I am an NHMRC Leadership Fellow and Professor of Virology at the University of Sydney. I am a global expert in the evolution of viruses and the first person to release the genome sequence of SARS-CoV-2, enabling the rapid design of vaccines. In 2021 I received the Prime Minister's prize for science. I am giving these comments in a personal capacity.

I wish to comment on some scientific aspects of the Australian government's response to COVID-19.

Overall, the Australian government's response to COVID was excellent and should be praised. The government listed to the science, generally provided a clear message, and acted to protect the public health. Clear evidence for this is that, for virtually every available metric, Australia performed better than the majority of developed nations during the pandemic.

However, there is room for improvement in some areas. I make three specific recommendations:

1. A broader set of pandemic plans.
2. Wider expert advisory groups, with a broader skill base.
3. Improved vaccine procurement, vaccination policy and vaccination advice.

1. Pandemic Plans

As in most developed nations, the pandemic plan in place in Australia was based on influenza. Hence, all the epidemiological models and strategies for disease control assumed that a pandemic virus would have characteristics like that of influenza. Although there are similarities, SARS-CoV-2 is not influenza. In particular, because of its high infectivity, pandemic plans for influenza assume that the virus can only be suppressed, not eliminated. However, this was not the case for early variants of SARS-CoV-2 that had relatively low infectivity relative to later variants. With sufficient control measures it was possible to fully eliminate SARS-CoV-2 transmission, as demonstrated by New Zealand and some Australian jurisdictions for extended periods (until the emergence of Omicron). Hence, the epidemiological models utilized for SARS-CoV-2 were not necessarily the most appropriate and may have incorrectly shaped control policies in some instances. Moving forward, it will be important to have pandemic plans in place for pathogens with a broader range of epidemiological and biological properties.

2. Expert Advisory Groups

One of the major wins for Australia was that the scientific advice provided to the government was generally good, timely, and acted upon. This sits in stark contrast to countries like the UK and the USA.

While the science-government interface generally worked well in Australia, mistakes were made. Of most note, the government seemed to only rely on the advice provided by a particular set of clinicians and epidemiologists, largely ignoring the work of other groups with other skill sets. This was most stark with respect to the delay in accepting that SARS-CoV-2 was subject to airborne transmission. As 2020 wore on, a large body of data accumulated, particularly from ventilation and air flow studies, that the virus was airborne. Yet these crucial data were minimised by the expert groups advising the government, who focused on clinical and epidemiological data which better fit their expertise and hence frame of reference. The WHO fell into exactly the same trap. Randomised control trials were considered the evidential "gold standard". While this is true for most therapeutic interventions, a broader set of data are of value when investigating such issues as airborne transmission. The effective denial of airborne transmission, in the face of mounting evidence for its occurrence, resulted in incorrect advice on PPE, especially for health care workers, and hence a larger number of COVID infections. This was undoubtedly a major misstep.

As a consequence, there should clearly be a broader range of skill groups providing advice to government. These should include, for example, experts in virus transmission, ventilation systems and PPE design. In particular, it is crucial that the Chief Scientist of Australia and the Australian Academy of Science be given more prominent roles as they can draw on a wide range of scientific expertise. They seemed to be effectively side-lined during the COVID-10 pandemic, yet should be a key part of any future pandemic plan.

3. Vaccines and Vaccination

Australia's vaccination policy was generally a success. However, the vaccine roll-out was slow and there was a delay in the purchase of sufficient mRNA vaccines (although this likely did not

have a major impact on pandemic control in the long term). Thankfully, Australia is now investing in mRNA technology.

One aspect of the initial delay in vaccine procurement was an over-emphasis by some in government on producing a "home grown" Australian vaccine, specifically that designed by researchers at the University of Queensland. While it was correct that this vaccine project was funded and supported, because of the untested nature of the technology and the complexity of the problem it would have been advisable to have invested earlier in a broader set of vaccine technologies developed in other localities. Indeed, it was clear from early clinical trials and data from other localities that the mRNA vaccines were efficacious and should have been procured. Again, a broader advisory group may have been able to provide better advice. In addition, in both Australia and globally there was a marked lack of surge capacity for vaccine production. Hopefully, the new investment in mRNA technology in Australia will be help address this issue.

The clarity and timing of vaccine advice provided by ATAGI should also be improved. Although it is important that ATAGI provide guidance, this was often too late, confusing, and sometimes seemingly of little scientific basis given the data available in other localities (e.g., which age groups should be vaccinated using which vaccines and when). As a specific case in point, the decision to offer XBB vaccines to the broader adult population (i.e., aside from the elderly and immunocompromised) in Australia was made far too late. To achieve as wide an update as possible, vaccine advice (and vaccine categories) should be far simpler. The skill base of ATAGI may also need to be expanded.

Finally, for future pandemics, it should be mandated that any vaccines not used in Australia should be automatically given to lower income countries.

Prof. Edward C. Holmes FAA FRS
NHMRC Investigator Fellow and Professor of Virology,
The University of Sydney