Thank you for the opportunity to make a submission and raise my views and experiences about the Government's COVID-19 response. I'm a researcher who considered biosecurity for a PhD topic before COVID-19 and the pandemic made it clear that we were not ready.

I hope that the inquiry focuses on pandemic prevention. More than any other global catastrophic risk, we are able to prevent novel pathogens from emerging and to identify and eliminate them if they do. Given the huge human and economic costs of pandemics – and that pandemics worse than COVID-19 are possible – prevention should be our top priority.

The paper "The costs and benefits of primary prevention of zoonotic pandemics" (Bernstein 2022) makes the economic case for a focus on pandemic prevention. The paper shows that – even on pessimistic assumptions and without considering the potential impact of emerging technologies – significant investment in pandemic prevention is overwhelmingly justified.

In light of that analysis, the new Australian Centre for Disease Control should focus on efforts to prevent novel pathogens from emerging and being able to control them if they do.

My submission goes primarily to 'preventive health measures' in terms of reference 3.

Sources:

The costs and benefits of primary prevention of zoonotic pandemics - PMC (nih.gov)

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.

The diagnostic and wastewater infrastructure and talent built up over COVID-19 response should not be wound down but proactively pivoted for public health. Clinical metagenomics, wastewater testing and the testing of airports, cruises and other ports of entry could provide welcome data to improve the National Notifiable Diseases Surveillance System (NNDSS) and provide a volume of samples to test routinely with metagenomic sequencing for novel pathogens. Keeping this diagnostic infrastructure 'warm' would also mean that in the next pandemic, diagnostic capability could expand more easily, which we know first-hand is essential to halting community transmission of a pathogen. [redacted] in a testimony to the U.S. House Hearing on "Biosecurity for the Future: Strengthening Deterrence and Detection" said:

> *"Sustainably financed systems for early detection and robust response can stop outbreaks at the source before they evolve into global pandemics"*

Any early detection system must be robustly financed into perpetuity and resistant to funding cuts, and one way to do this is to have a public health monitoring system that is consciously set up to be useful both in "peace-time" and health emergencies.

I think the inquiry should familiarise itself with the diagnostics of different sampling types like:

- Clinical diagnostics
- Wastewater monitoring and,

- Airports, cruises and other ports of entry.

It should also familiarise itself with technology developments around:
- Metagenomics (both clinical and wastewater)
- CRISPR-based diagnostics
- Improvements to and multiplexing of PCR and LAMP

It should also familiarise itself with the many emerging cost-effectiveness and effectiveness models, as well as obstacles on such systems in literature to inform the design of an early detection system. For example:

- Sharma et al (2023) Threat Net: A Metagenomic Surveillance, Health Security estimates that for $400-800 million dollars it would have a 95% change of detecting a novel SARS-CoV-2 like respiratory pathogen after 10 emergency department presentations and 79 infections across the US
- The pre-print by Liu et al (2023) Quantitatively assessing early detection strategies for mitigating COVID-19 and future pandemics estimates that hospital monitoring could have detected COVID-19 ~1000 cases earlier. Wastewater surveillance could provide an early warning for pandemics with long incubation periods. Different pathogens would suit different early detection sampling and platforms.
- Wegryzyn et al (2022) Early Detection of Severe Acute Respiratory Syndrome Coronavirus 2 Variants Using Traveler-based Genomic Surveillance at 4 US Airports, September 2021–January 2022, Clinical Infectious Diseases provided early-warning variant detection, reporting the first US Omicron BA.2 and BA.3 in North America.
- Liang et al (2023) Managing the Transition to Widespread Metagenomic Monitoring: Policy Considerations for Future Biosurveillance, Health Security outlines a number of policy obstacles that need to be overcome for a public health monitoring system with sequencing as it's backbone to be successful over the next decades

How well we handle the next pandemic will largely be a function of how quickly we can detect and understand it. Every element of the terms of reference hangs off this. On that basis, early pathogen-agnostic detection systems need to be invested in now to get ahead of the next pandemic. With how necessary PCR diagnostics were in controlling case numbers before vaccine uptake was high, in my opinion, it would border on negligence if we don't improve our diagnostics ability before the next pandemic pathogen outbreak. I recommend the Inquiry direct the new CDC to explore the benefits of a pathogen-agnostic early detection system for both the near-term public health benefits and the long-term early detection pandemic warning system.

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.