What the Doherty Modelling really tells us about opening up at 80 per cent vaccination

Eight facts about 80 per cent

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INTRODUCTION

Rarely, if ever, has an Australian Prime Minister relied on statistical modelling as heavily as Scott Morrison. Modelling by the Doherty Institute is the sole piece of evidence on which the Prime Minister has formed the view that it is 'safe' to significantly reduce the social distancing measures that have helped Australia keep its death rate so much lower than that experienced in most countries around the world.

It is true that high vaccination rates lead to a significant reduction in the spread of COVID19, hospitalisations and deaths from the virus. But it is also true, as the Doherty modelling makes clear, that lifting restrictions on peoples movement, mixing and mingling when 80 per cent of adults are vaccinated will lead to up to 40,000 Australians **per day** becoming infected in the months after restrictions are lifted.

The Doherty modelling also makes clear that, even after 80 per cent of adults are vaccinated, lockdowns will still be a common feature in Australia, that large numbers of days will be lost to illness and quarantine and over 760 deaths are expected from the virus.

Perhaps most significantly, the Doherty modelling results are based on the assumption that the effectiveness of the Testing Tracing Isolation and Quarantine (TTIQ) system never deteriorates below the level experienced during Melbourne's second wave infections that saw daily cases top 700 per day. As the Doherty modelling states:

> TTIQ assumptions are based on the performance of the Victorian public health response at the height of the second wave in 2020 as our best estimate of achievable effectiveness at high case loads.[1]

Given that NSW case numbers have already topped 1,000 per day and that the last time the NSW government publicly announced data on unlinked cases more than 800 of their daily cases were unlinked it would seem optimistic in the extreme for Scott Morrison to continue to base his national plan on the assumption made by Doherty, back in June 2021, that the effectiveness of TTIQ would not fall below that experienced during Melbourne's second wave.

The fact that the Doherty Modelling is based on a wide range of simplifying assumptions is not a criticism of the model, it is a truism. All statistical models, be they economic, climate or epidemiological, are based on assumptions which help users of the model to focus on the linkages between variables. But it is also a truism that when the assumptions in a model diverge significantly from reality the results of the model will be a poor predictor of what will happen in the real world.

The job of the modeller is to make the assumptions they have made clear, and the job of the user of a model is to make the value judgment about the appropriateness of basing significant decisions on the basis of assumptions that might be unrealistic.

The purpose of this paper is to highlight some of the assumption and less commonly reported but important results of the Doherty Modelling. Different users will inevitably make different decisions about whether the simplifying assumptions made in the modelling are sufficient for realistic decision making purposes or not.

1. 80 per cent target means 9.2 million unvaccinated

While 80 per cent vaccination may seem like a high target, given the target applies only to those aged 16+ the true target vaccination rate for all Australians is only 64 per cent.

While children are less likely to experience serious illness or death from COVID 19, the fact that there are over five million Australians under 16 years of age means that a significant number of children are likely to be exposed to COVID-19 before they have been offered a vaccine.

While those who have been vaccinated have a significantly lower risk of hospitalisation or death from COVID19, 'letting the virus rip' through the 9.2 million Australians who

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[1] Doherty (2021) p.7

will be unvaccinated when we 'open up' will impose significant health and economic costs on that at portion of the community.

2. Model assumes no state borders, and contains no analysis of the risk of COVID-free states opening up to states with large outbreaks

One of the simplifying assumptions in the Doherty modelling is that Australia is assumed to be one large population, with no state borders, in which the initial cases of COVID-19 that 'seed' an outbreak are evenly distributed across the country. Likewise, it assumes that the age, demographic and socioeconomic status of people living in each state, and each region, are the same. In the words of the Doherty report:

> The model was based on the simplifying assumption of a single national epidemic.[2]

The significance of this assumption depends entirely on how the model is used. If the purpose of the modelling is to show how transmission of COVID-19 is likely to spread under different vaccination scenarios, then the assumption that Australia is one large pool of people makes no difference. But if the modelling is to be used to help understand the consequences of opening the borders between a state with a large COVID-19 outbreak (such as NSW and Victoria) and no cases of COVID-19 then the modelling is of no use.

The Doherty Institute specifically recognises the need to do further modelling to understand the way COVID-19 would spread through different regions and communities:

> Acknowledging Australia's vast geographical distances and the variable size, demography, rurality/remoteness and public health/health service capacity of states and territories our next phase of work will adapt the agent-based model framework to represent the key population characteristics and public health and clinical capacities of each.[3]

And to be clear, the word 'borders' is not mentioned once in the Doherty report.

Despite the lack of any modelling by the Doherty Institute on the risk to a COVID-free state of opening their borders to a state with a large outbreak, the Commonwealth Attorney General has argued that it would be much harder for states to defend a hard

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[2] Doherty Institute (2021) p.2
[3] Doherty Institute (2021) p.4

border closure as reasonable and necessary by the time that 80 per cent of Australian adults are vaccinated.[4]

Last November, the High Court ruled that Western Australia's border closures were Constitutional on the basis that they were 'proportionate' to the risk of COVID-19. However, the Attorney General appears to be relying on the Doherty modelling to argue that this is no longer the case, stating:

> Once you hit 80 per cent, you are in a fundamentally different position if you are looking at the issue of proportionality.[5]

Likewise, the Business Council of Australia seem unaware, or unconcerned, that the Doherty Institute have not modelled the impact of opening the borders between states with high case numbers and those without. The CEOs of 80 large companies signed a letter claiming:

> Informed by modelling from the Doherty Institute it [the National Plan] balances the risks from COVID in a more vaccinated population, with the risks of indefinitely keeping our country divided and cut off from the world…[6]

To be clear, the Doherty modelling is silent on both the costs and benefits of 'keeping our country divided' as it assumes that there are no divisions between us.

3. Daily cases numbers are likely to explode with 80 per cent vaccination

According to the Doherty modelling, even if Australia waits until 80 per cent of adults have been vaccinated before lifting restrictions of movement it is likely that by early next year around 40,000 Australians **per day** will be infected with COVID-19. This is because, as discussed above, a vaccination target of 80 per cent of adults means that 9.2 million Australians will still be unvaccinated, and the modelling finds that the virus will move rapidly through those millions of unvaccinated Australians.

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[4] Ferguson and Chambers (2021) *Michaelia Cash: states border powers fall at 80 per cent vaccination,* https://www.theaustralian.com.au/nation/michaelia-cash-states-border-powers-fall-at-80-per-cent-vaccination/news-story/ccef193b3c20e3d91283864a6446528f

[5] Ferguson and Chambers (2021) *Michaelia Cash: states border powers fall at 80 per cent vaccination*

[6] Ferguson and Chambers (2021) *Michaelia Cash: states border powers fall at 80 per cent vaccination*

Figure 1 replicates a diagram from the Doherty modelling which shows that with both 70 and 80 per cent vaccination among adults the virus still spreads rapidly through the population.

Figure 1: Strong growth in daily new infections with partial TTIQ
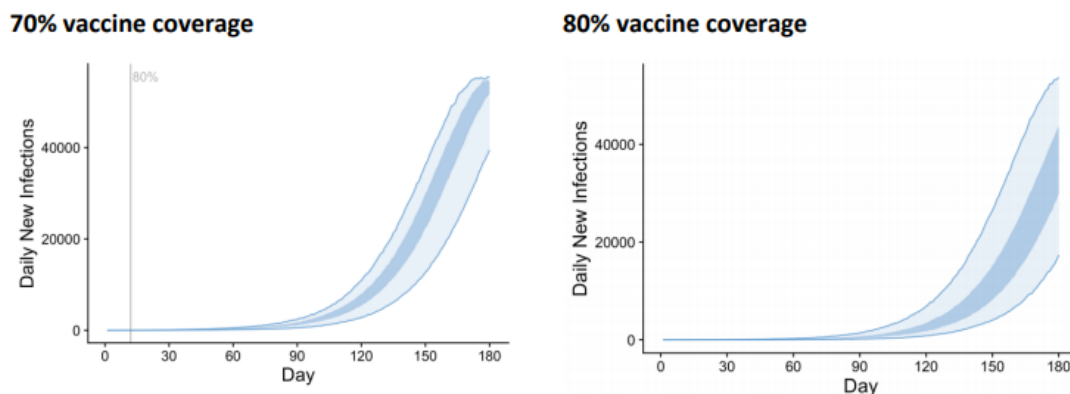
The results presented in Figure 1 are based on the Doherty scenario of Australia having a 'partially effective' Testing Tracing Isolation and Quarantine (TTIQ) system in place. While the Doherty modelling also contains a more optimistic scenario in which 'optimal TTIQ' effectiveness is maintained (see below for more detail) it is important to highlight that:

- The Doherty modelling makes clear that at high caseloads optimal TTIQ is unlikely to be achieved
- In NSW with case numbers of only 1,000 per day the TTIQ system has already degraded so badly that they no longer even report on the proportion of unlinked cases
- The ACT Chief Minister has already stated that it is not helpful to continue to refer to the 'optimal TTIQ' scenarios.[7]

While the Prime Minister refers to his plan to lift movement restrictions when 70 per cent of adult Australians are vaccinated as 'safe' it is not clear whether it is well understood that the Doherty modelling, which makes no reference to the Prime Minister's plan as being 'safe', forecasts that around 380,000 people will become infected in the first 6 months after 'opening up'. Of these cases, the modelling predicts over 12,000 people will be hospitalised and around 1,400 deaths. With restrictions

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[7] Barr in ABC (2021) IN FULL: ACT records 13 new local COVID-19 cases | ABC News, https://www.youtube.com/watch?v=-hRpgZaV76g

lifting at 80 per cent, after 180 days, cases are expected to be over 220,000, with 7,000 hospitalisations and 760 deaths.

4. Effectiveness contact tracing is assumed to be unresponsive to case load

The CEO of the Doherty Institute, and the Prime Minister, have both made clear that the results of the Doherty modelling are not sensitive to whether the initial number of cases that 'seed' an outbreak is 30 (as assumed in the modelling) or significantly higher.

While this is an accurate description of how the model operates, few likely understand that the conclusion is directly driven by the assumptions in the model. The claim that initial case numbers do not matter is determined by an *assumption* that no matter how many cases there are the effectiveness of TTIQ never declines. The effectiveness of TTIQ is hardwired to never fall below that of Melbourne in the winter of 2020. When the model is built to be indifferent to initial cases, the results and conclusions will always be indifferent to initial cases.

While the assumption that there is a floor below which TTIQ effectiveness cannot fall may have seemed reasonable in June 2021 when the Doherty modelling was being prepared, it is hard to believe that the same assumption would be made if the analysis was conducted today while NSW is reporting more than 1,000 cases per day with over 80 per cent of those cases being unlinked to a known case.

The Doherty modelling makes clear that maintaining the effectiveness of a TTIQ system is fundamental to our ability to reduce the number of deaths from COVID-19. The Doherty modelling also makes clear that it has not modelled the consequences of opening borders between a state with high case numbers (and a failing TTIQ system) and states with low case numbers (and effective TTIQ systems). These two assumptions interact in important ways when considering the risks of opening movement between two such states, such as NSW and WA. Of particular concern under the current circumstances is the complete silence of the Doherty modelling on the risk that allowing the outward movement from states with large numbers of mystery cases would pose to the TTIQ systems of other states. Given the silence of the Doherty Institute on these risks it is not at all clear what the basis of the Prime Minister's confidence about the 'safety' opening up interstate travel restrictions is, especially as vaccinated people can still spread COVID-19.

Figure 2 provides evidence for why the assumptions about TTIQ effectiveness used in the Doherty modelling need to be updated if it is to be used to inform a debate about

reducing movement restrictions between states. It shows that the daily number of unknown cases in NSW are now much higher than the Melbourne outbreak of 2020. NSW has recently shifted how they announce case data, with data on unknown cases relegated out of the press conferences, but still available online.[8] A lack of public discussion over cases with unknown linkages may make it harder for other states to assess the risks of reducing border restrictions between NSW and other jurisdictions.

Figure 2: Unknown plus under investigation cases, VIC 2020 vs. NSW 2021
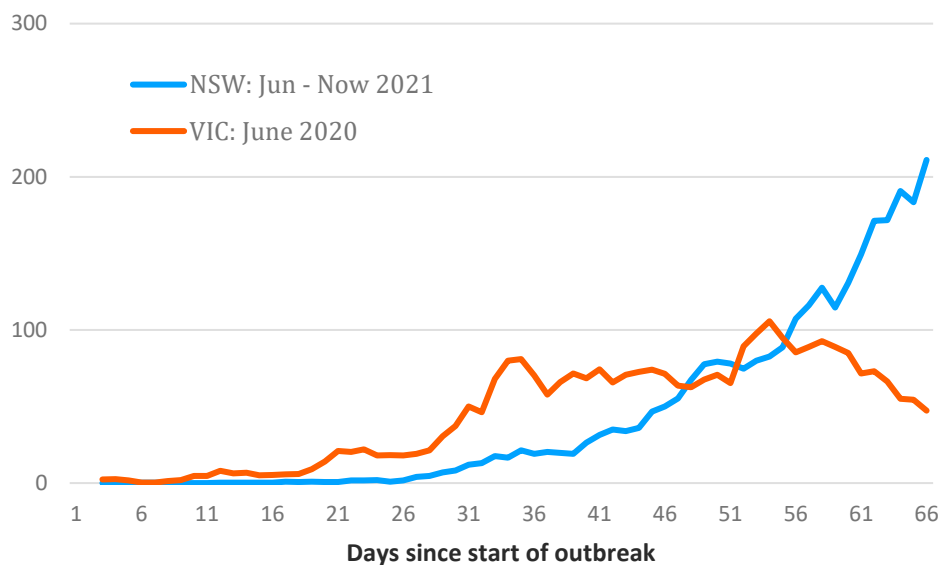
Source: Analysis of data provided by www.covid19data.com.au
Note: NSW line represents unknown case plus cases 'under investigation' 10 days after current reporting day.

The fact that an assumption in a model becomes outdated as new evidence is collected from the real world is not a criticism of the model. However, it is fair to criticise those like the Prime Minster who continue to rely on the conclusions of a model that is based on assumptions are clearly inappropriate for the situation at hand.

5. Contract tracing is crucial to keep Australians safe

It is hard to overstate just how important the assumptions about the effectiveness of TTIQ are to the conclusions of the Doherty modelling. Figure 3 shows the significance of the assumption by comparing the modelling results for the number of deaths under two scenarios:

1.   50 per cent vaccine coverage and an optimally efficient TTIQ system,

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[8] Data.NSW (2021) *COVID-19 cases by notification date, location…*
https://data.nsw.gov.au/data/dataset/nsw-covid-19-cases-by-location-and-likely-source-of-infection/resource/2776dbb8-f807-4fb2-b1ed-184a6fc2c8aa

2. 70 per cent vaccine coverage and a partially effective TTIQ system.

As the figure makes clear, a slight reduction in the effectiveness of TTIQ leads to a 10-fold increase in the likely number of daily deaths, even if vaccination rates are significantly higher.

Figure 3: Projected daily deaths, optimal v's partial TTIQ
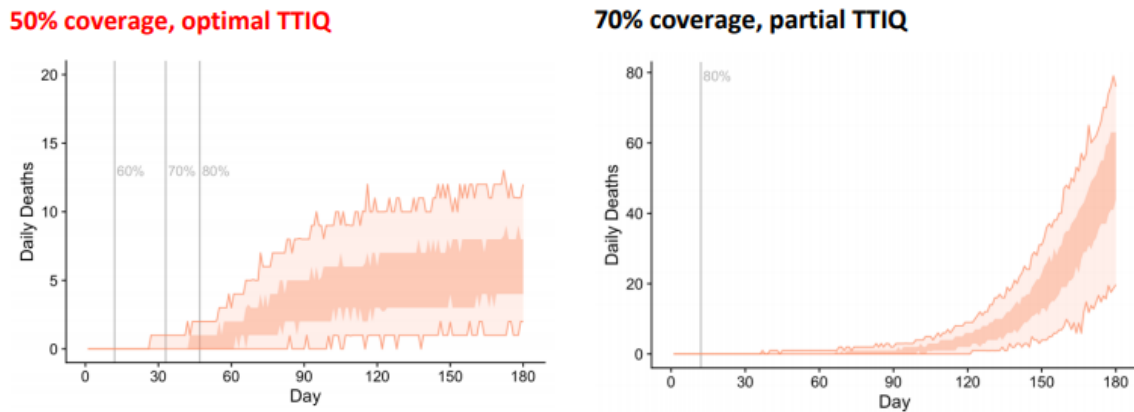
Source: Doherty Institute (2021) Addendum p. 10

Table 1 provides further examples of why the Doherty modelling provides such strong support for state governments who want to maintain the effectiveness of their TTIQ systems by keeping case numbers low and restricting movement between states with low case numbers and states with high case numbers.

As shown in Table 1, according to the Doherty Institute, moving from 70 per cent vaccination to 80 per cent vaccination sees case numbers fall from 385,983 to 227,702 in the six months after opening up, moving from 70 per cent vaccination with partial TTIQ to 70 per cent vaccination with optimal TTIQ sees case numbers fall from 385,983 to just 2,737.

Table 1: Infections, ward admissions, ICU admissions and deaths over the first 180 days for 70% and 80% coverage with and without optimal TTIQ

70% Coverage	Partial TTIQ	Optimal TTIQ
Symptomatic infections	385,983	2,737
Ward admissions	12,337	88
ICU admissions	2,733	21
Deaths	1,457	13
80% Coverage	Partial TTIQ	Optimal TTIQ
Symptomatic infections	227,702	1,149
Ward admissions	6,951	37
ICU admissions	1,505	8
Deaths	761	5

Source: Doherty Institute (2021) Addendum p.12

The key point of the Doherty modelling is that combining high quality TTIQ and high rates of vaccination are necessary to provide Australians with a safe path forward. It makes clear that if states open up before high quality TTIQ systems have been re-established in states like NSW there will be large numbers of avoidable deaths.

6. The modelling says stay at home orders are still common

Under the most realistic scenarios, the Doherty modelling predicts that stay at home orders will still be a regular experience for many; up to 46 per cent of the time.

Table 2 sums up the situation.

Table 2: Time in moderate lockdown (stay at home orders), percentage

	Optimal TTIQ	Partial TTIQ
Baseline PHSM & 70% coverage	34%	77%
Baseline PHSM & 80% coverage	4%	47%
Low PHSM & 70% coverage	0%	46%
Low PHSM & 80% coverage	0%	0%

Source: Doherty Institute (2021) Tables S4.2 – S4.5, p.36-39

To ensure stay at home orders are a thing of the past the effectiveness of the public health 'test, trace, isolate, quarantine' (TTIQ) regime needs to be as good as it was when cases were close to zero, **plus,** continuous low level Public Health and Social Measures (PHSM) **plus** vaccine coverage at 70% or above.

To be clear that is not a return to a pre-COVID world. According to the modelling low level PHSM means capacity restrictions on the hospitality and arts industries. A continued 'recession' in these industries, with big weddings, funerals, parties, live music festivals, and packed MCGs remaining memories of the past.

The modelling scenario from Table 2 most relevant to current conditions and the government's plan is probably *Low PHSM & 70% coverage* where stay at home orders are likely for 46 per cent of the time.

7. Lots of sick days and mandatory isolation

Sick days and home isolation will be a relatively common occurrence if opening up with 70 per cent or 80 per cent vaccination rates occurs without optimal TTIQ.

At 70 per cent vaccination and partial TTIQ between around 5,000 and 18,000 Australians will be absent from work and in mandatory isolation 150 days after 30 new cases are reached (Figure 4).

Figure 4: Numbers absent from the work due to infection and mandatory isolation
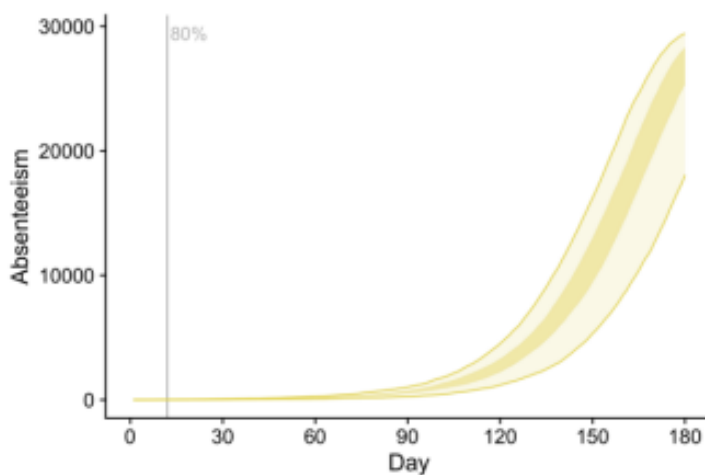
Source: Doherty Institute (2021) Addendum Figure 3.1, p.8

The projection for 80 per cent vaccine coverage is not presented but as with the other results the higher vaccine coverage with partial TTIQ, likely, simply delays the large increase in sick days and home isolation a number of days.

8. Opening at 70 per cent and then reaching 80 per cent is different to opening at 80 per cent.

From the previous points it should be clear how important the effectiveness of TTIQ is to model's projection of outcomes after opening up.

A less important aspect of the modelling, but likely also not fully recognised, is that opening at 70 per cent (and later achieving 80 per cent) keeps you in the 70 per cent

scenario. As far as the model is concerned there is no magical jump to the (slightly) better looking at 80 per cent scenario if you open up at 70 per cent. You don't restart with the 80 per cent scenario.

Opening 70 per cent gives the spread of COVID a head start that is not contained simply by achieving 80 per cent vaccination.

It means opening early and hoping to vaccinate your way to a low infection level is not borne out in the modelling. More so if TTIQ is less than optimal.

Conclusion

The Doherty modelling pulled together the best available information from June this year to help policy makers understand the relationship between the effectiveness of TTIQ, the rollout of vaccinations and the effectiveness of other public health measures on the spread of COVID19 and the subsequent amount of hospitalisations and lives lost.

The Doherty model does not provide a 'cost benefit analysis' of the National Plan and it does not, as the BCA suggests, help us to 'balance the risks' of opening up with staying locked down 'indefinitely'. Indeed, the Doherty modelling makes clear that lockdowns and other restrictions on movement will continue to play a significant role in our future until vaccination rates are much higher than 80 per cent.

Like any modelling exercise, the Doherty modelling is based on a wide range of simplifying assumptions. While making these assumptions is not a not a flaw in the modelling process, it would be a flaw in the decision making process if governments, state or federal, were to rely on modelling that was based on assumptions that were made before the scale of the NSW outbreak could have been anticipated.

As the Doherty modelling makes clear:

> Ongoing situational assessment of measured transmission potential and circulating SARS-CoV-2 variants in the Australian population over coming months will allow benchmarking of these hypothetical scenarios to guide real time policy decision making about the transition to Phase B of the National Plan.[9]

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[9] Doherty Institute (2021) p. 3

The hypothetical scenario that TTIQ effectiveness would not decline below the level experienced during Melbourne's second wave is no longer a useful guide for 'real time policy decision making'.

Likewise, the hypothetical scenario that the opening up of restrictions would take place in an environment in which a small number of cases are evenly distributed around Australia is no longer a useful guide for 'real time policy decision making' when one state is experiencing a major outbreak and a collapse in its TTIQ effectives.

And given that the Doherty modelling makes clear that there is likely to be a significant role for ongoing lockdowns when TTIQ effectiveness is degraded it is clear that the current political debate about 'the case for opening up' has diverged significantly from the actual findings of the Doherty modelling.

The 'hypothetical scenarios' in the Doherty modelling provide a good basis for an initial discussion about the role of vaccines AND restrictions on movement to keep Australians safe. As the situation in Australia continues to diverge from the scenarios envisioned in the Doherty modelling the case to update the modelling based on significantly different assumptions continues to strengthen, and the need for political leaders to pay close attention to the detail of the Doherty modelling rises.