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# Doherty modelling - Assumptions of TTIQ and their impact on Phase 2 modelling

***The effectiveness of TTIQ is likely to be dependent upon case numbers, but current modelling does not take this into account. As cases rise to unplanned for levels, current TTIQ assumptions undermine Doherty modelling of Phase 2.***

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## SUMMARY

Modelling by the Doherty Institute is being used by the Federal government to justify a 70-80 per cent population vaccine coverage ratio for transition to Phase B of the National Plan.

While most discussion has been around the vaccine coverage ratio options in the modelling, and the number of initial cases at the time of the transition to Phase B, a more significant issue with the Doherty modelling is its assumptions about the efficacy of the test, trace, isolate, quarantine (TTIQ) and, in particular, the assumption that the ability to TTIQ with COVID19 does not decline with the number of 'mystery cases' circulating in the community.

At 70 per cent vaccine coverage, the contribution to driving down the infection rate (the transmission potential or TP) is roughly equally split between the TTIQ response

and the effect of the vaccine itself (Figures 1.1 and 1.2, page 11)[1]. That is, the path to a successful transition to Phase B has as much to with the effectiveness of TTIQ response as it does with vaccination rates. Put simply, if the TTIQ assumptions are optimistic then the results of the Doherty modelling will be excessively optimistic, and the frequency of future lockdowns and the likely number of deaths will be far higher than has been suggested.

The way the Doherty model is designed requires the modeller to input an assumption about TTIQ effectiveness. Once entered, this TTIQ effectiveness assumption does not respond to or vary with other model variables or output. Put simply, in the Doherty model the effectiveness of TTIQ is decided before the modelling exercise starts and then remains constant, regardless of the growth in daily case numbers or the stock of 'mystery cases'. It is exogenous to the model.

In reality, the effectiveness of TTIQ is likely dependent on a range of factors, most importantly the current levels of cases. It likely degrades as case numbers increase driving infections higher.

The Doherty modelers admit this linkage between TTIQ and case numbers on multiple occasions when discussing the model. For example, in the executive summary when outlining the impacts across various vaccine coverage rates they say:

> In these scenarios reduced effectiveness of the public health 'test, trace, isolate, quarantine' (TTIQ) response is anticipated due to high caseloads;[2]

And later in the main report:

> 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 caseloads.[3]

While it may have been appropriate to make the simplifying assumption that TTIQ efficacy did not vary with daily cases and mystery cases when there were small numbers of both, note that the NSW outbreak is already larger than the Victorian second wave, and likely to grow rapidly before Australia achieves 70 per cent vaccination, there is a strong case for making TTIQ 'endogenous' to the model before making any decisions about the transition to Phase B.

[1] Doherty Institute (2021) Doherty modelling report revised 10th August 2021, p. 11, https://www.doherty.edu.au/uploads/content_doc/DohertyModelling_NationalPlan_and_Addendum_20210810.pdf

[2] Doherty Institute (2021) p. 2

[3] Doherty Institute (2021) p. 7

# OVERVIEW OF THE DOHERTY MODEL

The Doherty Institute modelling has, to greatly simplify, three moving parts to predict the level of transmission potential[4] (TP):

1. Vaccine coverage as percentage of the population over 16;
2. Effectiveness of public health 'Test, Trace, Isolate, and Quarantine' (TTIQ);
3. Public Health and Social Measures (PHSM), above the baseline of minimal density/capacity restrictions seen in NSW March 2021.

The effectiveness of the public health TTIQ is measured on a 'time to case isolation' basis. The less effective the TTIQ, the longer the period of time before a positive case isolates to limit infection.

The modelling, at various times, uses two levels of TTIQ response:

1. *Optimal TTIQ*: based on "a limited timeseries of case data from NSW between July 2020 and January 2021."[5]
2. *Partial TTIQ*: "calibrated against VIC 4 August 2020 – the peak of daily locally-acquired COVID-19 cases in Australia"[6]

While it is not stated explicitly in the Doherty modelling, using the data that is provided it is possible to calculate that the Doherty Modelling is based on the assumption that 'partially effective' TTIQ is 12 per cent less effective than 'optimal' TTIQ.[7]

The exact definition of each is a little unclear, and more complex than the dot points above suggest, but for the most part the *partial TTIQ* definition is employed in the scenario that suggests a 70 per cent vaccine coverage is sufficient for transition to phase B, with transmission potential (TP) close to, but not below 1. Such an assumption about partial TTIQ seems reasonable if for no other reason that it is best to be conservative with modelling assumptions (from an economist's point of view).

But it is an assumption. It does not change over the course of each modelled scenario.

[4] TP is similar to the effective reproduction number or $R_{eff}$. Below 1 no public health actions are required and outbreaks will be self-limiting. The higher above 1 it moves the more rapidly case numbers will escalate.

[5] Doherty Institute (2021) p. 33

[6] Doherty Institute (2021) p. 33

[7] Professor Allan Saul (2021) On ABC Radio 23 August 2021: *Have we misunderstood the Doherty modelling?,* www.abc.net.au/radionational/programs/healthreport/have-we-misunderstood-the-doherty-modelling/13510298

In reality, the effectiveness of TTIQ is likely to be a function of current case load. As cases go up the effectiveness of TTIQ will likely fall.

Keep in mind, the current modelling, with a *partial TTIQ* and 70 per cent vaccine rate the transmission potential (TP) remains greater than 1, **unless,** medium PHSM (i.e. stay at home orders) or higher **are in place for most of the time.**

That is, the scenario used to justify a transition to Phase B has case numbers going up, from a starting point of 30 cases Australia wide.

The sensitivity of the modelling to small changes in TTIQ is summarised in Table 1. The table shows that even with 80% vaccination and initial baseline restrictions (PHSM), the time in moderate restrictions (i.e. stay at home orders) can range from 4% to almost 50% depending on effectiveness of TTIQ.

**Table 1: 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

If the effectiveness of TTIQ is in reality a function of daily case numbers, then as daily case numbers increase the effectiveness of TTIQ falls which drives up the rate at which case numbers climb.

This constitutes a positive feedback loop.

Furthermore, the positive feedback loop would likely already be in place if the transition to phase B started with an existing case load significantly different from zero.

The solution is to re-do the modelling with a TTIQ effectiveness that is responsive to caseload to understand the likely outcomes more accurately in the transition to Phase 2.

# SUGGESTED QUESTIONS OF CLARIFICATION

- Is the effectiveness of TTIQ likely to decline with rising case numbers, and if so, is this decline likely to be linear or exponential?
- Is the effectiveness of TTIQ also likely to decline with the number of unlinked cases in the community, and if so, is this decline likely to be linear or exponential?

- In the modelling provided by the Doherty Institute to the National Cabinet there are two estimates of TTIQ efficacy, the ‘optimal’ and ‘partial’ estimates. Do these values vary directly with the number of daily cases or unlinked cases, or are they fixed ‘exogenous’ variables?
- When the ‘optimal’ and ‘partial’ estimates of TTIQ efficacy were selected by the Doherty Institute, what was the proportion of unlinked cases/total cases in NSW? What is that figure today?
- Does the rise in the proportion of unlinked cases in the community suggest that TTIQ effectiveness is declining?
- TTIQ effectiveness in the ‘partially effective’ TTIQ appears to be 12 percent less effective than the ‘optimal’ scenario. Is this correct?
- The difference between deaths from COVID-19 between the ‘optimally effective’ TTIQ and partially effective TTIQ are significant (17 and 1,908 respectively) for 70% vaccine rollout. Would the difference be even higher if the efficacy of TTIQ was even lower than the ‘partially effective’ scenario? Would any increase in deaths with lower TTOIQ likely be linear or exponential?
- Given that the NSW outbreak is already larger than the Melbourne second wave outbreak, and given that the outbreak in NSW may be significantly larger by the time that 70 per cent vaccination is reached, would it be prudent to model more conservative TTIQ efficacy scenarios?
- Does the Doherty modelling consider the possibility that some states might have significantly higher daily cases and mystery cases?
- If some states had uncontrolled outbreaks and others did not, does the Doherty modelling show that it is in the community benefit to open the borders between such jurisdictions?
- Is the conclusion of the Doherty Modelling that ICU capacity will not be overwhelmed if Phase B is entered at 80 percent based on the assumption that cases are evenly distributed across Australia’s states and territories?