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Australian COVID-19 response: Lessons and future directions

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Abstract

The COVID-19 pandemic has produced enormous impacts at public health, economic, and societal levels. Following the initial strategy to limit public health burden, so-called "flattening the curve", the pursuit of an elimination strategy has brought Australia public health success and international plaudits. Initial success was driven by Federal-State government partnership, community support for restrictions and testing, and public health systems for testing, tracing, and isolating. The Victorian "second wave" in winter 2020 stretched public health systems, but community support for "lockdown" measures ensured control was achieved. Hotel quarantine for returned overseas travellers has been largely successful, although ongoing breaches and intra-hotel infections indicate the need for enhanced infection control including against aerosol transmission. Future issues include the level of vaccination required before an elimination strategy can be replaced, and whether herd immunity is achievable, or the more feasible target of "disease immunity" pursued.

Introduction

The severe acute respiratory syndrome novel coronavirus (SARS-CoV-2) pandemic and resulting coronavirus disease (COVID-19) burden has been the major global health issue of this century. The "whole of society" impact of the COVID-19 pandemic is unusual for a public health issue, albeit not unprecedented given historical global pandemics.

The first Australian case of SARS-CoV-2 infection was diagnosed on 25 January 2020, in a traveller returning from Wuhan, China, and the first locally acquired case on 2 March. Contact tracing with isolation, and a ban on non-residents entering Australia from high-risk countries (China, South Korea, Italy), were implemented between 1 February and 11 March. Subsequent measures included 14-day self-quarantine for all returning travellers (15 March), closure of borders to all non-residents (19 March), physical distancing recommendations (21 March), closure of gathering places (23 March), and stage 3 "stay at home" isolation requirements (29 March) (Price et al., 2020). During the "first wave" of the Australian epidemic, the number of cases increased rapidly to a peak of 460 daily on 28 March, before declining to fewer than 10 per day in mid-April and late-May. Stage 3 requirements were relaxed by the end of April; by mid-May, restaurants and businesses had largely re-opened.

Initial uncertainties

A major initial controversy in relation to SARS-CoV-2 was the extent of morbidity and mortality following infection. Initial limited testing, uncertainty around proportion with asymptomatic infection, and lack of representative population-based studies made estimates problematic. Although the initial focus of COVID-19 was in Wuhan, China, the overwhelming of healthcare services in Northern Italy in March 2020 was the first evidence of the enormous burden of severe illness. The case fatality rate (proportion of deaths among diagnosed cases) was around 5 in 100 cases, and clearly higher in older age groups. As further data emerged, a better assessment of the key infection fatality rate (proportion of deaths among all infections) was possible: a systematic review indicated around 0.5 to 1 in 100 infections, with considerable age-specific variance. For example, the estimate for a person of 80 years was around 10 in 100, but less than 1 in 100 for those under 60 years (Levin et al., 2020).

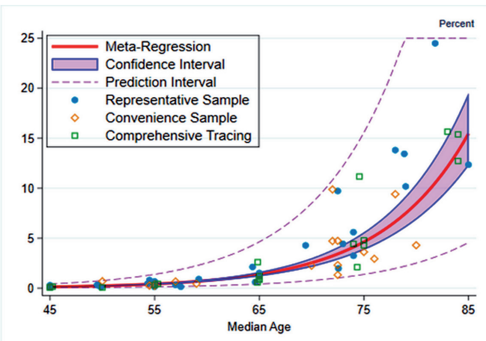

Figure 1: SARS-CoV-2 infection fatality rate (number per 100) by age.

The efficiency and modes of transmission of SARS-CoV-2 were further areas of initial uncertainty. The infection transmission efficiency factor or "reproductive number" *R*, a measure of the number of infected per infected individual, appeared to settle in the 2–3 range as data emerged, particularly from China. Clearly, introduction of non-pharmaceutical interventions (masks, physical distancing) has an impact in reducing the *R* value. On the other hand, new "variants of concern" have emerged with possible enhanced transmission efficiency.

The major modes of transmission were initially thought via respiratory droplets and fomites, thus the institution of close contact restrictions and hand hygiene as major prevention measures. As new evidence accumulated, the role of aerosol transmission has become clearer, and the associated need to consider further prevention measures: improved masking (e.g. N95); adequate ventilation for indoor spaces, even when reasonable physical distancing is maintained (Greenhalgh et al., 2021).

Australian COVID-19 response

Initial Australian Government-commissioned mathematical modelling indicating intensive care units would be overwhelmed by an unmitigated COVID-19 epidemic was clearly pivotal to adoption of major restrictions during the first wave in March 2020 (Moss et al., 2020). The strategy was to prevent the potential exponential rise in cases and a storm of severe illness, the so-called "flattening the curve" approach. These restrictions, including "stay-at-home" regulations and limitations on gatherings, had the desired effect, with cases rapidly declining by early April. In fact, by end-April the COVID-19 storm — never cyclonic — had passed and many restrictions had eased.

The Victorian second wave

The number of COVID-19 cases in Australia was low through May 2020, with several jurisdictions including New South Wales having long periods of no or very few locally acquired cases through May and June 2020. In Victoria, small numbers of daily cases continued through May, with meatworks and school "clusters" plus hotel quarantine breaches seeding major community spread by late June; "lockdown" measures were introduced, and mandatory masking added, in early to mid-July. This "second wave" of COVID-19 cases concentrated in Melbourne, easily surpassed the combined Australian "first wave" in terms of case numbers (around 3,000 per week in late July) and deaths (around 100 per week during August).

Although other Australian jurisdictions have had short-term lockdowns and temporary measures, including mandatory masking in public, the prolonged nature of the Victorian restrictions (only eased from mid-September) clearly separates their experience from the remainder of Australia's.

As of May 2021, Australia had reported around 30,000 COVID-19 cases (20,500 from Victoria) (Figure 2), with total deaths of 910. Over the previous six months, there had only been one death, highlighting the recent public health success.

The Victorian experience in turning around a rapidly escalating and broad community epidemic and achieving effective elimination by October 2020 is relatively unique internationally. This demonstration of effective government leadership and community action consolidated the growing realisation that an elimination strategy was achievable.

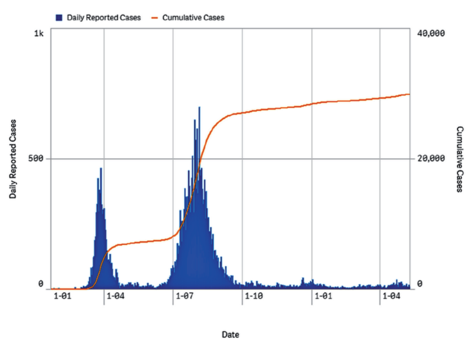

Figure 2: COVID-19 daily cases in Australia.

Australia takes on elimination strategy

Eradication of global infectious diseases has been a near-impossible task, with only smallpox on the list of human infections to achieve such a public health goal. Elimination — the reduction of incidence of infection or disease to zero in a defined geographical area or population — is clearly a lower bar, with several infectious diseases including poliomyelitis achieving this in large parts of the world. The initial scepticism around COVID-19 elimination related to the global pandemic nature of spread and inability to completely close our borders to international travel.

The demonstrations in New Zealand, Taiwan, and Vietnam that country-level elimination could be achieved, even if relatively short-lived, together with elimination success in several Australian jurisdictions led to the adoption of either an elimination strategy or "zero community transmission" strategy at state and federal levels.

Despite ongoing hotel quarantine breaches in most jurisdictions taking international travellers (largely Australian residents), there has been relatively limited local transmission of SARS-CoV-2 during 2021. The economic advantages that have followed elimination, despite occasional short-term lockdowns, have clearly demonstrated the success of such a strategy at public health and societal levels.

Lessons from the COVID-19 response

There are several lessons that should be taken from the Australian COVID-19 response to date that should shape the future response, but also have implications for broader public health responses:

- COVID-19 "*holds a mirror to*" public health systems and finds any weaknesses

- "*Flattening the curve*" not enough; community transmission control = health & economic benefits
- Australia has benefited from the Federal system of government, with generally impressive leadership from jurisdictional political and public health representatives
- Vulnerable populations have been protected, with some key exceptions
- Prevention is paramount, with false hope in "miracle cures."

Future directions for COVID-19 response

Despite the clear public health success of the Australian COVID-19 response, there are ongoing challenges that will need to be faced through 2021 and beyond. The escalation of cases and deaths in India and other low- and middle-income countries is in stark contrast to ongoing COVID-19 elimination success in several countries including Australia, and the marked turnaround of high caseload epidemics through a combination of non-pharmaceutical interventions and rapid COVID-19 vaccination in United Kingdom, United States, Israel, Qatar, and other countries.

COVID-19 vaccine implementation

The development and licensing of several highly effective and safe vaccines in less than 12 months from the initial isolation of SARS-CoV-2 as the causative agent for COVID-19 is truly remarkable (Kwok, 2021).

In vaccine development, several years (often much longer) are required to develop and license, let alone implement, effective vaccines. The intense focus and investment in COVID-19 vaccination is unprecedented in science, and the variable success in implementation of non-pharmaceutical interventions in most settings around the world placed further urgency on rapid development. Several classes of COVID-19 vaccine have been developed, including mRNA, adenovirus (chimpanzee and human) vector, sub-unit nanoparticle, and attenuated virus forms. Although different vaccine technologies have been utilised, all have incorporated the SARS-CoV-2 spike protein, which includes the receptor binding domain — key for cell binding and entry.

The failure of the University of Queensland COVID-19 vaccine, that incorporated "molecular clamp" technology to stabilize the spike protein and enhance immunogenicity, was clearly disappointing, but research is continuing to develop modifications for potential future evaluation. The "failure" was not due to a lack of immunogenicity, which was impressive in early phase evaluation (Chappell et al., 2021), but use of an HIV protein segment within the clamp element led to a small proportion of individuals developing false positive HIV antibody results, enough of a concern to halt further development.

The Australian Government has multiple COVID-19 vaccine contracts with companies, including ChAdOx1 nCoV-19 (Voysey et al., 2021) (Oxford/AstraZeneca, 53 million doses), BNT162b2 (Polack et al., 2020) (Pfizer/BioNTech, 40 million doses), NVX-CoV2373 (Novavax, 51 million doses), mRNA-1273 (Moderna, 25 million doses), and with CSL for local manufacture of the Oxford/AstraZeneca vaccine. The phased rollout of the vaccine programme, with initial priority to hotel quarantine staff and frontline healthcare workers, and the elderly (70 years and older), followed by younger age groups with selected underlying medical conditions that increased their risk of more serious COVID-19, has been slower than anticipated, with around 3 million doses delivered by May 2021. The identification of thrombotic thrombocytopaenia syndrome (TTS), including cerebral venous sinus thrombosis, linked to Oxford/AstraZeneca vaccination (generally occurring 4 to 20 days post-vaccine dose one) was a clear setback to rollout plans. Given relatively higher risk of events (overall around 1 in 100,000 to 150,000) in younger age groups and the lower COVID-19 morbidity and mortality risk, many countries have restricted the vaccine to older groups. In Australia, for those under 50 years, other vaccines are preferred.

COVID-19 vaccine real-world impacts

The rapid implementation of COVID-19 vaccines in settings with ongoing high infection rates has clearly demonstrated that impressive clinical trial efficacy has translated into high-level real-world effectiveness. In fact, it is relatively unique in that real-world effectiveness may have even exceeded expectations. This relates to the phase 3 clinical trials evaluating efficacy in relation to prevention of COVID-19 (symptomatic illness), but not being powered to fully evaluate efficacy against severe COVID-19 disease, hospitalization, and death. Furthermore, most trials were unable to evaluate efficacy in relation to prevention of all infections (including asymptomatic).

A key feature of the real-world data has been the similar effectiveness of COVID-19 vaccines that appeared to quite different efficacy in phase 3 trials. For example, in United Kingdom, both Pfizer/BioNTech and Oxford/AstraZeneca vaccines demonstrated effectiveness after the first dose (from 14 days) of around 90% against severe disease and hospitalization, and 60–70% against all infections. The latter, coupled with a further United Kingdom study demonstrating that vaccine breakthrough cases have 40–50% reduced infectiousness (through evaluation of ongoing household-based infections), demonstrates the considerable impact COVID-19 should have on overall transmission. Further data from Israel, Qatar, and other settings has demonstrated similarly impressive real-world effectiveness of COVID-19 vaccines.

SARS-CoV-2 variants

Several new variants of SARS-CoV-2 have emerged, particularly in the setting of rapidly escalating epidemics. Those variants with either evidence of increased infectiousness, increased virulence (higher rates of severe disease), or reduced COVID-19 vaccine efficacy have been labelled "variants of concern". These include the B.1.1.7, initially isolated in United Kingdom, which appears to have both increased infectiousness (30–50%) and increased virulence, but has relatively limited impact on COVID-19 vaccine effectiveness. In contrast, the B.1.351 variant, initially isolated in South Africa, may not have increased infectiousness or virulence, but has evidence for reduced COVID-19 vaccine efficacy. Other variants of concern include P.1 (Brazil origin), B.1.429/7 (United States origin), and B.1.617 (India origin) (Chakraborty et al., 2021).

Pathway to opening up for Australia

The considerable COVID-19 success that Australia has achieved through the pursuit of an elimination strategy has brought clear public health, societal, and economic benefits. The pathway out of the constraints of the pandemic will require careful considerations of the risk of new community outbreaks against the potential benefits of opening up.

The Australian COVID-19 vaccination rollout should accelerate over the coming months, with the prospect that a large majority of adults could have received at least their initial dose by end-2021. Given the impact of both vaccines on risk of severe disease and hospitalization and the initial emphasis on older populations, such coverage should provide "disease immunity." The impressive real-world data on vaccine effectiveness against all infections and infectiousness among breakthrough cases indicate that major herd immunity effects are also possible within this timeframe.

Several questions remain in relation to the opening-up. First, will people who have been fully vaccinated be allowed to travel internationally before full opening of borders, and what will the requirements be for quarantine on their return? Second, will the broader quarantine strategy be modified based on the vaccination status of returned travellers? Third, will children be required to be vaccinated prior to the opening-up? Presumably, this will depend on learnings from countries such as Israel and the United Kingdom with high adult population vaccine coverage before opening-up. This may be sufficient to prevent large outbreaks, including among children, particularly as they do appear to be both less susceptible to infection and less infectious.

Conclusion

COVID-19 holds a mirror to public health systems and finds any weaknesses. Based on this tenet, the Australian COVID-19 reflection is one of general positivity. Our public health systems have improved during the epidemic, but have largely held up, particularly capacity for testing, contract tracing, and organisation of isolation. The community support for COVID-19 testing and restrictions has been superb, with surprisingly limited resistance to such measures. At times, bipartisanship has been lacking, and Federal-State collaboration sub-optimal, but political leadership has generally been sound and followed public health advice. The pathway to the COVID-19 "other side" will however require some risk as the country opens up, but assuming support for vaccination, major disease burden is unlikely.

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