the health of others and



There seems to be a lack of understanding about how our health is connected to the health of others and our environment.

our environment. Yet we recognise that one person’s actions, like drunk driving or smoking indoors, can harm others and have legislation to prevent those harms from happening to each other. Similarly, when someone infected with a virus goes to an indoor event without taking precautions, they risk spreading illness to others. Even while wearing a properly fitted respirator, there is still a risk of being infected by someone who doesn’t know they’re contagious.

Since the pandemic began, I’ve tested positive for COVID three times. Yet, I’m often perceived as unusual for trying to protect myself from a preventable illness that causes me great harm.

I’ve had many encounters where people question why I’m wearing a mask. For example, a pharmacist assistant was confused about why I had one on, assuming I was sick. I was actually wearing it to stay healthy. At a recent event, where masks were required for participants, someone driving by yelled at us, equating the masks with hiding our identities. The masks made us visibly different, and I was glad I wasn’t the only person standing out.

Each infection has left me bedridden for about a week, followed by several more weeks of recovery. After my latest infection, my recovery took even longer, with my POTS becoming more severe. Simple tasks, like standing or sitting up, made me light-headed, and I was unable to work for four weeks due to extreme fatigue. Only after two months was I well enough to resume my regular activities, like going to the gym. Avoiding infection is really important to me to prevent a deterioration in my health.

In late 2022, I started working at a bakery but soon realised it wasn’t a safe environment for me. One of my coworkers came to work while sick with COVID. My boss, aware of my health conditions, didn’t inform me, and I felt my well-being was disregarded. As a result, I left the hospitality industry in early 2023 and transitioned to working from home.

As a transgender person, I’m aware of the increased risk of developing long COVID.¹⁰² I’ve been encouraged to see that some queer event organisers are taking steps to protect attendees by providing masks and using air purifiers. When I attended Le Freak’s show at Fringe, I was impressed to see nearly all of the audience was wearing masks. I’m attending two more shows where these precautions are in place, allowing me to enjoy public events without compromising my health. Regardless of someone’s vulnerability to illness, no one should have to choose between protecting their health and participating in public life.



There is a significant and growing burden of disease caused by long COVID and ME.

INVESTING IN A HEALTHIER AND MORE PRODUCTIVE FUTURE

Investing in preventing post-acute infection syndromes

COVID-19 is not the first airborne virus to cause a post-acute infection syndrome. ME which has been described in medical literature for hundreds of years, is also predominantly caused by viruses such as influenza, Epstein Barr virus (Glandular fever) or Ross River fever.³⁰

There is a significant and growing burden of disease caused by long COVID and ME. While estimates vary, many studies have shown that at least 10% of COVID infections may lead to the development of long COVID.¹⁰³⁻¹⁰⁵ Long COVID shares many symptoms and biological abnormalities with ME, with up to 45% of those with long COVID meeting the diagnostic criteria for ME after six months.¹⁰⁶ This adds significantly to the existing number of people in Australia already living with ME, which research estimates to be 0.4 to 1% of the population: up to 250,000 Australians.¹⁰⁷

Long COVID represents the constellation of post-acute and long-term health effects caused by SARS-CoV-2 infection; it is a complex, multisystem disorder that can affect nearly every organ system and can be severely disabling.³⁶ The disease burden spans from mild symptoms to profound disability, the scale making this a huge, new health-care challenge.¹⁰³

“The oncoming burden of long COVID faced by patients, health-care providers, governments and economies is so large as to be unfathomable.”

– Professor Danny Altmann, et al.,
Nature Reviews Immunology¹⁰³



In 2022, long COVID cost the Australian economy almost
\$10bn
in labour and other factors.

The cumulative global incidence of long COVID is estimated to be around 400 million individuals,¹⁰³ and to have an annual economic impact of approximately \$1 trillion—equivalent to about 1% of the global economy.³⁶ One study, published in August 2024, demonstrated that long COVID cost the Australian economy almost A\$10 billion in 2022 alone.^{14,108} The authors noted that ‘*widespread SARS-CoV-2 infections in Australia mean that even a small proportion of infected people developing long COVID-related illness and disability could have important population health and economic effects*’.¹⁴ This is in addition to the estimated \$10 to 14.5 billion ME costs the Australian economy annually.^{109,110}

In addition to the costs of post-acute infection syndromes, such as long COVID and ME, there are significant direct and indirect socioeconomic costs associated with airborne disease transmission.⁹ Even in the absence of post-acute infection there are other impacts on the workforce, including reduced productivity (related to increased sick leave and presenteeism), declines in employee engagement, sick leave costs and others.⁹ It follows, therefore, that reducing transmission through improved indoor air quality can prevent these costs occurring, and deliver significant benefits to organisations, and societies that prioritise safer indoor air environments.

Tracey

In January 2022, I contracted the Delta variant of COVID-19. I was confined to bed for a fortnight. During February and March, I slowly recovered, managing to resume work and beginning to exercise again. However, one day I experienced debilitating chest pain, nausea and dizziness. A series of tests could find nothing wrong. But I continued to suffer an overwhelming sense of fatigue. Even the simplest task – for example, cutting up vegetables for dinner – would lead to several days of bed rest.

Over the subsequent months, these unusual symptoms worsened. During the night, I'd wake up with an 'electric shock' feeling in my foot, which turned out to be small fibre neuropathy. I found it difficult to stand for any longer than a few minutes, without extreme tachycardia. My histamine symptoms were through the roof; each day it felt like I was coming down the flu.

Twice, I was raced to hospital due to crippling vertigo. I simply couldn't move my head without the world spinning on its axis. Eventually, I had to buy a wheelchair, as I couldn't get from bed to the ensuite toilet without fainting or falling. I was unable to leave the house, except for medical appointments.



My digestive system began to falter. It would switch wildly between constipation and diarrhoea. Ultimately, I restricted my diet to steamed vegetables and tiny portions of raw or quickly cooked protein, as this is all my body could handle.

The worst aspect what the 'post-exertional malaise' after any kind of activity: physical, emotional or cognitive. While writing my latest book, I was only about to concentrate for 20-30 minutes each day, before lying in a darkened room for hours to recover.

In the middle of 2022, I was admitted to the Long COVID clinic at St Vincent's hospital. I'm grateful to the doctors at St Vincent's who contributed towards a diagnosis and treatment. Still, it took until early 2024 for me to (almost) fully recover.

It's impossible to overestimate the impact on someone's life, their family and community, and the Australian economy, from this devastating illness. During these two years, I was only able to work sporadically, while lying in bed with the computer on my stomach. While grateful for Medicare and private health insurance, I was only too aware of the burden this mysterious illness was putting on the health system.

It's impossible to overestimate the impact on someone's life, their family and community, and the Australian economy, from this devastating illness [long COVID].

To this day, I don't know how I contracted the virus. My vaccinations were all up-to-date, and I wore a mask where possible. However, in December 2021, I socialised in three venues with family as part of Christmas celebrations. None of them were ventilated. Of course we were social distancing, but we had no control over the safety of the air in these places. This is what sparked my passion for the clean air movement.

Every human has a right to breathe clean air. It's shocking to think of the number of people living with Long COVID and its related conditions, because of the lack of understanding, regulation and legislation around ventilation and air filtration.

This is a fixable problem that would be life-changing – indeed, life-saving – for millions of people.



Cost-benefit analysis – the economic imperative for investing in safer IAQ

BY PROFESSOR QUENTIN GRAFTON, ASSOCIATE PROFESSOR LONG CHU AND PROFESSOR TOM KOMPAS

Poor IAQ is a hidden cost to people and business through the transmission of illnesses and reduced productivity, as such, there are two main types of benefits from improving IAQ – reduced sickness and improved focus.¹¹¹

The following analysis of the benefits of improved indoor air quality are based solely on reduced sickness, through the avoided costs of COVID-19 and long COVID cases that would not occur due to enhanced air quality in public spaces. Our estimates, derived from 2022 data and findings in the *Medical Journal of Australia*, focus exclusively on reductions in labour supply, meaning they underestimate avoided costs, as they do not account for the impact on non-working individuals.¹⁴ Further, ‘reduction in labour supply’ does not include the costs of reduced quality of life, losses due to caring responsibilities, or increased healthcare utilisation.

In 2022, long COVID cost the Australian economy almost A\$10 billion due to declining labour supply and reduction in other production factors.¹⁴ New estimates for 2022, which include both COVID and long COVID, indicate a 1.9% reduction in labour supply, equating to a \$20 billion loss in labour value-added alone, or roughly a \$39 billion reduction in gross domestic product (GDP), assuming a proportional decrease in other factors (*Pers. comm Grafton, Chu and Kompas*

October 2024). This figure includes the effects of both typical COVID-19 cases (with recovery within a week) and long COVID cases.

Benefits

While there is considerable uncertainty regarding the scale in the reduction in COVID cases from improving indoor air quality, we assume a range from 30% (a lower estimate accounting for infections in private spaces) to 90% (the best-case scenario with highly effective filtration). Our most likely estimate is a 60% reduction in cases.

Consequently, the benefits of improved indoor air quality in public spaces, even at the lowest reduction in labour supply, amount to \$12 billion. At the highest estimate, benefits could reach \$25 billion, assuming a 60% reduction in cases. These are annual estimates for 2022 alone; future-year benefits would likely increase due to avoided costs of repeated infections, which may increase the prevalence of long COVID.¹¹² Conversely, future-year costs would likely decrease due to operating and maintenance costs being lower than initial investment.

Estimating costs involves assessing air filtration, installation, and operating expenses, along with the number of public buildings in Australia.

The benefits of improved indoor air quality in public spaces, even at the lowest reduction in labour supply, amount to \$12 billion. At the highest estimate, benefits could reach \$25 billion.

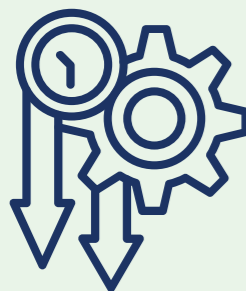




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New estimates for 2022, which include both COVID and long COVID, indicate a
1.9%
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Total benefits at a 60% case reduction could range between \$24bn and
\$50bn
over the 2022–2024 period.



This equates to a \$20bn loss in labour value-added alone, or roughly a
\$39bn
reduction in GDP.



The benefit-cost ratio for Australia, based on these preliminary estimates, would range from
1.5 to 3.1

Drawing from the recently published report, *Time to clear the air: the economic benefits of improving New Zealand's indoor air quality*, which estimates a cost of NZ\$125 million for upgrades with an additional NZ\$10 million per year in operating costs, we scale this to Australia's economy (about seven times larger than New Zealand's).¹¹¹ This suggests a capital cost of approximately \$875 million and annual operating costs of \$70 million. The New Zealand analysis is based on upgrading classrooms and office buildings, as this is where the current standards and levels of compliance are relatively low and where the potential benefits are greatest.¹¹¹

Alternatively, if we assume an average filtration unit cost of \$5,000 per public building, and considering Australia has around 1.4 million apartment dwellings and potentially 1 million public buildings, we arrive at a capital cost of roughly \$12 billion, with annual operating costs of \$1.2 billion (assuming 10% of the capital cost).

Benefit-Cost Ratio

The benefit-cost ratio (BCR) depends on assumptions about the benefits (avoided costs) and costs of filtration. Based on ongoing excess deaths (lower in 2024 than in 2022),¹¹³ we can reasonably assume avoided costs for at least three years, not just 2022.

Even if costs are halved in 2024, which may not be the case due to the cumulative risk of long COVID increasing with repeated reinfections, total benefits at a 60% case reduction could range between \$24 billion and \$50 billion over the 2022–2024 period.

For costs, assuming filtration units were installed in 2022 and operating costs incurred through 2024, the total would be approximately \$16 billion.

Thus, the BCR for Australia, based on these preliminary estimates, would range from 1.5 to 3.1 (assuming the higher cost estimates). By comparison, the New Zealand report's BCR was between 3.4 and 4.6.¹¹¹

In conclusion, while there is uncertainty around the benefits and costs of improving indoor air quality in public spaces, there is a high level of confidence that the BCR in Australia exceeds 1.0—meaning the benefits are likely to outweigh the costs. A more detailed study by the Productivity Commission, or a similar agency, is recommended to determine the precise BCR for Australia. The preliminary analysis, along with New Zealand's findings, strongly supports the need for such a study. However, we note that given access to safer indoor air is a critical accessibility and inclusion issue for people living with chronic health conditions, implementing this report's other recommendations should not be delayed pending the Productivity Commission's findings.

Daniel

As a kid, I loved music. So, when the opportunity came to audition for X Factor in Sydney, in 2013, I was so happy. At the time I was 14 years old and it really felt like all my dreams had come true. Following the auditions I was accepted into the show and went on to become one of the top 30 boys! It was best experience of my life.

After I left school, I followed my childhood dreams and began working in the music industry. As a 17-year-old, working doing artist development, life was exciting. Every day was different – it often involved long days, late nights, and attending events and industry parties. I loved my job!

Sadly, in May 2022 my life turned upside down. I initially developed post-vaccine complications, which were resolving, when I was subsequently infected with COVID. I have not been able to work at all, and now I often struggle to leave home. My symptoms include devastating fatigue, struggles with my cognition and focus, chest pain and fluctuating blood pressure. Like many others who are now living with long COVID, I have also been diagnosed with Postural Orthostatic Tachycardia Syndrome (POTS), a condition that causes my heart to race and intense dizziness when standing up.

Over the last year, I racked up thousands of dollars in bills from hospital visits, medical tests, specialist appointments and medication trying to find treatments that can help me get better.

Compounding the financial stress, I haven't been able to work in the industry I love so much because I'm too ill to work. I might have one or two good days where I gaslight myself into thinking that I could go back to work, and I'll be looking at a job – and then the next day I'll be completely bedridden again.

Recently, I went for meeting as part of my mutual obligations with JobSeeker, with the disability employment services, and they questioned why I was wearing a respirator mask. They said it would be much harder for me to get a job while wearing a respirator, even though I need to keep myself safe to protect my health from the risk of reinfection. I'm unsure how to navigate a return to work safely in the absence of safe indoor air.

Even accessing healthcare safely has been a struggle. Not long after my May 2023 infection I was hospitalised because my post-COVID POTS was so extreme I could barely stand up. As I waited for treatment on the ward, I was in a shared room with another patient who had respiratory symptoms, but who refused to conduct a rapid antigen test, on doctor's orders, because they didn't want to be isolated. As a result, I spent a terrifying night in a shared room with a patient whose behaviour put my health at increased risk, and there was nothing I could do about it.

I wish people understood the isolation that people like me have experienced since developing long COVID. Having to rely so much on a parent at the age of 25 is a very humbling experience. That's put a lot of strain on the relationship with my mum.

It is also extremely challenging to watch the world move on, knowing that every day people are putting themselves at risk of developing long COVID themselves, and finding themselves in the same situation. I wouldn't wish this on anyone. We have to find a way to help people who already have long COVID, to be safe from the risks of reinfection, and to prevent more people from having the same experience. That means making indoor air safer for us all to breathe.

They said it would be much harder for me to get a job while wearing a respirator, even though I need to keep myself safe to protect my health from the risk of reinfection.



We have the tools, now we need indoor air quality performance standards

With our knowledge of how IAQ impacts the transmission of airborne pathogens, and their impact on health and health inequalities, it is necessary that we effectively use the available tools to ensure that everyone can breathe more safely indoors

Creating safe indoor air environments can be achieved through the implementation of a variety of tools and technologies. In August 2024, Australia's Chief Scientist published a report '*The impact of Indoor Air Quality on the transmission of airborne viral diseases in public buildings: a systematic review of evidence*' on behalf of the Prime Minister's National Science and Technology Council.

The Chief Scientist's report noted that there are four broad categories of IAQ strategies that have the potential to reduce the transmission of airborne diseases in public buildings, including:

1. Installation of air cleaning technologies – HEPA filters
2. Use of air disinfection technologies – Ultraviolet-C (UVC) lights, also known as germicidal UV or UVGI, which can be generated using lights emitting short wavelength radiation (180-280nm)
3. Dilution of contaminated air with cleaner air – through natural and mechanical ventilation
4. Control of contaminated air dispersion.⁹

By combining multiple approaches that include air filtration, UVC lights and ventilation we can tailor IAQ solutions to meet the requirements of a wide variety of indoor spaces.

The Chief Scientist's report also noted that there were four methods for monitoring IAQ to support reducing airborne disease transmission, including:

1. Direct air sampling for pathogens
2. Measurement of background ventilation rates
3. Monitoring CO₂
4. Monitoring particulate matter concentrations.⁹

With our knowledge of how IAQ impacts the transmission of airborne pathogens, and their impact on health and health inequalities, it is necessary that we effectively use the available tools to ensure that everyone can breathe more safely indoors. In addition to the use of the above technologies, we also need to use the knowledge we have to educate the public and raise awareness of IAQ and its role in our health. By monitoring, and displaying live data on IAQ, we can make the invisible visible and help raise awareness of the role of IAQ in our health.

Unfortunately, as noted by Morawska et al., there is no single national government authority with responsibility for IAQ in most countries, and this is also the case in Australia.³⁹ Where relevant legislation does exist, responsibilities are spread between different organisations in individual States and Territories. For example, the State or Territory Department of Education is responsible for IAQ in schools, and

similarly the State or Territory Department of Health is responsible for IAQ in health care facilities.³⁹ Compounding this, there are currently no performance standards for indoor air, only design and operation standards, which are frequently not met during construction. Buildings are often not commissioned prior to final instatement and occupation, meaning that design objectives are not met.¹⁸

Since the start of the pandemic, many organisations have provided guidelines for improving indoor air quality to reduce the transmission of airborne pathogens. In late 2022, the White House hosted the first '*Summit on Indoor Air Quality*' and subsequently asked ASHRAE, a global society advancing human well-being through sustainable technology for the built environment, to develop a 'national pathogen control' standard.

In June 2023, the ASHRAE Standard 241 (ASHRAE 241) for the control of infectious aerosols was published.⁶⁴ The purpose of ASHRAE 241 was to establish design and operation standards for minimum ventilation requirements aimed at reducing the risk of disease transmission through exposure to infectious aerosols in new buildings, existing buildings and major renovations.¹¹⁴ ASHRAE 241 provides a practical approach to achieve equivalent clean air flow rates that apply to buildings when running in

'infection risk management mode'. However, ASHRAE 241 compliance does not apply to the ongoing performance of the ventilation systems. At any given time, there may be occupants who have a significantly increased risk of poor health outcomes from any airborne infection, so, arguably, infection risk management mode or an appropriate metric should always apply to ensure accessibility for everyone.

Indoor air quality design standards focus on the planning and engineering aspects of indoor environments, while IAQ operation standards cover the day-to-day management and functioning of indoor spaces. As with the ASHRAE standards in the US, in Australia, several key standards and guidelines cover the design and operation of IAQ in various settings, including the Australian Standard (AS) 1668 series,¹¹⁵ the National Construction Code,¹¹⁶ the Australian Building Code Board,¹¹⁷ and Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) Guidelines. Australian design and operation standards are yet to be updated to prevent and control airborne pathogens.

Design standards are necessary to ensure buildings are designed to provide desired IAQ, operational standards are necessary to ensure proper functioning i.e., ventilation control, maintenance protocols and occupant behaviour, but they only set a baseline.



For a competitive market like corporate real estate, voluntary healthy building certifications (such as the WELL Building Standard,¹¹⁸ Fitwel,¹¹⁹ and others) play an important role in demonstrating industry best practice. It's time to establish a national data repository that supports ongoing analysis, enables benchmarking and demonstrates best practice. Organisations seeking to comply with standards should be required to share their data for the repository on an ongoing basis.

In May 2024, the International WELL Building Institute (IWBI), launched the International Healthy Building Accord which included a commitment to achieving 'Health Equity'. Noting that,

*"Advancing health equity through better buildings helps everyone feel welcome, seen and heard. Multiple studies show that employees in diverse and inclusive workplaces are more likely to innovate, enjoy their jobs, work harder, and ultimately stay with their employers for longer. By adopting inclusive design strategies, equitable access to healthy spaces and research-based design strategies we can reduce health disparities and ensure the advantages of healthy buildings reach our most vulnerable and marginalised populations."*¹²⁰

Now we need to establish IAQ performance standards, to measure the actual IAQ against established benchmarks, that effectively lower the risk of poor health outcomes from airborne pathogens and other pollutants, at all times, in all public spaces. There are many reasons why, even if buildings are designed and operated according to the relevant standards, IAQ is still not as desired. This may be because a building's occupancy density is exceeded, there is a fault in the system, or that the space is not being used according to its intended purpose, and without IAQ performance standards, these faults may not be detected promptly. It's time to consider demonstration of compliance with IAQ performance standards in-real time as important, not just as a one-off exercise when it is built and/or in response to an issue. In Australia, we have precedents we can build on, such as NABERS and the energy disclosure, and can apply the same approach for IAQ.

In March 2024, 40 international experts, led by QUT's Distinguished Professor Lidia Morawska, published a blueprint for mandating national IAQ performance standards for public spaces.^{53,100} The authors noted that despite decades of research and advocacy, most countries do not have legislated IAQ performance standards. They recommended proposed parameter levels for monitoring CO₂, PM_{2.5}, carbon monoxide (CO), and ventilation rates, noting that the actual values can be lowered, or increased, by jurisdiction.⁵³

If we wait for an airborne pathogen to be declared an epidemic, or pandemic, before switching the operation of building ventilation systems to infection risk management mode we are reacting too late to contain the threat and to protect those at greatest risk.

We do not take a sample of our drinking water at the tap after we have swallowed the water to show it was safe to drink. Similarly, we should not have to measure air quality in a way that tells us we have been exposed to unsafe air. As in the case of the water treatment plant, we need to have regulations, monitoring and compliance of our built environment systems that will reliably provide safe air to all occupants, at all times. We do not know the vulnerability of people entering our buildings, nor those with whom they are in close contact.

We do not take a sample of our drinking water at the tap after we have swallowed the water to show it was safe to drink. Similarly, we should not have to measure air quality in a way that tells us we have been exposed to unsafe air.

Effective prevention and control of airborne pathogens requires a proactive approach. For specifically managing infection risk we don't yet have the sensing technology to measure the level of pathogens in the air. Until we do, all we have are measures for improving IAQ through CO₂, PM_{2.5} and ventilation rates as described by Morawska et al. in March 2024, which are aligned with airborne infection risk mitigation. In the absence of pathogen sensing technology, the best we can do is to aim to effectively reduce infection risk by increasing pathogen removal rates through increasing ventilation rates, filtration, and disinfection. We can measure the rate of the potential removal, which is usually expressed as an equivalent clean air rate and set performance standards based on these proxies.

We need Australian IAQ design, operation and performance standards that account for potential epidemic risk, at all times. These IAQ standards must be set for the effective reduction of the transmission of airborne pathogens with the known, most contagious, pathogen in mind. Current modelling suggests airborne infection risk to be greatest for SARS-CoV-2 (Delta and later variants) and that it requires increased ventilation rates, above 14Ls⁻¹ person⁻¹ coupled with air disinfection and filtration technology, to reduce transmission risk.³⁹



It's time to make indoor air safer for everyone to breathe

“It's not just reasonable to expect (clean indoor air), I'd say it's our fundamental right.”

– Distinguished Professor Lidia Morawska¹²²

The pandemic has driven the acknowledgement that many infectious diseases are airborne (albeit belatedly) and that we need to breathe clean air to minimise the risk of infection in our shared indoor spaces. This is particularly important for people who face increased risks of poor health outcomes from airborne infections. There are lessons to be learned from the ongoing pandemic that should be implemented now.⁸ Acting on this hard-earned knowledge would help prevent further harm from existing variants of SARS-CoV-2, protect against future SARS-CoV-2 variants, and protect against new and emerging threats from airborne pathogens with epidemic, or pandemic, potential.

Recognising that many viruses are airborne and transmitted primarily indoors where air is inadequately, or inappropriately, ventilated and that they cause disproportionate harm to people living with high-risk conditions, underscores the vital need to prioritise creating safe and accessible IAQ in all public spaces.

As the Morawska et al. blueprint for IAQ performance standards demonstrates, consensus has already been reached; it's time to mandate IAQ performance standards for all public buildings. To ensure accessibility for everyone, regardless of health status, IAQ performance standards, that effectively lower

the risk of poor health outcomes from infection by airborne pathogens and other airborne pollutants, should be established and applied to all public indoor spaces with urgency.

We can ensure everyone can breathe safely indoors through existing legislative frameworks. In acknowledging IAQ as an accessibility issue, we must act to address it through safe IAQ performance standards if we are to fully deliver the accessibility theme within the Australian disability strategy, and the principles of workplace health and safety legislation.¹²¹ Any IAQ performance standards should apply to all public spaces as covered by the Disability Discrimination Act, and the Premises Standards should be updated to include IAQ as an accessibility feature.

The implementation of targets and of standards for buildings as they impact indoor air quality should be considered an urgent priority to prevent and control the transmission of infectious diseases and reduce the disproportionate harm they cause to people living with high-risk conditions.

In doing so, we can make indoor spaces safer, healthier and more accessible for everyone, and create a world where everyone can breathe safely indoors.

Recommendations

Over the next year, we call on the Government to action six priority recommendations:

1. Acknowledge IAQ as an accessibility issue that must be addressed to deliver the accessibility theme within the Australian Disability Strategy. In addition, note that a lack of access to safe air spaces represents a potential breach of the Disability Discrimination Act 1992
2. Set IAQ performance standards, that effectively lower the risk of poor health outcomes from infection by airborne pathogens and other airborne pollutants, for all public spaces as covered by the Disability Discrimination Act, and update the Premises Standards to include IAQ as an accessibility feature
3. Address the gaps in the implementation and enforcement of existing workplace health and safety laws and ensure that appropriate steps are taken to prevent infection risks from airborne pathogens
4. Prioritise implementation of IAQ performance standards in four key settings
 - a. Education (including early years, primary and high schools)
 - b. Healthcare (including hospitals, primary health, allied health, pharmacies etc.)
 - c. Disability, aged care and other residential settings
 - d. Workplaces

5. Recognise that infection prevention control (IPC) is a shared, whole of community issue, not just a healthcare setting issue, and direct the newly established Australian Centre for Disease Control (CDC) to include IPC in its remit
 - a. Direct the Australian CDC to update IPC guidance, for all settings, to include appropriate mitigations for the prevention of transmission of airborne pathogens
6. Direct the Productivity Commission to conduct a benefit-cost analysis for investments required to meet IAQ performance standards in all public spaces

Over the next year, we call on employers to action two priority recommendations:

1. Adopt and demonstrate compliance with IAQ performance standards for all business premises
2. Acknowledge IAQ as an accessibility and inclusion issue and incorporate it into existing equity, diversity, inclusion, and belonging policies

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ACSQHC	Australian Commission on Safety and Quality in Health Care
COPD	Chronic obstructive pulmonary disease
CO	Carbon monoxide
CO₂	Carbon dioxide
CRC	United Nations Convention on the Rights of the Child
DDA	Disability Discrimination Act 1992
EDIB	Equity, diversity, inclusion, and belonging
HAI	Healthcare acquired infection
IAQ	Indoor air quality
Ls⁻¹ person⁻¹	Litres per second per person
Ls⁻¹ student⁻¹	Litres per second per person
ME	Myalgic encephalomyelitis
PM_{2.5}	Fine particulate matter
PPE	Personal protective equipment
RSV	Respiratory syncytial virus
WHS	Workplace health and safety