Mapping the Queensland analytics response to COVID-19: a health system perspective

Introduction

On 19 October 2022 Griffith University hosted senior clinicians, Queensland State Government Health officials, senior academics from a range of disciplines and private sector data analysts at a Round Table discussion in Brisbane. The purpose was to reflect on the COVID-19 analytics response by a consortium of public and private organisations, brought together during the pandemic by Queensland Health, to the onset of the COVID-19 pandemic in January 2020 and its course over subsequent months.

The Round Table would document what worked well and what could have been done better with the benefit of hindsight. Critically, participants were strongly of the view that the lessons to be learned from the experience must not suffer from that phenomenon increasingly recognised as a major threat to good governance – *institutional amnesia*.[1] The resulting narrative could then be used to inform processes already underway to develop a permanent national (and certainly a State) capability and framework/blueprint for networked ecosystems inter-operability using intelligence drawn and matched from multidisciplinary sources. It would supplement generic expertise in disaster and crisis management, at which Queensland has become remarkably adept in recent decades.

The outcome would ideally be a platform for seeking philanthropic, University and Government input to establish a centre of intelligence and ongoing monitoring capability for persistent, recurrent and emerging threats to our way of life and our economies.

Responses to the COVID-19 outbreak in all jurisdictions were conditioned by local factors of politics, economics, demography, system preparedness and agility and many others. The mix of political considerations, economic interests, and the preservation of life in particular will always produce a potent result, and this was the context within which health officialdom had to operate in Queensland and everywhere else. Importantly one must take themselves back to January 2020 to understand the risk, the trade-offs and the uncertainties when reflecting on what worked well for the response. In taking oneself back in time, it would be apparent that the health systems across Australia would be unable to absorb a surge in demand caused by COVID-19, a reality observed in Italy and in China – where in some countries more people died from non-COVID-19 conditions due to a lack of access to a functioning health care system. Accordingly, in reading this document one must have this reality front of mind, as it would not have been for a number of months before the risks, trade-offs and uncertainties become someone manageable, or at least understood.

Simon Benson and Geoff Chambers in their book *Plagued* (Pantera Press: Sydney 2022) document the flurry of activity in Canberra from late January 2020 as realisation dawned about the enormity of the health and social challenges presented by COVID- 19 at a time

[1] Stark, Alastair (2019). *Explaining institutional amnesia in government. Governance 32* (1) 143-158. https://doi.org/10.1111/gove.12364

when the then governments were still responding to the summer bushfire crisis. The recent review by Peter Shergold et al *(Fault lines: An independent review into Australia's response to COVID-19:* John and Myriam Wylie Foundation, Minderoo Foundation, Paul Ramsay Foundation: 2022) contributes one objective perspective of the circumstances surrounding the national response and the lessons to be learned, as part of a broader conversation around governmental response to the pandemic.

There is an emerging literature on the international pandemic response. The work by Arjen Boin, Allan McConnell and Paul t'Hart (*Governing the Pandemic – the politics of navigating a mega-crisis: Palgrave Macmillan 2021)* provides a useful framework within which to analyse governance challenges arising from frequent, severe and often overlapping crisis events. The four main challenges Boin et al single out for attention as the world community grapples with the aftermath are:

- the need to make sense of what's unfolding;
- to just get on with the appropriate response at a time of great uncertainty;
- to develop credible narratives about what is occurring; and
- to aim for crisis closure and a return to 'normal'.

Participants in the Round Table were assured of confidentiality under Chatham House rules. No individual views or statements would be revealed in the summary report. This prompted deep reflections and a robust exchange of views and recollections on what happened and why and, importantly, the lessons learned.

It is thus important to stress that the narrative draws largely on the perspectives of Queensland Health officials, their advisers and planners, and that decisions made at the time were based on information, analysis and advice available in what was a volatile and rapidly-evolving situation. This report forms the collective memory of their experience. It keeps citations from secondary or other sources, except those above, to a bare minimum to preserve that approach. Of course, there are many other perspectives to be harvested and narratives to be told – from business, emergency service workers, national and other state/territory bureaucracies, public and private health practitioners, civil society, local communities to name just a few. The Shergold review is just the first of what will probably be many reputable analyses of Australia's response. Collectively these will be a rich source of guidance for the broader conversation that will prepare jurisdictions and systems in the key areas needed for an appropriate response for when (not if) the next pandemic arrives.

Summary

In early January 2020, analysis within Queensland Health of the available data sought to understand the probable (but also imminent) impact of a highly transmissible virus on the Queensland Health system. The analysis used very early published data out of China, some weeks before the World Health Organisation declared a Public Health Emergency on 30 January 2020. Initial forecasts saw ten percent of infected Queenslanders hospitalised and one in three of those Queenslanders in intensive care (ICU). It was a grim picture of the likely inability of the Queensland health system to maintain performance: the consequences for the

system, and for the preservation of life, would likely be catastrophic – not just on those infected but those who would require and be unable to access health care services.

These findings were extremely concerning. Upon reflection, had there not been the relative freedom of media reporting at that time in China (and Italy) with respect to the impacts of the virus in those communities and health systems, then it is conceivable the validity of the modelling and forecasts could have been questionable, because the numbers were beyond comprehension, certainly without precedent in the past century.

In response to the imminent risk, teams were rapidly convened, led by a small group of senior officials in Queensland Health. Their task was to develop nowcasting and forecasting systems using case numbers to predict, inter alia, the probable number of beds and ventilators that would be needed. Throughout the crisis, data on infection rates was updated and available on most days by 6am, which facilitated rapid data transmission and analysis even allowing for the initial ten to fourteen delay between infection, symptoms onset and testing. Personal relationships, sometimes forged in chance meetings, were critical in connecting up the multidisciplinary expertise both within Queensland Health and with outside elements.

Flow charts were prepared in Queensland Health for senior politicians and members of the Leadership Board (the State Government's leading officials) and dramatically brought home to them the likely extent of infection and the implications across the entire gamut of public policy responses and administrative capacities. This collaborative approach was mandated in the aftermath of the State's Summer of Disasters in 2010-11 and 16 major natural disaster events after 2011, including 23 emergency declarations between 2018 and the identification of the COVID threat in January 2020. The national bushfire emergency of the 2019-20 summer was very front of mind.

Further refinement of the January data identified at what point the system would exhaust capacity of funded and available public beds[2]. Given that forecasts demonstrated capacity would be exhausted rather rapidly, the analysis delved into capacity that might be released upon the suspension of Category 3, and subsequently Category 2, Elective Surgeries. Eventually the modelling enabled an assessment of all public and private available beds across Queensland upon the activation of contracts with private hospitals. The mere presence of an ICU or general hospital bed did not ensure availability: a bed was only useful if adequate staff, equipment, Personal Protective Equipment (PPE), and medication could support it.

Beyond beds and ventilators, decision-makers and health system managers needed to be assured about availability of pharmaceuticals used for ventilation; the use of a ventilator is moot if it cannot be used because of a shortage of medications or reluctance of clinicians to employ medications with which they might be unfamiliar. In response, modelling was undertaken to understand the quantum of medications and PPE required for the forecast case numbers, and to identify first, second and third-line therapies. The outcome of this initiative

[2] Hospital beds can mean something different in a range of conditions. In many cases system operators will consider the definition to mean funded beds (i.e., those funded for staffing), yet there are more physical beds available. However, funding may not be available to staff the additional beds to the thresholds required. Nuances in the use of such terms is critical in a crisis, especially when traditional models of care will not be accepted as a means of being able to provide care and preserve life to as many persons as possible within the infrastructure available.

saw an improvement in quality use of medicines and PPE, the optimisation of stock holdings across state, and a more connected system. These systematic responses were all achieved within approximately ten weeks, with the prototype itself developed in just 72 hours – a significant undertaking.

Given the magnitude of consequences for relying on information from that nowcasting and forecasting system, from April 2020 Professor George Milne from the University of Western Australia was contracted to provide complementary analysis to assist with the assurance of internal modelling, and advance the understanding of the effectiveness of public health initiatives including school closures and social distancing. A key feature of the Queensland Health response would continue to draw in multi-disciplinary and multi-jurisdictional expertise to test assumptions, modelling techniques and outcomes.

A few months into the pandemic, it was evident that intelligence about infection rate was, at best, ten days old and relied on a social contract with the population to submit to testing and voluntary isolation. Accordingly, information on the number of people infected from the declared case numbers was delayed and likely incomplete. In response, data was sought on the presence of SARS-CoV-2, the virus that causes COVID-19, in wastewater. This improved the timeliness of early detection from ten days to about three days, and improved the completeness of intelligence on the basis that 20-40% of cases were estimated to be asymptomatic, a significant jump in the spatial fight against the virus, and reduced reliance on the social contract with the general populace. This information was correlated with anonymous human mobility data, using mobile phone and app data. Anonymous human mobility data enabled unconscious biases to be addressed and more evidence-based decision making. Bringing together these sources enabled public health units to be put on notice much earlier, public messaging to seek more testing in at-risk communities and to address some of the issues around equity of access to testing and treatment – particularly for our vulnerable communities in remote Queensland.

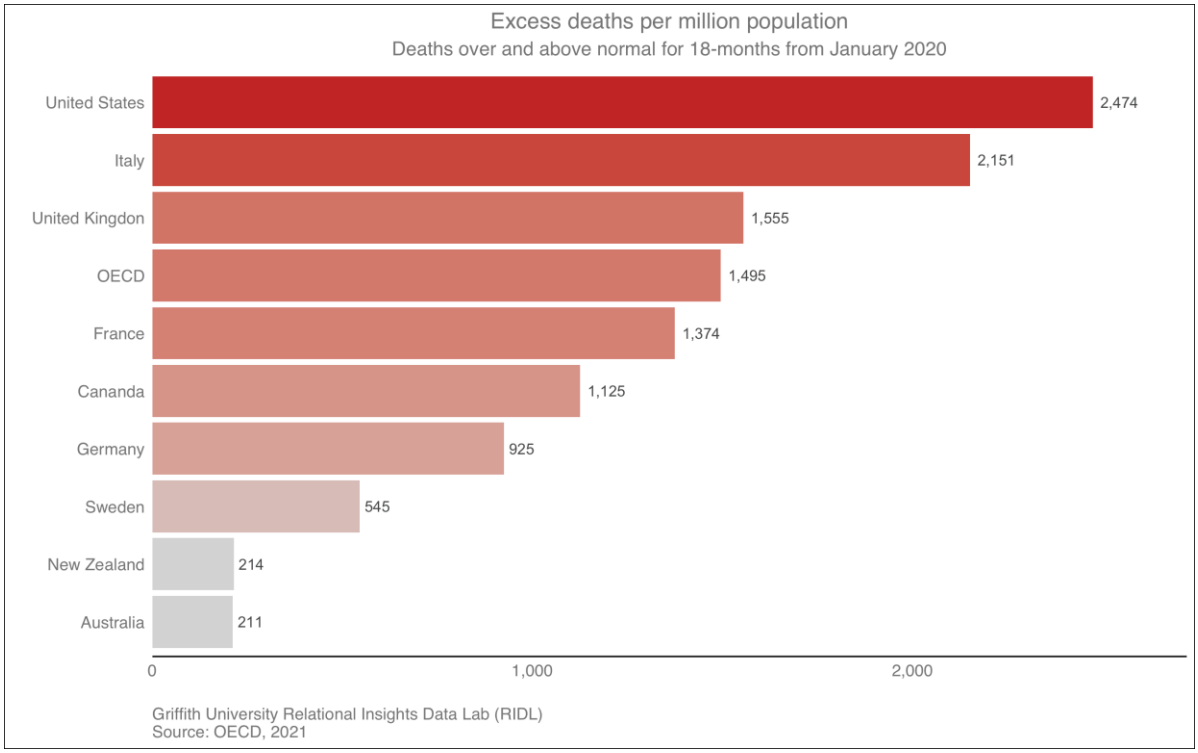
Approximately a year on from the first nation-wide lock-down, a multidisciplinary team of health experts, epidemiologists and economists from across Australia delivered a road-map for getting life back to normal. This was in response to a conflict between epidemiologists and economists in the public arena about the response and the way forward. It will be important for resilience in all associated systems that we learn from individual experiences in responding to COVID-19. Much of what was delivered in response to COVID-19 can be put down to relationships, and to particular individuals in leadership and/or influential roles at that time. Future officials and decision makers must not have to re-learn how to establish evidence-based responses to unknown threats of such magnitude as they happen. There is an obvious opportunity cost for not doing so – both to life, our way of life and our economies.

Given the impact that COVID-19 has had on decision-makers, let alone our way of life and our economy, the biggest risk our society faces in the short-term is a 'trigger happy' policy response (sometimes balanced by a rational desire to go hard and go early to get on top of whatever is happening), including possibly reacting when the risk is not there for fear of not acting soon enough – which was the problem for some decision-makers and their critics during COVID-19. It is for that reason that we must take the opportunity to share, learn, and build on what has been learnt.

Key themes

Several key themes emerged early in the Round Table and were continually reinforced as the discussion continued. They should come as no surprise, but are worth stating nonetheless. Given the promise of confidentiality to participants, the following narrative cannot capture the full richness of that discussion, but will attempt to cover the essential points in the spirit of the four factors identified by Boin, McConnell and t'Hart above.

Above all, however, the **Go Hard, Go Early** approach to understanding and dealing with what was unfolding across all dimensions of the response dominated the thinking of Queensland Health officials and Ministers and was arguably the reason why actual hospitalisation and death rates were significantly below those initially feared. The response in Canberra and the national policy and coordination strategies adopted subsequently were similar, but also heavily conditioned. Mistakes were undoubtedly made along the way; many mitigation strategies such as lockdowns of varying lengths and severities were controversial and contested. Queensland had short and sharp effective lockdowns, Victoria had slow building, long ineffective lockdowns. It is important to document all of these along with the more positive outcomes of reduced infection-spread and, therefore, reduced mortality. The complete socioeconomic impact is still unravelling, looking at excess deaths per million for the 18-months from January 2020 illustrates the impact of varied policy responses.



Economic outcomes data points out that economies fare better under fast effective policies that minimise the impact on the economy, this stands in stark contrast with many

economically focussed policy punters. If COVID-19 has thought us anything it should be that complex policy is never either/or. Public health is linked to the economy and vice versa, interdisciplinary policy interventions are the safest road to the best societal outcomes.

Similarly, it will be vital to avoid the factors that lead to institutional amnesia, where for a variety of reasons organisations and the network of actors who work in and with them leave the workforce, forget or do not reflect on, and then practice, the lessons to be learned.

1. **Data, data, data**

Every participant recognised the intrinsic importance of rapid access to as much reliable data and analytical capacity as possible from multiple sources, thus forming a coherent view of the macro-picture, down to what was happening at the micro-level. This included who was infected, where and when they were, and which sectors of the health system and outside it were being impacted. The drive was to make information-gathering and dissemination as transparent as possible. This was moderated by the need to apply nuance and judgement to the relevance of data and reliability of sources, and acknowledgement of the need to deal with significant apprehension in the community.

If for no other reason, the sheer volume, velocity, veracity, variability, and value of data enabled an appropriate level of public confidence, and confidence within the system itself, that the managers of the public health response and practitioners were doing everything possible to understand the cause and course of the pandemic and to minimise the potentially catastrophic outcomes for individuals and whole communities. This enabled decision-makers to hold firm in the face of loud voices in the media and elsewhere questioning the response.

Data was sourced from clinicians, other jurisdictions, relevant areas of the public and private sectors and universities. At the most basic clinical level, front-line practitioners must be able to know about treatment options including novel therapies and medications. Data ownership could have become a major issue but was largely avoided by the fundamental drivers of the need for transparency, clear instructions from the top that silos would not be tolerated given the urgency, the utility of all proven data sources and a multidisciplinary approach. For example, forensic and other scientists conducting routine research on blood tests for antibodies could guide vaccination strategy by plugging their results into Health networks.

Initial indications of volatility and possible health system collapse included the availability of ICU beds, thus raising questions about supply and demand for staff, clinical interventions and equipment including PPE. Supply chains and stocks of PPE became a critical issue to be managed, all compounded by threatened or actual border closures, competition between regions for limited supplies, and the ability - or inability - to rapidly move supplies to where and when they were most needed. This required a high and sophisticated level of central planning as well as open communication with end users in a dispersed and distributed system such as Queensland. This was not always optimum. Historical BAU supply and demand pattens of ordering were rendered irrelevant, leading to alternative and flexible distribution projections that still had to recognise equity considerations.

Australia is fortunate to have both private and public hospital systems that could work together. To have been able to observe the experience of China and Italy where, in some instances, the concerning political and medical response in China (and **to** China from external parties), was also valuable. It was clear early on how important the international network can be for sharing data, and of course, this includes other Australian states and territories where different strategies were in place at different times in terms of lockdowns and border closures. Some of these were, and remain, controversial.

Data on the emotional wellbeing of health staff became of particular interest to system planners, as was the vulnerability of staff to infection according to age and other factors, and the possible loss or unavailability of large cohorts of critical staff and whole hospitals.

Understanding the course of the disease for individuals factored in the delay between infection and symptoms onset, and it was soon obvious the infection data were always to some extent out of date in terms of understanding spatial distribution; in other words, there was a need to look backwards in time to assess forward workforce, infrastructure needs and system interoperability.

Data from the wastewater testing project quickly became a vital tool for assessing spatial spread. This relatively simple strategy analysed wastewater samples along various nodes of local sewage systems for viral fragments, eventually allowing for the monitoring of up to two thirds of the State's population. This intelligence was enhanced by other data captured from mobile phone and app usage tracking individuals in time and space – ranging from broad demographic areas to Statistical Area 1 (SA1)[3] level and even to individual locations such as restaurants where cross-infection might prove to be an issue. Noting that the data used in the COVID-19 analytics response had privacy restrictions applied by the data supplier before it was used by government officials, and their teams. Looking forward, this raises the question of what data sources are out there we just do not know about or have not yet been invented. Even with stringent privacy restrictions in place on present data sources, it also raises the issues of data confidentiality, privacy and intrusiveness that will have to addressed.

The anonymous mobility data was a rich and vital tool for monitoring human movement during the pandemic. Approximately thirty percent of persons in Australia can be covered in this way, and these data are extrapolated with census data to gain a nationally representative figure. Health officials could use the data to predict where outbreaks might occur, based on movements from other hot spots. In some cases, the data allowed assessment of likely infection well in advance of what testing might pick up, and importantly where testing strategies should be focused

Anonymous mobility data could also model compliance with public health orders, supporting both initial planning and assessing their impact on the spread of the virus. For example, it was shown that persons became less compliant with stay-at-home orders about three months into the crisis, which helped to justify retaining the "go hard go early" strategy. This

[3] Statistical Areas Level 1 (SA1s) are geographic areas built from whole Mesh Blocks. Whole SA1s aggregate to form Statistical Areas Level 2 (SA2s). SA1s are designed to maximise the geographic detail available for Census of Population and Housing data.

behavioural analysis was invaluable during the pandemic and will be for the management of future crises. These insights were used to modulate the public messaging and informed the tone of new strain outbreaks, to ensure public compliance remained high when necessary.

From mid-December 2020, mobile phone data was integrated with case data to pick up transmission links that might otherwise have been missed. As a specific example, anonymous mobility data established a link between a restaurant in Potts Point (Sydney) and the declaration of cases in South East Queensland. This kind of data integration informed policy responses such as the establishment of testing centres. Case data established areas of outbreak and anonymous mobility data established the usual domicile of residents in particular areas, thus informing where best to place testing locations. For example, it allowed decision to be made to stand up testing centres in locations that were yet to report a declared case, and to promote to the public the need to come forward for testing – as the intelligence suggested the virus was in a given community, but the declared cases were yet to be visible. It is important to note that focusing just on the home location of a person is was too simplistic, as this may or may not have been where actual outbreaks occurred. In future, linking data in this way means the whole is greater than the sum of the parts for a comprehensive public health response.

A point reiterated during the Round Table was not just the importance of data collection, but its importance in relation to time and place. Wastewater testing, while no doubt invaluable in the early stages of the pandemic with isolated outbreaks, became less so once outbreaks were more widespread. The clear lesson is that as a situation evolves so must the purpose and nuances of data sourcing.

Participants at the Round Table also emphasised the need to balance the cost of data collection with the opportunity cost: the choice not to collect. For example Queensland, just like many other jurisdictions, has the capacity to collect and analyse blood samples before and after vaccination to understand population infection trends and immunisation responses. This opportunity was not taken up and potentially valuable insights lost, but bearing in mind the imperative to work out in the middle of a rolling crisis what was needed to know and what was available to know, and the attendant costs.

2. **Modelling**

Good modelling practice underlines the need to use the experience of COVID-19 to plan for the next pandemic. Modelling expertise was deliberately sought from outside the Health bureaucracy to draw on the best available expertise and to eliminate, as far as possible, bias or unintentional mis-reporting. The modelling framework developed in this instance can be applied to other (non-health) phenomena.

Key to the success of modelling the COVID-19 pandemic was that much existing modelling from Australia and elsewhere could be repurposed and modified. Existing influenza data were used as a base, adding census data for age, health status and so on. Extrapolated from these, other factors such as decisions on school vacations and closures, curfews etc could test social distancing recommendations.

Modelling was critical to understand the impacts globally and at the local level as early daily infection data began to be available. Linking data sources in, across and outside government could highlight infection rates and the effectiveness of various vaccine types, factors such as cross-border movements, as well as the emergence of different disease variants (Delta/Omicron). Modelling these data extended to the option of stopping elective surgery and the implications of this.

Repatriation of Australians overseas, international students and the overall economic impacts became a key issue: going hard going early meant that without modelling and monitoring, these factors could potentially undermine the national response.

Supply and demand modelling for PPE, medications, equipment availability also had to be both on-time and predictive.

In order for the modelling to provide actionable insights within an acceptable timeframe, speed of development was key. This required timely access to key subject matter experts from the fields of data analytics, systems and data access along with access to key health professionals.

Some of the modelling commissioned in the early stages of the pandemic was developed in a period where our understanding of the virus was also developing rapidly – an agile approach to development was key in navigating this changing landscape. It was also important that the analytics output also be flexible enough to incorporate the uncertainty, allowing for user inputs where appropriate.

3. **Validation**

Self-evidently, the collection and use of such different and disparate data sources meant that validation became a critical part of their application. Again, validation was sought from external sources as well as from staff data analysts.

The whole-of-system implications of the pandemic were recognised throughout, and so economic, demographic, political, educational and many other dimensions were not forgotten in what was first and foremost a health crisis.

4. **Acknowledge and communicate feasible innovation and initiative**

There were many instances of innovative treatments at the local level and adoption of these learnings across the system, aided by rapid communications, and consistent with clinical reluctance to engage in any practice that could compromise patient safety.

In one instance, a clinical specialist in a regional location found it difficult to gain wider recognition of a technique using AI technology for matching facial characteristics with appropriately fitted and effective masks. Factors such as ethnicity, gender and age can

materially affect the utility of PPE such as face masks for individuals. Adoption of techniques such as this can possibly lead to significant savings in redundant or inappropriate PPE and resulting wastage, but is also potentially extremely expensive to operate on a mass scale among c.50,000 Health staff, let alone among the general population if ever mask-wearing again became mandated.

Similarly, the wide climatic variability of Queensland means that standard PPE is some areas quickly becomes unusable or unwearable, and this must be taken into account in supply chain planning and logistics.

The concept and the methodology of matching masks to faces was essentially borrowed from the mining industry where dust protection is paramount. Another example from the mining industry is also instructive. Mine sites are inherently hazardous environments and any actual or perceived threat that could lead to injury or death is immediately subject to rigorous forensic examination. Unions, management, contractors and any other on-site sectors of the workforce are involved in this process and outcomes automatically incorporated in standard operating procedures that apply across the entire sector. Severe penalties can follow transgression.

The underlying issue here is the need for rapid and transparent transmission of relevant information, both clinical and otherwise at times of crisis, both into the planning and decision-making centre and back out again from it. But this raises the twin problems of the potential barrage and multiple sources of such information (not all of them reliable or sponsored by benevolent actors) enabled by modern technology, so that the intended audience just turns off from either weariness or distrust. Prudent management of officially sanctioned data sources is clearly a high priority.

5. **Be Prepared**

Eighty years after the Spanish Flu wreaked havoc around the world, a highly pathogenic virus was detected in South East Asia in 1997: H1N1 – Avian Influenza. A significant outbreak in China in 2002 caused 813 deaths. Soon after, at the end of February 2003, severe acute respiratory syndrome (SARS) was identified in China. And in 2020, the world had SARS-CoV-2 – leading to COVID-19. That is, on average, one pathogen of concern emerging in South East Asia every decade or so. On the balance of probabilities, in the next 8 years we are likely to have another pathogen of concern, and Asia is not the only potential source. Since January 2020 the transparency and globalising forces have changed. It is important to note that in the current geopolitical environment China might not share information as quickly. Resilience must be built with these variations in mind, we cannot rely on others to inform Australia of the dangers headed our way.

The current COVID-19 pandemic is still with us. Rolling peaks of infection remain, infections and deaths are still occurring even though incidence has been mitigated by increasing number of people with antibody protection either because of successful vaccination strategies or because they have already been infected. But individual re-infection with COVID-19 is possible, and another SARS-type virus could appear at any time – or another virulent disease

akin to Ebola, or some other as yet unknown pathogen. As noted in the introduction, on the balance of probabilities we could expect another pandemic event within the next decade.

The only antidote to this is vigilance: maintaining close relationships with international health monitoring bodies and research into novel treatments. Whether vigilance extends to broadscale routine testing of wastewater, for example, depends on what is being tested for, and who is responsible for doing the testing. Many isolated communities with high levels of morbidity or other factors do not have networked or closed sewage systems. The issue of cost (and opportunity cost) then comes into play, but so does equity. Other issues such as privacy noted above in the context of phone tracing are also in play.

Meanwhile, participants in this Round Table were clear that the lessons learned in areas such as logistics, workforce planning, the functionality of strategies such as lockdowns (i.e., their purposes, their timing, severity and duration), data sourcing and analysis, testing regimes and system interoperability must be reinforced by documentation, dissemination and repetition and be built into standard operating procedures. The literature on institutional amnesia and its antidotes provides a useful guide on what can be done to maintain appropriate levels of alertness.

6. Contributors

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