THIS REPORT HAS NOT PEER REVIEWED

Covid-19 Modelling Aotearoa

Modelling the effect of alternative Covid-19 isolation policy options

Samik Datta, Oliver Maclaren, Michael J. Plank, Giorgia Vattiato

Released to COVID-19 Modelling Government Steering Group: 3 May 2023
Minor revisions: 16 August 2023

1. This work uses a mathematical model (Covid-19 Modelling Aotearoa's "ordinary differential equation" model) to investigate the potential effect of alternative Covid-19 isolation policy options.
2. We ran the model under scenarios representing six different policy options requested by the Covid-19 Modelling Government Steering Group: (1) 7-day isolation (status quo); (2) no isolation mandate, 7-day guideline (low compliance); (3) no isolation mandate, 7-day guideline, high compliance; (4) 5-day isolation; (5) 5-day minimum isolation with test-to-release (one negative test result required) up to 7 days maximum isolation; (6) 5-day minimum isolation with test-to-release (one negative test result required) up to 10 days maximum isolation.
3. For scenarios (4)-(6) (change to mandatory isolation period), we estimated the effect of the isolation policy on transmission (as measured by the instantaneous reproduction number) using previous modelling results estimating the average length of time someone is infectious after ending isolation [1] and a set of simplifying assumptions (see Appendix).
4. In particular, we assumed that the proportion of infected individuals following the isolation policy is between 33% and 50%, and that this proportion does not change even if the policy itself does.
5. For scenarios (2)-(3) (no mandate), we used estimates for the increase in transmission from [2]. These scenarios are more uncertain and subjective than scenarios (4)-(6) because it is difficult to predict the behavioural response to switching from mandated to non-mandated actions. Scenario (3) assumes that there are high levels of compliance with non-mandatory guidance for 7-day isolation, which is likely to require measures such as clear guidance, strong public health messaging, provision of free tests, and financial support to isolate. If these conditions are not met, it is more likely that impacts will be higher, e.g. as in scenario (2) - low compliance.
6. For each scenario, we used the ODE model to calculate the cumulative number Covid-19 infections, hospitalisations and deaths over the 6 months following the policy change. We assumed that the change in transmission occurred gradually over a 30-day period starting on 15 May 2023. Other assumptions and methods are as detailed in our recent work modelling the effect of an end to mandatory isolation [2].
7. We ran the model under three different assumptions about the effect of seasonality on transmission during the upcoming winter period, namely where

there is no effect of seasonality, and where seasonality causes transmission rates to increase gradually from 1 April to a peak on 1 July that is either 10% or 20% higher than on 1 April. (These values are approximately in the range estimated for the effect of seasonality in other human betacoronaviruses and influenza viruses in temperate climates [3].)

8. Tables 1-3 show the differences in cumulative infections, hospitalisations and deaths in scenarios (2)-(6) relative to the baseline model representing the status quo (scenario (1)), under the three levels of seasonality. These results provide estimates of the relative change in the impact of Covid-19 under alternative options.
9. Tables 4-6 show the absolute numbers of cumulative infections, hospitalisations and deaths in the model under each scenario (1)-(6). These results should not be viewed as absolute predictions because they may be more sensitive to model assumptions and to factors that are not included in the model (e.g. significant new variants, unanticipated seasonal or behavioural patterns).
10. For further details of model assumptions, limitations and caveats please refer to [2].

Table 1. Model results for the short-term and long-term impact under different isolation policy scenarios and no seasonality. Differences in cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under five policy scenarios and no seasonality (corresponding to no winter increase in transmission). Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. All results are relative to the baseline model with no policy change and the same level of seasonality. In each table cell, the first line shows change in absolute numbers and the second line shows relative (percentage) change compared to baseline. Values in brackets represent the 95% confidence intervals on these differences.

Scenario	**Short-term impact** Difference in cumulative numbers from 0 to 7 weeks post policy change, relative to status quo			**Long-term impact** Difference in cumulative numbers from 0 to 26 weeks post policy change, relative to status quo			**Difference in peak hospital occupancy**
	Infections	**Hospitalisations**	**Deaths**	**Infections**	**Hospitalisations**	**Deaths**	
No seasonality							
(2) No mandate (low compliance: +10 - 15%)	+117000 [+52000, +171000] +37.8% [+24.8%, +52.8%]	+499 [+263, +852] +29.2% [+18.6%, +40%]	+27 [+12, +50] +12.1% [+7.2%, +16.3%]	+166000 [+118000, +225000] +13.4% [+9%, +23.8%]	+1203 [+644, +1844] +17.3% [+11.1%, +30.1%]	+187 [+108, +379] +19.9% [+11.9%, +35.2%]	+200 [+10, +360] +71.1% [+2.4%, +120%]
(3) No mandate (high compliance: +5 - 10%)	+67000 [+24000, +106000] +21.2% [+11.7%, +32.4%]	+280 [+122, +532] +16.3% [+8.7%, 24.6%]	+15 [+6, +32] +6.9% [+3.4%, +10.2%]	+102000 [+61000, +153000] +8.2% [+4.5%, +16.6%]	+744 [+320, +1238] +10.5% [+5.5%, +20.6%]	+114 [+55, +255] +12.1% [+6%, +23.9%]	+100 [+0, +220] +34.4% [+0%, +73.9%]
(4) 5 day, no TTR (+1.3 – +3.8%)	+21000 [+6000, +37000] +6.6% [+2.8%, +11%]	+88 [+29, +184] +5.1% [+2.1%, +8.4%]	+5 [+1, +11] +2.2% [+0.8%, +3.6%]	+35000 [+16000, +60000] +2.8% [+1.1%, +6.7%]	+256 [+80, +477] +3.6% [+1.4%, +8.1%]	+40 [+14, +98] +4.1% [+1.5%, +9.3%]	+20 [+0, +70] +7.5% [+0%, +24.8%]
(5) 5-7 day, TTR (+0.13 – +0.4%)	+2000 [+1000, +4000] +0.7% [+0.3%, +1.1%]	+9 [+3, +19] +0.5% [+0.2%, +0.8%]	+1 [+0, +1] +0.2% [+0.1%, +0.4%]	+4000 [+2000, +7000] +0.3% [+0.1%, +0.7%]	+28 [+8, +52] +0.4% [+0.1%, +0.9%]	+4 [+1, +11] +0.4% [+0.2%, +1%]	+0 [+0, +10] +0.6% [+0%, +2.4%]
(6) 5-10 day, TTR (-1.4 – -0.5%)	-8000 [-13000, -2000] -2.3% [-3.8%, -1%]	-31 [-64, -10] -1.8% [-2.9%, -0.8%]	-2 [-4, +0] -0.8% [-1.3%, -0.3%]	-13000 [-23000, -6000] -1.1% [-2.7%, -0.4%]	-97 [-185, -30] -1.4% [-3.2%, -0.5%]	-15 [-37, -5] -1.6% [-3.6%, -0.6%]	+0 [-20, +0] -1.6% [-8.2%, +0%]

Table 2. Model results for the short-term and long-term impact under different isolation policy scenarios and weak seasonality. Differences in cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under five policy scenarios and weak seasonality (corresponding to peak winter transmission rates on 1 July of 10% higher than on 1 April). All results are relative to the baseline model with no policy change and the same level of seasonality. Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. In each table cell, the first line shows change in absolute numbers and the second line shows relative (percentage) change compared to baseline. Values in brackets represent the 95% confidence intervals on these differences.

Scenario	Short-term impact Difference in cumulative numbers from 0 to 7 weeks post policy change, relative to status quo			Long-term impact Difference in cumulative numbers from 0 to 26 weeks post policy change, relative to status quo			Difference in peak hospital occupancy
	Infections	Hospitalisations	Deaths	Infections	Hospitalisations	Deaths	
Weak seasonality (+/- 10%)							
(2) No mandate (low compliance: +10 - 15%)	+143000 [+80000, +213000] +33% [+21.9%, +50.9%]	+681 [+320, +1132] +27.4% [+17.1%, +40%]	+39 [+19, +73] +12.7% [+7.1%, +18.2%]	+174000 [+127000, +242000] +15.2% [+9.9%, +25.7%]	+1300 [+664, +2005] +19% [+11.9%, +31.5%]	+204 [+117, +418] +20.7% [+12.4%, +34.5%]	+200 [+0, +390] +51.3% [+0.5%, +106.1%]
(3) No mandate (high compliance: +5 - 10%)	+82000 [+37000, +135000] +18.9% [+10.5%, +31.5%]	+387 [+152, +713] +15.6% [+8.1%, +24.8%]	+22 [+9, +46] +7.3% [+3.4%, +11.5%]	+108000 [+66000, +166000] +9.4% [+5%, +17.8%]	+806 [+334, +1358] +11.5% [+6%, +21.4%]	+124 [+59, +280] +12.5% [+6.3%, +23.2%]	+100 [+0, +240] +25.2% [+0.2%, +65.6%]
(4) 5 day, no TTR (+1.3 – +3.8%)	+26000 [+9000, +47000] +6% [+2.5%, +10.8%]	+123 [+37, +249] +4.9% [+2%, +8.5%]	+7 [+2, +16] +2.3% [+0.8%, +4%]	+37000 [+17000, +65000] +3.3% [+1.3%, +7%]	+279 [+85, +525] +4% [+1.5%, +8.2%]	+43 [+15, +106] +4.3% [+1.6%, +8.8%]	+20 [+0, +80] +5.7% [+0%, +22%]
(5) 5-7 day, TTR (+0.13 – +0.4%)	+3000 [+1000, +5000] +0.6% [+0.3%, +1.1%]	+13 [+4, +25] +0.5% [+0.2%, +0.9%]	+1 [+0, +2] +0.2% [+0.1%, +0.4%]	+4000 [+2000, +7000] +0.4% [+0.1%, +0.8%]	+30 [+9, +57] +0.4% [+0.2%, +0.9%]	+5 [+2, +11] +0.5% [+0.2%, +0.9%]	+0 [+0, +10] +0.5% [+0%, +2.1%]
(6) 5-10 day, TTR (-1.4 – -0.5%)	-9000 [-17000, -3000] -2.2% [-3.7%, -0.9%]	-44 [-87, -13] -1.8% [-3%, -0.7%]	-3 [-6, -1] -0.8% [-1.4%, -0.3%]	-14000 [-26000, -6000] -1.3% [-2.7%, -0.5%]	-106 [-202, -32] -1.5% [-3.1%, -0.6%]	-16 [-40, -6] -1.6% [-3.3%, -0.6%]	-10 [-20, +0] -1.6% [-7.1%, +0%]

Table 3. Model results for the short-term and long-term impact under different isolation policy scenarios and strong seasonality. Differences in cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under five policy scenarios and strong seasonality (corresponding to peak winter transmission rates on 1 July of 20% higher than on 1 April). All results are relative to the baseline model with no policy change and the same level of seasonality. Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. In each table cell, the first line shows change in absolute numbers and the second line shows relative (percentage) change compared to baseline. Values in brackets represent the 95% confidence intervals on these differences.

Scenario	**Short-term impact** Difference in cumulative numbers from 0 to 7 weeks post policy change, relative to status quo			**Long-term impact** Difference in cumulative numbers from 0 to 26 weeks post policy change, relative to status quo			**Difference in peak hospital occupancy**
	Infections	**Hospitalisations**	**Deaths**	**Infections**	**Hospitalisations**	**Deaths**	
Strong seasonality (+/- 20%)							
(2) No mandate (low compliance: +10 - 15%)	+151000 [+101000, +232000] +27.5% [+19.2%, +45.5%]	+793 [+344, +1320] +24.2% [+15.3%, +38.8%]	+51 [+26, +96] +12.3% [+6.7%, +18.8%]	+175000 [+128000, +244000] +15.7% [+10.4%, +24.9%]	+1336 [+668, +2059] +19.1% [+12.3%, +30.1%]	+211 [+122, +439] +20% [+12.4%, +31.9%]	+180 [+0, +390] +33.3% [+1.1%, +82.9%]
(3) No mandate (high compliance: +5 - 10%)	+88000 [+49000, +150000] +16% [+9.3%, +28.9%]	+462 [+164, +844] +13.9% [+7.3%, +24.3%]	+29 [+12, +61] +7.1% [+3.2%, +11.9%]	+109000 [+66000, +168000] +9.8% [+5.3%, +17.2%]	+829 [+340, +1399] +11.6% [+6.2%, +20.4%]	+128 [+62, +295] +12.1% [+6.3%, +21.5%]	+90 [+0, +240] +16.1% [+0.4%, +51.7%]
(4) 5 day, no TTR (+1.3 – +3.8%)	+28000 [+12000, +54000] +5.2% [+2.3%, +10.1%]	+148 [+40, +300] +4.5% [+1.8%, +8.5%]	+9 [+3, +22] +2.3% [+0.8%, +4.2%]	+38000 [+17000, +66000] +3.4% [+1.4%, +6.7%]	+288 [+87, +541] +4% [+1.6%, +7.8%]	+44 [+16, +112] +4.1% [+1.6%, +8.2%]	+20 [+0, +80] +3.9% [+0.1%, +17.4%]
(5) 5-7 day, TTR (+0.13 – +0.4%)	+3000 [+1000, +6000] +0.5% [+0.2%, +1%]	+16 [+4, +31] +0.5% [+0.2%, +0.9%]	+1 [+0, +2] +0.2% [+0.1%, +0.4%]	+4000 [+2000, +7000] +0.4% [+0.1%, +0.7%]	+31 [+9, +58] +0.4% [+0.2%, +0.8%]	+5 [+2, +12] +0.4% [+0.2%, +0.9%]	+0 [+0, +10] +0.4% [+0%, +1.7%]
(6) 5-10 day, TTR (-1.4 – -0.5%)	-10000 [-19000, -4000] -1.9% [-3.6%, -0.8%]	-53 [-107, -15] -1.6% [-3%, -0.7%]	-3 [-8, -1] -0.8% [-1.5%, -0.3%]	-15000 [-26000, -6000] -1.3% [-2.6%, -0.5%]	-108 [-207, -33] -1.5% [-3%, -0.6%]	-17 [-42, -6] -1.6% [-3.1%, -0.6%]	-10 [-30, +0] -1.2% [-5.6%, +0%]

Table 4. Model results for the short-term and long-term impact under different isolation policy scenarios and no seasonality. Total cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under six policy scenarios and no seasonality (corresponding to no winter increase in transmission). Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. Values in brackets represent the 95% confidence intervals on these differences. Note these results may be more sensitive than those in Table 1 to model assumptions and factors not included in the model, such as significant new SARS-CoV-2 variants or unanticipated seasonal or behavioural patterns.

Scenario	Short-term impact			Long-term impact			Peak hospital occupancy
	Infections (1,000s)	Hospitalisations	Deaths	Infections (1,000s)	Hospitalisations	Deaths	
No seasonality							
(1) Baseline (status quo)	323 [166, 391]	1750 [1120, 2540]	232 [122, 357]	1249 [783, 1539]	7040 [4880, 9550]	962 [571, 1371]	280 [180, 410]
(2) No mandate (low compliance: +10 - 15%)	443 [218, 554]	2270 [1380, 3390]	259 [133, 405]	1414 [913, 1750]	8280 [5750, 11340]	1144 [689, 1695]	480 [290, 700]
(3) No mandate (high compliance: +5 - 10%)	390 [190, 494]	2040 [1240, 3070]	248 [127, 387]	1349 [851, 1678]	7780 [5320, 10750]	1073 [631, 1590]	380 [240, 570]
(4) 5 day, no TTR (+1.3 – +3.8%)	345 [172, 427]	1850 [1150, 2730]	238 [123, 368]	1287 [801, 1591]	7300 [4990, 10010]	996 [586, 1456]	310 [200, 430]
(5) 5-7 day, TTR (+0.13 – +0.4%)	325 [167, 394]	1770 [1120, 2560]	232 [122, 358]	1253 [785, 1545]	7070 [4890, 9600]	966 [572, 1380]	280 [190, 410]
(6) 5-10 day, TTR (-1.4 – -0.5%)	315 [161, 387]	1730 [1090, 2520]	230 [120, 356]	1236 [762, 1533]	6930 [4750, 9490]	945 [553, 1360]	270 [170, 410]

Table 5. Model results for the short-term and long-term impact under different isolation policy scenarios and weak seasonality. Total cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under six policy scenarios and weak seasonality (corresponding to a peak winter transmission rate on 1 July of 10% higher than on 1 April). Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. Values in brackets represent the 95% confidence intervals on these differences. Note these results may be more sensitive than those in Table 2 to model assumptions and factors not included in the model, such as significant new SARS-CoV-2 variants or unanticipated seasonal or behavioural patterns.

Scenario	Short-term impact			Long-term impact			Peak hospital occupancy
	Infections (1,000s)	Hospitalisations	Deaths	Infections (1,000s)	Hospitalisations	Deaths	
Weak seasonality (+/- 10%)							
(1) Baseline (status quo)	449 [253, 509]	2540 [1680, 3510]	320 [171, 478]	1169 [774, 1423]	6930 [4970, 9210]	1001 [618, 1430]	410 [280, 570]
(2) No mandate (low compliance: +10 - 15%)	587 [333, 707]	3210 [2080, 4580]	359 [190, 545]	1344 [911, 1632]	8250 [5920, 11120]	1203 [747, 1783]	620 [350, 880]
(3) No mandate (high compliance: +5 - 10%)	525 [290, 635]	2900 [1870, 4180]	342 [180, 519]	1272 [845, 1563]	7720 [5450, 10500]	1120 [683, 1669]	520 [350, 740]
(4) 5 day, no TTR (+1.3 – +3.8%)	472 [262, 552]	2660 [1730, 3740]	327 [173, 492]	1205 [792, 1476]	7190 [5090, 9710]	1041 [634, 1522]	440 [300, 600]
(5) 5-7 day, TTR (+0.13 – +0.4%)	452 [254, 513]	2550 [1680, 3530]	321 [172, 479]	1174 [776, 1429]	6950 [4980, 9270]	1006 [620, 1440]	410 [280, 570]
(6) 5-10 day, TTR (-1.4 – -0.5%)	439 [244, 504]	2490 [1630, 3480]	317 [169, 476]	1155 [753, 1416]	6810 [4830, 9150]	986 [600, 1418]	400 [260, 570]

Table 6. Model results for the short-term and long-term impact under different isolation policy scenarios and strong seasonality. Total cumulative infections, COVID-19 hospital admissions, and COVID-19 deaths following the policy change (15 May 2023), under six policy scenarios and strong seasonality (corresponding to a peak winter transmission rate on 1 July of 20% higher than on 1 April). Numbers in brackets in the "Scenario" column show the assumed percent increase in transmission due to the policy change. Values in brackets represent the 95% confidence intervals on these differences. Note these results may be more sensitive than those in Table 3 to model assumptions and factors not included in the model, such as significant new SARS-CoV-2 variants or unanticipated seasonal or behavioural patterns.

Scenario	Short-term impact			Long-term impact			Peak hospital occupancy
	Infections (1,000s)	Hospitalisations	Deaths	Infections (1,000s)	Hospitalisations	Deaths	
Strong seasonality (+/- 20%)							
(1) Baseline (status quo)	549 [361, 632]	3310 [2250, 4450]	418 [237, 622]	1133 [806, 1330]	7050 [5260, 9210]	1076 [688, 1536]	550 [400, 760]
(2) No mandate (low compliance: +10 - 15%)	701 [466, 848]	4140 [2590, 5650]	470 [264, 710]	1306 [944, 1533]	8440 [6010, 11150]	1281 [823, 1951]	740 [440, 1040]
(3) No mandate (high compliance: +5 - 10%)	636 [411, 770]	3800 [2410, 5200]	448 [249, 678]	1239 [877, 1468]	7910 [5640, 10530]	1196 [756, 1806]	650 [440, 900]
(4) 5 day, no TTR (+1.3 – +3.8%)	577 [373, 682]	3460 [2290, 4720]	427 [240, 642]	1169 [824, 1383]	7350 [5360, 9720]	1116 [705, 1631]	580 [410, 780]
(5) 5-7 day, TTR (+0.13 – +0.4%)	551 [363, 637]	3330 [2250, 4480]	418 [237, 624]	1137 [808, 1336]	7080 [5270, 9260]	1079 [690, 1546]	560 [400, 760]
(6) 5-10 day, TTR (-1.4 – -0.5%)	539 [348, 626]	3260 [2210, 4420]	415 [233, 620]	1118 [785, 1323]	6950 [5150, 9140]	1059 [669, 1524]	550 [380, 750]

Appendix. Simplified model for estimating the effect of different isolation periods on effective reproduction number

This Appendix describes a simplified model for using the results of Covid-19 Modelling Aotearoa's simulation model for isolation periods [1] to estimate the size of transmission change (change in average instantaneous reproduction number) under different isolation policy options. The estimates produced are used as inputs to the ODE model to produce scenarios for the relative change in the number of infections, hospitalisations and deaths over a given time period following the policy change, using the same methodology as in [2].

Parameters assumed to be policy-independent	
Rh	Average number of secondary infections within household
Ti	Average infectious period
a	Average number of secondary infections outside household per unit time when not in isolation
Rc = a Ti	Average number of secondary infections outside household with no isolation
T1	Average time infectious before starting isolation
Policy-dependent parameter	
T2	Average time infectious after isolation period ends

The reproduction number (average total secondary infections) is the sum of household and non-household reproduction numbers. In the absence of isolation, this is:

$$Rt = Rh + a\,Ti$$

Isolation results in a reduced reproduction number

$$Rt^* = Rh + a(T1+T2)$$

Therefore, the relative reduction r in the reproduction number as a consequence of isolation can be defined via $Rt^* = (1-r)Rt$, which implies that

$$r = 1 - (Rh + a(T1+T2)) / (Rh + a\,Ti)$$
$$= (1 - q)\,(1 - (T1+T2)/Ti)$$

where q = Rh / (Rh + a Ti), which is the average proportion of transmission that occurs within household for someone who does not isolate.

We use results from Covid-19 Modelling Aotearoa's simulation model [1] for the time infectious after the isolation period ends (T2). We use the results assuming the higher RAT sensitivity for test-to-release (TTR), reflecting the fact that the likelihood of detecting an active infection depends on individual-level variables (e.g. testing technique) as well as the theoretical sensitivity of the test itself, and is therefore likely to be higher for individuals who have recently recorded at least one positive test result. We use the values from [1] of Ti =118 hrs for the average infectious period and T1 = 48 hrs for the average time infectious before starting isolation (which may be a combination of pre-symptomatic transmission and delay from symptom onset to starting isolation). We assume a plausible range for the proportion q of transmission that would occur within households (in the absence of any isolation) of 30-60%.

Under the assumption that everyone follows the isolation policy, this gives the following results (see Table below) for transmission levels under six scenarios: (1) no isolation at all; (2) 5 day isolation period; (3) minimum 5 day, maximum 7 day isolation period, with test-to-release (one negative test); (4) 7 day isolation period (status quo); (5) minimum 5 day, maximum 10 day isolation period with test-to-release (one negative test).

Policy	Avg time infectious after release, T2 (hrs)	Transmission reduction relative to no isolation (r)	Transmission change relative to status quo
No isolation	70	-	+ 26-57%
5 days	19.3	17-30%	+ 4-10%
5-7 days TTR (1 test)	10.0	20-36%	+ 0.5-1.0%
7 days (status quo)	8.9	21-36%	1
5-10 days TTR (1 test)	5.0	22-39%	- 2-4%

In reality, not everyone will follow the isolation policy: asymptomatic or mild cases may not test; others may choose not to test or may not follow the isolation requirements. We therefore calculate the relative reproduction number under the assumption that a fixed proportion p of the population follows the policy (and the remaining proportion do not isolate at all), and **the proportion following the policy does not change, even if the policy itself does**.
Under this assumption, the relative reduction in reproduction number as a consequence of isolation is

$$r = p\,(1 - q)\,(1 - (T1+T2)/Ti)$$

The value of p is unknown (and is a simplification of reality because there will be some people who partly follow the policy, e.g. by reducing contacts but not fully isolating and/or by isolating for a shorter period of time than required). However, considering a range of plausible values for p gives a way of estimating a range of possible effect sizes under different policy options. The following two tables show model estimates for two values of p (p = 33% and p = 50%), corresponding to one third to one half of all infections following the isolation policy.

Policy	Avg hours infectious after release	Transmission reduction relative to no isolation (r)	Transmission change relative to status quo
p = 50%			
No isolation	70	-	+ 12-22%
5 days	19.3	9-15%	+ 2.0-3.8%
5-7 days TTR (1 test)	10.0	10-18%	+ 0.2-0.4%
7 days (status quo)	8.9	10-18%	1
5-10 days TTR (1 test)	5.0	11-19%	- 0.7-1.4%
p = 33%			
No isolation	70	-	+ 7-14%
5 days	19.3	6-10%	+ 1.3-2.3%
5-7 days TTR (1 test)	10.0	7-12%	+ 0.1-0.3%
7 days (status quo)	8.9	7-12%	1
5-10 days TTR (1 test)	5.0	7-13%	- 0.5-0.9%

This is a highly simplified model that makes several simplifying assumptions. Key assumptions are summarised in the Table below, along with an assessment of the likely direction of effect these assumptions will have on the model predictions for the change in transmission relative to status quo.

Assumption	**Reality**	**Likely direction of effect on predicted transmission increase relative to status**

		quo
People not isolating (either because there is no policy or because they are in the 1-p of the population who don't follow the policy) continue life as normal throughout infectious period	Some people will effectively isolate (or at least reduce contacts) because they are too sick to work/socialise.	Transmission increases relative to status quo will be smaller than model predicts.
Infectiousness is constant throughout infectious period	Infectiousness is likely lower towards the end of infectious period	Transmission increases associated with releasing people from isolation earlier (e.g. changing from (7 to 5 days) will be smaller than model predicts.
The proportion of people following the policy does not change even if the policy itself does	The proportion may change if the policy becomes easier/harder to comply with or	Transmission increases will be smaller than model predictions the proportion complying increases, and larger than model predictions if the proportion complying decreases.
The average period of infectiousness prior to starting isolation is 48 hours	The actual period is unknown and could be smaller or larger than 48 hrs	If more than 48 hrs, transmission increases will be smaller than predicted. If less than 48 hrs transmission increases will be larger than predicted.
Rate of non-household transmission events is constant per unit time spent infectious and not in isolation	The rate may decrease over time due to contact saturation effects (e.g. if you tend to see the same set of co-workers every day)	Transmission increases will be smaller than predicted.
Number of secondary household infections is not affected by isolation policy	A reduction in isolation period could mean less time spent in the home and therefore reduce household transmission	Transmission increases will be smaller than predicted (though this is likely to be a weak effect given that risk of exposure for household contacts may saturate fairly quickly with time).

For a more detailed sensitivity analysis on the effect some of these assumptions have on estimated transmission parameters, see [4].

Acknowledgements

The authors acknowledge the role of the New Zealand Ministry of Health, StatsNZ, and the Institute of Environmental Science and Research in supplying data in support of this work. The authors acknowledge the role of the COVID-19 Modelling Government Steering Group in helping to design the modelling questions to support the Public Health Risk Assessment. The authors are grateful to Emily Harvey and Matt Parry for comments on a previous version of this report and to Nigel French, Amanda Kvalsvig, Markus Luczak-Roesch, Melissa McLeod, L. Martis, Ben Ritchie and Patricia Priest for feedback on related modelling work. This work was funded by the New Zealand Department of Prime Minister and Cabinet and Ministry of Health.

References

1. Harvey, E. P., Looker, J., O'Neale, D. R. J., Plank, M., Priest-Forsyth, E., Tren, J. (2022). Quantifying the impact of isolation period and the use of rapid antigen tests for confirmed COVID-19 cases. Covid-19 Modelling Aotearoa, https://www.covid19modelling.ac.nz/quantifying-the-impact-of-isolation-period
2. Datta, S., Gilmour, J., Harvey, E., Maclaren, O. J., O'Neale, D. R. J., Patten-Elliott, F., Plank, M. J., Priest-Forsyth, E., Turnbull, S., Vattiato, G., Wu, D. (2023). Modelling the effect of changes to the COVID-19 case isolation policy.
3. Kissler, S. M., Tedijanto, C., Goldstein, E., Grad, Y. H., Lipsitch, M. (2020). Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. Science 368: 860-868.
4. Harvey, E., O'Neale, D. (2023). Further estimates of the effect and impact of different case isolation policies. Covid-19 Modelling Aotearoa, https://covid19modelling.blogs.auckland.ac.nz/modelling-the-effect-of-covid-19-isolation-policy-options/