Covid-19 Modelling Aotearoa

Quantifying the effect of a change in case isolation settings

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This memo was provided to the NZ Ministry of Health on November 16th, 2022 in response to a request for rapid advice on November 15th, 2022. The memo presents results for specific scenarios of interest: case isolation of 7 days or 5 days with no test-to-release, and 5 days with test-to-release.
The method and results used here are from a previously published, internally reviewed report.

COVID-19 Modelling Aotearoa[1] has been asked to provide guidance on the likely outcomes of changing case isolation settings in Aotearoa.
We understand that the change being proposed is a shift from the requirement to isolate for 7 days (i.e. release on day 8) to the requirement to isolate for a minimum of 5 days and a maximum of 7 days, with possible early release on days 6 or 7 for individuals who have returned a single negative result on a Rapid Antigen Test (RAT).

- In all cases day 0 is the earlier of the date of symptom onset or the date of first positive test result.
- In the test-to-release (TTR) scenario, the earliest that an individual could be released from isolation would be on day 6 (i.e. isolating from day 0 to day 5), if they returned a negative RAT result on that day.

We have used a stochastic simulation model to calculate average population-level case isolation outcomes for a range of metrics. Details of the model along with parameter values and model assumptions are described in a previous report[2].

Key findings:
We find that moving from a 7 day no TTR policy to the TTR policy considered here increases the time cases are infectious in the community, but reduces the amount of excess isolation. Moving to a 5 day no TTR policy from the TTR policy increases the time spent infectious in the community significantly, with a much smaller reduction in excess isolation.

- Switching from the status quo of 7 days isolation to a TTR (min 5, max 7 days, 1 test) isolation regime results in an increase in the average number of hours infectious post-release per confirmed case: from 8.9 to 12.4 hours (+39%).

[1] https://www.covid19modelling.ac.nz/
[2] Harvey, P. et al. *Quantifying the impact of isolation period and the use of rapid antigen tests for confirmed COVID-19 cases*
https://www.covid19modelling.ac.nz/quantifying-the-impact-of-isolation-period/ (2022)

- However this increased risk is accompanied by the reward of a decrease in the average number of hours spent in isolation after the infectious period ends (excess isolation): 83.2 hours drops to 50.9 hours (-39%).
- If the TTR policy change was accompanied by effective messaging around the fact that a positive RAT means you are likely to still be infectious even if it is after day 7 and should take precautions until testing negative or day 10 (as per CDC advice), this policy has the potential to be safer than the current policy.
- In contrast, switching to a case isolation regime of 5 days isolation with no TTR has a less favourable risk/reward trade off.
    - Hours infectious in the community with no TTR increases to 19.3. This is an increase of 117% from the current policy, and an increase of 6.9 hrs (+56%) compared to 12.4 hours for the TTR policy.
    - Additionally the number of hours spent in excess isolation decreases by only a relatively small amount compared to the TTR policy, to 45.2 hours. This is a 46% decrease from 83.2 hours for the current policy, but only an 11% decrease from the 50.9 hours for the TTR policy.
- Most of the reward of reducing the number of hours spent in isolation after infectiousness has ended can be realised through the use of a TTR policy. Comparing TTR to only 5 days of case isolation doesn't show much benefit, despite the increase in risk.
- There is some evidence to suggest that for Aotearoa it may be appropriate to use a longer estimate for the infectious period than the mean of 5 days used in the main results. Results for this longer infectious period are included later in this note. Given the uncertainty in this parameter it is worth noting that a TTR policy mitigates against the risk of underestimating the infectious period while retaining any possible benefits for those who have a shorter infectious period.

Policies considered

The three policies considered are described below and their resulting consequences are summarised in **Table 1**.

Status quo - 7 days isolation, no TTR.

Under this scenario, all individuals are released from isolation on day 8. This results in isolation periods that will vary between 7 and 8 days depending on the time of symptom onset or positive test time on day 0. We assume an average isolation period of 7.5 days (from noon on day 0 until midnight on day 7).

Test-to-release; minimum 5 days, maximum 7 days, 1 test.

Under this scenario cases must isolate until the end of day 5 at least. On days 6 and 7, individuals can exit isolation 'early' if they test negative on a RAT. If they have not returned a negative test result by day 8, they are allowed to exit isolation, regardless of their infectious status.

5 days isolation; no test-to-release.

This scenario is provided to illustrate the effect of shortening the isolation period to 5 days with no requirement to test before existing isolation. Under this scenario, all cases are released on day 6, and spend an average of 5.5 days in isolation.

Summary of results

	7 days, no TTR	**TTR; min 5, max 7**		**5 days, no TTR**
RAT sensitivity modelled	-	75% RAT sensitivity	95% RAT sensitivity	-
Average hours infectious post-release	8.9 hrs [5.1, 13.5]	12.4 hrs [7.9, 18.1]	10.0 hrs [5.8, 15.2]	19.3 hrs [12.4, 27.1]
Average hours excess isolation	83.2 hrs [72.8, 94.3]	50.9 hrs [44.0, 57.9]	53.0 hrs [45.8, 60.5]	45.2 hrs [37.9, 53.4]
Average isolation duration	7.5 days	6.1 days [6.0, 6.2]	6.2 days [6.1, 6.3]	5.5 days
Percent of cases infectious at release	14.6% [9.7%, 20.1%]	20.8% [15.4%, 26.9%]	17.6% [12.1%, 23.7%]	29.7% [22.4%, 37.2%]

Table 1 - *Population-level results of the impact of different case isolation policies on: number of hours of infectiousness after release; number of hours of 'excess' isolation (extra hours a confirmed case spends in isolation after their infectious period has ended); number of days spent isolating; and proportion of cases released while still infectious. For the TTR policy we have modelled two levels of RAT sensitivity. Values in square brackets are 95% confidence intervals.*

Impact of RAT sensitivity estimates

We have run simulations with two levels of RAT sensitivity, one drawn from a distribution with a mean of 75% and the other with a mean of 95%, and show both results in **Table 1**.

The 75% sensitivity results are likely to be a pessimistic estimate of test sensitivity, as literature which compares viral culture to RAT results finds test sensitivities of 90-95%. Because any confirmed cases have already tested positive on a RAT, we believe that

using the higher RAT sensitivity estimate is reasonable. The 75% sensitivity results could be interpreted as already incorporating some level of poor RAT technique and reduced compliance in testing. The higher sensitivity estimate for RATs (95%), reflects a high compliance situation.

The higher RAT sensitivity estimates result in increased effectiveness of the TTR policy in terms of reductions in both hours infectious after release and the proportion released while still infectious, and result in very little increase in the overall average isolation time and excess isolation.

Important public health considerations

In addition to the key findings listed above, other important considerations to consider collectively with these results are.

- The likelihood that these results will reflect reality depends on how policy change is communicated.
    - Implementation and messaging matters. A change in policy must be accompanied by strong, clear messaging around the requirement and reasoning for testing. If not, there is a risk that the general public will default to a 5 day isolation period, and not test to release.
    - It is recommended that a TTR policy should be presented as '7 days isolation' but with the possibility to release earlier if one returns a negative test after day five. This would help avoid the drift to '5 days isolation'.
- Messaging around a positive RAT indicating infectiousness is crucial.
    - With any messaging around isolation periods it is also important to note that if someone has finished their required isolation period, but is still testing positive, they are likely to still be infectious. While they may not be *required* to isolate they are likely still infectious and should act accordingly.
- Messaging around staying home when unwell, even if negative on a RAT, and continuing to test for a number of days after symptom onset is important.
    - MOH data shows a mean of 2 days from symptom onset to first positive RAT and that 25% of cases take more than 3 days to test positive.
- Access to tests, and to good information about how to interpret test results, will continue to matter as an equity issue, especially if TTR is introduced.
- Decreasing the minimum required isolation period does not necessarily mean people can or should return to work earlier.
    - Shortening or removing isolation requirements does not solve workforce disruption issues, because many cases are too unwell to work, even if they are legally allowed to. Additionally, if a person with dependents is the first infection in their household, it is likely that they will need to be caring for household contacts that have fallen ill during their isolation period.

- This has negative equity implications**:** shorter isolation periods could mean some people will be expected to return to work when they aren't actually healthy (but aren't infectious if testing negative). This will negatively affect those in precarious employment, doing a job where they are unable to work from home, workers without sick leave, people in casual work, people in precarious housing, people with disabilities, etc.

Additional modelling considerations and caveats

Many cases will not be isolating from day zero

Ministry of Health data reports that the mean time from reported symptom onset until first positive RAT result for the first case in a household is 1.9 days. This data shows that only 20% of individuals report testing positive on the first day of symptom onset, with 24% taking more than 3 days after symptom onset to return a positive test. This means that for 80% of individuals the time spent in isolation is shorter than what is prescribed by any given policy, unless they were already isolating due to symptoms.

In the results presented here we use the prescribed isolation period, and assume isolation started at symptom onset. However, if you think that people will not be isolating properly until they return a positive test result, you should subtract ~2 days off the reported isolation durations in **Tables 1 and 2** for the actual time spent isolating under different policies.

A longer infectious period may be more realistic

A key parameter for these simulations is the distribution of the infectious period of infected individuals. This in turn depends on the definition of day zero that is used in different studies and in different jurisdictions.

For the results above, we have used an estimated distribution for the infectious period based on fitting to a number of international studies. Recent literature[3] has suggested that, for Omicron infections, using symptom onset to start the isolation period may start the 'clock' before the infectious period has begun. This results in a longer observed infectious period when symptom onset is used to mark day zero of an isolation period. Data from the Ministry of Health indicates that over 79% of confirmed cases had a symptom onset date, and hence a day zero, before their positive test result. This suggests that the longer estimated distribution for the infectious period may be more

[3] Boucau, J. et al. Duration of shedding of culturable virus in SARS-CoV-2 Omicron (BA.1) infection. *New Engl. J. Medicine* **387**, 275–277, DOI: 10.1056/nejmc2202092 (2022).

applicable in the context of Aotearoa. Results for this longer infectious period distribution are shown in **Table 2** below.

The distributions for the infectious period used in this note are:

- **Shorter** estimated infectious period: gamma distribution for the infectious period of individuals with a mean of 4.9 days (median of 4.3 days) after symptom onset.
- **Longer** estimated infectious period: gamma distribution for the infectious period with a mean of 7.8 days (median of 7.1 days) after symptom onset.

	7 days, no TTR	**TTR; min 5, max 7**	**5 days, no TTR**
RAT sensitivity	-	75% RAT sensitivity	-
Average hours infectious post-release	36.6 hrs [25.4, 50.4]	45.1 hrs [32.6, 58.1]	61.5 hrs [46.6, 77.4]
Average hours excess isolation	40.7 hrs [32.3, 49.4]	23.0 hrs [18.5, 28.5]	17.4 hrs [13.3, 22.1]
Average isolation duration	7.5 days	6.4 days [6.3, 6.5]	5.5 days
Percent of cases infectious at release	41.4% [33.2%, 49.8%]	50.2% [41.8%, 57.5%]	62.2% [54.5%, 69.2%]

Table 2 - *Population-level results of the impact of different case isolation policies with a **longer infectious period** modelled: number of hours of infectiousness after release; number of hours of 'excess' isolation (extra hours a confirmed case spends in isolation after their infectious period has ended); number of days spent isolating; and proportion of cases released while still infectious. For the TTR policy we have modelled a single (conservative) level of RAT sensitivity. Values in square brackets are 95% confidence intervals.*