I was excited to see Australia announce the creation of a Centre for Disease Control. COVID-19 made it clear that Australia needs an institution of this kind. I'm also glad that Australia has commissioned this Inquiry, including to inform the priorities of the CDC.

There's a long-standing public health adage that "prevention is better than a cure". The same logic applies to pandemics. Pike et al in The Origin and Prevention of Pandemics show that the "wait-and-respond approach is not sufficient and that the development of systems to prevent pandemics *before* they are established should be considered imperative to human health." I think this insight should be foundational to the direction of this Inquiry.

My submission focuses on a couple of select issues, but my overall view is that pandemic prevention should be a key priority of the CDC and that our institutions and leaders should never concede that pandemics are inevitable.

I believe that the Australian government should be investing in better Indoor Air Quality (IAQ) to reduce the risks of future pandemics. Australians spend at least 90% of their time indoors and every year, Australians fall ill as a result of exposure to airborne pathogens while indoors. Worse still, respiratory transmission is a primary transmission route for pandemics. Therefore, reducing respiratory transmission will not only result in less illness for Australians but also safeguard us against the next pandemic. In addition to proven approaches and technologies, there are promising, effective, and scalable interventions, such as Ultraviolet germicidal irradiation (UVGI), which Australia could be supporting in the hopes of deployment before the next pandemic.

The Lancet COVID-19 Commission Task Force has proposed Non-infectious Air Delivery Rates (NADR) as measurable goals for ventilation and filtration targets that protect against infectious disease transmission. Air delivery rates to different sized rooms can be compared using the normalised measure of Air Changes per Hour (ACH) – the number of times the volume of air in a room is exchanged with fresh, pathogen-free air each hour. Ventilating a room with fresh outdoor air while exhausting air in the room reduces the concentration of pathogens in the air produced by the room's occupants. Filtration and disinfection technologies can achieve comparable effects to ventilating a room with fresh air can be measured by Equivalent Air Changes per Hour (eACH) – the number of ACH required to achieve the same reduction in pathogen concentration.

Traditionally, air changeovers are achieved through opening a window or having an HVAC (Heating, ventilation, and air conditioning) system installed. The Air Safety to Combat Global Catastrophic Biorisk report summarises the cost-effectiveness of different mechanical IAQ interventions. A modern HVAC system costs $135 USD per ACH, assuming it is updated to current standards for filtration and air delivery rates. However, many buildings do not have an HVAC system installed and are often not ventilated – schools, cafes and restaurants, homes, and smaller and older workplaces are just some examples of poorly ventilated spaces that we visit every day. Modern HVAC systems can be expensive or difficult to retrofit into buildings but represent an important step towards delivering non-infectious air. However, there are more cost-effective technologies that are easier to retrofit and could be widely adopted to keep Australians safe and healthy indoors. One example is portable air cleaners using HEPA filters which are estimated to cost approximately $110 USD per eACH and are simple to retrofit into buildings that are unsuitable for HVAC.

Ultraviolet germicidal irradiation (UVGI) is the use of ultraviolet light to inactivate or kill pathogens such as bacteria, fungal spores and viruses. UVGI lights in indoor spaces could decrease the number of pathogen particles in the air in a safe, scalable and simple manner. Upper room UVGI lamps use 254nm wavelength UV light to sterilise the air in the top of rooms as it circulates and cost approximately $14 USD per eACH. Far-UVC lights are a newer innovation that can bathe an occupied room in far-UVC wavelengths. It uses a shorter wavelength of 222nm, which appears to be safe for skin and corneas yet it still inactivates the comparatively smaller pathogen particles. Unlike other interventions, Far-UVC has potential to reduce short range and conversational distance transmission and sterilise surfaces, in addition to reducing long-range airborne transmission like mechanical ventilation, portable air cleaners and 254nm UVGI. It is estimated to cost $15-46 per eACH, however, still requires additional R&D to make it cost-effective and scalable.

Given that we have a mix of proven approaches for a variety of buildings and promising technology, I believe Australia should be investing in the deployment of what we know works and the research and development of what we know is promising. UVGI technology has the potential to make all indoor environments safe for Australians to occupy without fear of respiratory illness at an affordable price. Through supporting research and development in this technology, Australia can lower the burden of respiratory illness and protect against the next pandemic.

Public commentary has focused on the possible origins of COVID-19, including whether it was a "lab leak". Regardless of the specifics of COVID-19 specifically, I've been shocked to learn about the high rate of safety incidents at labs handling dangerous pathogens. A publication from Manheim and Lewis found that from 1975-2016 there were 71 reported high-risk human-caused pathogen exposure events – as well as evidence of underreporting.[1] An anonymous survey on biosecurity and accidents in Belgium reported almost 100 laboratory-acquired infections in a 5 year study period.[2] A lab leak also likely began the 1977 flu pandemic.

Given pandemics can cost millions of lives and trillions of dollars, it seems clear that safety standards (or adherence to standards) fall far short of what is appropriate. While I'm firmly in favour of science, and think that science is a force for good in fighting pandemics, it has to be done responsibly.

As an outsider, there is little transparency about how physical containment facilities in Australia are regulated. The Office of the Gene Technology Regulator seems to focus mostly on GMOs and provides little information about its functions regarding physical containment facilities.

To the extent that information is available, OGTR's 2022-23 annual report is proud that it certified a record 132 physical containment facilities last year, meaning that there are now

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[1] David Manheim and Gregory Lewis, 'High-Risk Human-Caused Pathogen Exposure Events from 1975-2016' (2022) 10 F1000Research 752.
[2] Biosafety and Biotechnology Unit, 'Laboratory-Acquired Infections in Belgium (2012-2017)'.

1,874 “high-level” facilities operating in Australia. It also reports that it only conducted 49 inspections in the same period, including no inspections of the highest-level PC4 facilities.

Reviewing older reports, no PC4 facilities were inspected in 2021-22 either, and only 1 inspection occurred in 2020-21. Despite only conducting 49 inspections in 2022-23, 26 certified physical containment facilities were found to be non-compliant. In this context, the report noted that OGTR takes a “cooperative approach” to compliance and that no culpability was found in any of these cases.

In addition to seeming shortcomings in oversight, the guidelines themselves are troubling. The rules for PC4 facilities were last updated in 2007 and reference standards like AS1324.1 on air filters and AS/NZS 2243.3 on lab safety, which don’t appear to have been updated since 2001 and 2002 respectively. AS1324.1 specifically has been criticised by the HVAC industry for being based on inaccurate research from the 1950s and has now been superseded by ISO 16890.

While this is a grim picture on multiple fronts, it’s not necessarily a criticism of OGTR. OGTR only has 51 employees and has wide-ranging regulatory functions apart from these topics.

I think that this Inquiry should recommend a thorough review of biosafety – including the suitability of requirements, degree of adherence, and adequacy of oversight – for all research that involves human or animal pathogens. The review should include a risk assessment that takes into account the potentially catastrophic global consequences of errors, and ensures that our approach to mitigation is proportionate to that risk.

Citations:

- OGTR Annual Report 2022-23
- Australian Government Department of Health and Aged Care, Office of the Gene Technology Regulator Annual Report 2021-22 (ogtr.gov.au)
- Guidelines for the certification of physical containment facilities | Office of the Gene Technology Regulator (ogtr.gov.au)
- Bringing the Australian air filter standard up to speed - HVAC&R News (hvacrnews.com.au)

I think pandemics are one of the most important issues of our time, and expert assessments that the risk of pandemics is increasing are alarming. I think this inquiry should carefully consider how future pandemics could start and ensure it makes specific recommendations to reduce their likelihood. This should include the known mechanisms that have been with humans since time immemorial, such as zoonoses, as well as more recent risks, such as lab leaks, and emerging threats, such as engineered pathogens.