Go hard, go early, go forever?

A contribution to the debate on vaccination, elimination and opening up in a Delta world

tailrisk economics

te maha hoki o nga pihikete

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Introduction

This paper discusses the direction of covid-19 policy, and in particular opening up to the rest of the world once the population is substantially vaccinated. The issue is this: should we join the rest of the world and live with an endemic virus as a necessary but relatively low price of opening up, or should the elimination strategy be retained. The government's thinking seems to be that we can have it both ways. Elimination should continue to be the strategy and is consistent with some opening up to the rest of the world.

The questions we address below are:

- Is elimination truly compatible with an open economy?
- What are the benefits and costs of elimination, once the vulnerable population is vaccinated?
- Is the Government's strategy based on sound analysis? To that end we examined the Skegg reports to the Minister, and reports on modeling by Te Punaha Matatini (TPM), the Government's preferred (and only?) modeller.

And our very preliminary conclusions are:

- Elimination is not compatible with a substantial opening to the world.
- The costs of elimination will exceed the benefits by a margin.
- The published advice and analysis was weak, or biased to an elimination conclusion.

Government strategy

On 12 August 2021 the Government announced its opening up strategy, which charted a very cautious path to reopening. The international tourist and education export industries will be written off for at least another season.

It concluded that:

Elimination retained as best strategy to keep COVID out and economy open

The Prime Minister claimed that the plan:

“ *is informed by the best available scientific evidence and public health advice”.*

Structure of this report

The focus of this paper is on this ‘best available’ scientific evidence.
We review the documents, which we assume provided the advice that underpins the strategy:

- The reports from the Strategic Covid-19 Public Health Advisory Group (the Skegg reports) released on 11 August 2021;
- Te Punaha Matatini’s ‘A Covid Vaccination model for New Zealand’ 30 June 2021. We understand that the Advisory Group made us of this model.

Shortly after this report was finalised an update of the TPM modelling was released. The main points were presented by Shaun Hendy at a Covid update press conference. Even with a vaccination rate of 80 percent of eligible adults, it was concluded there would be nearly 9000 deaths over the next year. We have briefly reviewed this report. We found that the conclusions were an artifact on some key assumptions that had limited evidential support. The Australian modeling that TPM cited had a death rate 45 times lower than the TPM estimate.

We then set out our ‘back of the envelope’ assessment of the costs and benefits of an elimination strategy. We conclude that once the population is sufficiently vaccinated, ‘live-with-it’ is the preferred strategy. Elimination in the longer term is probably not, technically and legally, a viable, let alone an optimal, option.

The measures required to enforce it, may breach human rights and might not be legal. It is one thing to override human rights by claiming the measures are ‘necessary and proportionate’ when the potential death rate is relatively high, quite another when vaccination has cut that rate by a factor of 20, and when it is clear that the costs well exceed the benefits. Elimination relies on a large measure voluntary co-operation, and that will be increasingly withheld by those who do not benefit from it, but incur the costs.

Our ‘back of the envelope’ estimate of the costs and benefits of one year of an elimination strategy covers economic, soclal and political costs. The costs are $ 8 billion; the benefits are $1.493 billion. The benefits of avoided deaths, hospitalisations and illnesses were $493 million. In succeeding years the ratio of costs to benefits is likely to grow reflecting ongoing exclusion from the international tourist and education export markets. The benefits will mostly flow to the 'boomers'. The costs will be incurred more broadly. These assessments are largely speculative and are more an invitation for others to produce better numbers than hard estimates.

The Skegg reports

There were three reports to the Associate Minister of Health dated 10 June, 24 June and 27 July. The first report presents most of the arguments for an elimination strategy. Because of the changing circumstances over this period the tone and content of the reports changed. By the time the final report was written the Delta variant was front of mind, and ambitions for opening were being scaled back.

In the initial report the Skegg Committee addressed the question:

"Is an elimination strategy still viable as international travel resumes and/or are we going to need to accept a higher level of risk and more incidence of COVID in the community?"

And its response was that elimination was both viable and optimal.

the group concludes that an elimination strategy, as defined above "The elimination approach focuses on zero-tolerance towards new cases, rather than a goal of no new cases" should still be viable as international travel resumes.

We interpret this to mean that they are prepared to accept the risk of some more cross border transmission cases by opening the border a little, but they will be stamped out as they emerge. Thus elimination is not incompatible with some opening of the border.

This is a bit of a play on words. It is not the observed outcome (i.e. zero cases) that determine the success of the policy. It is the intent to get the numbers down to zero. So even if case numbers were, say, 100 a day with no reasonable prospect of getting to zero, because new cases were constantly being seeded from offshore, it could still be an elimination, rather than a suppression, policy as long as the intent was there. However, the Commission's approach does not appear to be just a ploy to assist a dignified retreat from elimination. It appears that they are being real about it. Population control measures will still be used to fight individual outbreaks. It is just that they will not necessarily be as aggressive when there is widespread vaccination, though harsh measures remain an option. There would have to be a strong preference for tight controls on the border to reduce the number of new cases.

One problem with the Skegg report is that it does not engage with the question of how tight the border controls would have to be to be compatible with an 'elimination' strategy. One approach would have been to define elimination in terms of the maximum number of cases over a year (say an average of 5 a day – which might be stretching the concept of elimination) and work back from there to the maximum acceptable number of border seedings, and then on to the required tightness of border controls. If they had done this they might have found that the scope for quarantine-free entry was very limited.

The arguments for an elimination strategy were as follows:

Protects the health system

Stamping out clusters of COVID-19 as they arise will mean that our health system is not overwhelmed by large numbers of patients requiring health care.

There was no analysis, in the report, that showed that the health system would be 'overwhelmed', or that considered what additional resources would be required to keep the demands on the system to a manageable level if the border was more open. It could be that the benefits from a more open border exceed the additional health care costs. It would have been useful if the issue had been framed that way.

Study finds elimination best from all perspectives

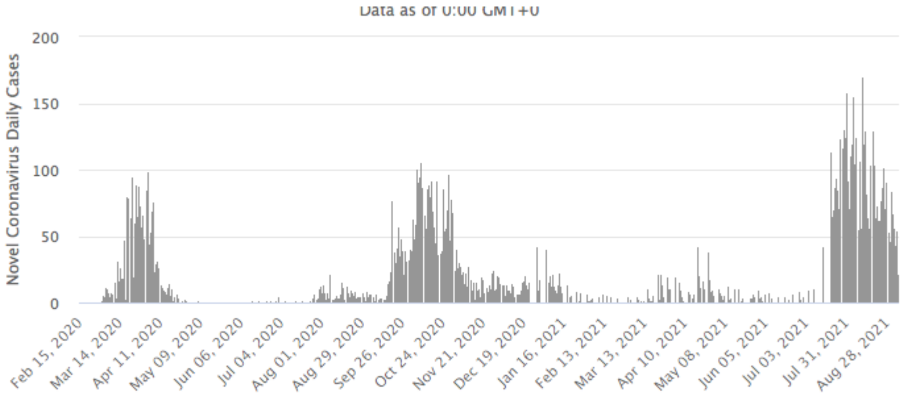
In a recent Lancet commentary, Oliu-Barton and colleagues compared five OECD countries that aimed for elimination of SARS-CoV-2 with 32 others that opted for mitigation, defined as "action increased in a stepwise, targeted way to reduce cases so as not to overwhelm health-care systems". These authors described elimination as "maximum action to control SARS-CoV-2 and stop community transmission as quickly as possible". They concluded that elimination created the best outcomes for health, the economy, and civil liberties.

The Olliu-Barton piece is just one of many, many papers on the merits or otherwise of varying Covid stratgies, and it was not a very good one. It is just a short opinion piece rather than a serious piece of analysis, by a group with a strong commitment to elimination.

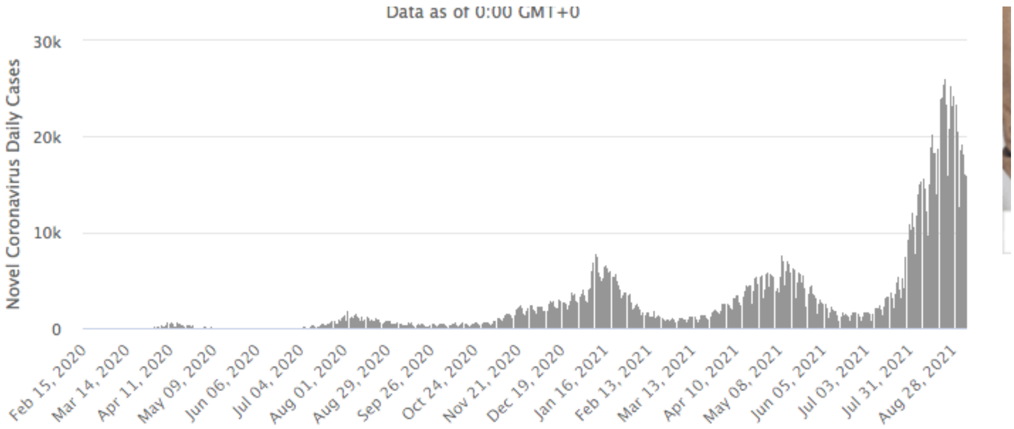
The five OECD countries were Iceland, Japan , Korea, Australia and New Zealand. Only New Zealand and Australia could have been described as 'hardout' elimination proponents. The others never resorted to lockdowns despite repeated resurgences in cases numbers. Iceland opened up to renewed tourism relatively early, accepting the risks. Japan was known for its as relatively laissez faire approach to Covid. Figure one shows the daily case numbers for Iceland, Japan and South Korea (source Worldometer).

Figure one: Daily covid case numbers

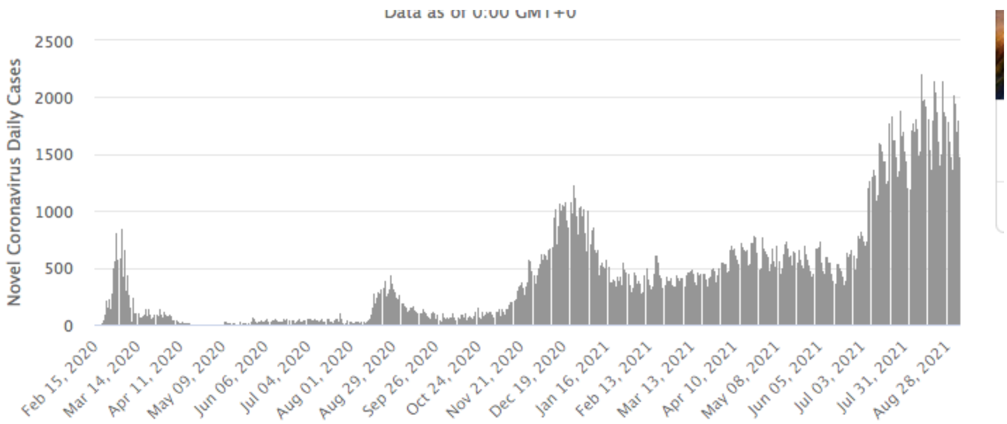
Iceland



Japan



S. Korea



In any event, pre-vaccine experiences are of uncertain relevance to post-vaccine decision-making. The reduction in the incidence of serious illnesses changes the balance of costs and benefits considerably.

Delivers a desirable lifestyle

By contrast, New Zealand has the opportunity to continue to enjoy a lifestyle that is relatively unaffected by the ravages of COVID-19.

Along with Australia and a few other countries, we should not need to be practising pronounced physical distancing, wearing masks in most indoor places, or separating the elderly and other high risk individuals (such as those with diabetes or obesity) from family and friends during winter months.

This one obviously did not stand the test of time. Most importantly the Committee did not engage with how life will be when the vulnerable are vaccinated, and facing risks which may be one twentith of those in an unvaccinated world.
Other countries are increasing taking a more relaxed approach to population based control measures. Living in a country committed to defending elimination, however, carries the risk of periodic lockdowns and disruptions.

This will be advantageous for our community life and economy, and it will make New Zealand a highly attractive place to visit or to settle in. In the wake of the pandemic, the Economist Intelligence Unit has just ranked Auckland as first, and Wellington as fourth, in their list of the world's most liveable cities.

If the Economist assessment were done today Auckland would almost certainly rank as highly undesirable. While an elimination strategy would deliver New Zealand a lower risk of serious infection, on average, than 'live-with-it' countries, the absolute risks, post vaccine, are low and only a small minority of tourists might see the lower relative risk as an advantage. They would have to balance that against the risk that travel plans could be disrupted by a more aggressive approach to population controls. Some septugenians might find New Zealand a more appealing place to settle, but we are not really in the market for that class of immigrant.

The option value

An important advantage of maintaining our New Zealand-type elimination strategy is that it keeps our options open. If this policy were to be abandoned now, so that endemic infection became established, it would probably never be possible to reverse the change. On the other hand, if it became clear over the next few years that the costs of elimination outweighed the benefits, it would be a simple matter to follow the example of other countries.

This argument depends on the value and price of the option. If the price, as we argue below, is high and the value relatively low, then we shouldn't continue purchasing the option.

And that was it. The Committee did not enage at all with the disadvantages of an elimination strategy, or express any serious interest in its economic consequences.

Te Punaha Matatini (TPM) A Covid Vaccination model for New Zealand 30 June 2021

This modeling appears to have provided analytical support for the Skegg Committee's deliberations.

TPM present three sets of modelled scenarios.

The first considers the proportion of the population that would need to be vaccinated to reduce the effective reproduction rate to below one. The implication is that any rate above one could pose an unacceptable risk if New Zealand is opened up to foreign travel.

The second considers the consequences of opening up foreign travel in terms of cases, pressure on hospital resources, and deaths.

The third looks at short-run outcomes, at various vaccination levels, if there is an outbreak when the border is still highly protected.

The key inputs into the models are:

- The basic reproduction rate, R_o. This describes the number of people that each case will infect, absent any change in behavior and public health interventions. It is said that the R_o for Delta is between 5 and 6, roughly based on the assumption of a doubling of the rate for the original virus. Results for three scenarios: $R_o = 3.0$, $R_o = 4.5$, and $R_o = 6.0$. are presented. They are described as being broadly reflective of of the ineffectivity of:the original variant of SARS-CoV2; the Alpha variant; and the Delta variant.

  As R_o for New Zealand was generally regarded as being around 2-2.5[1] rather than 3.0, a population R_o of 4.5 is probably a better estimate for Delta in this country.

- The efficacy of the vaccine. In their base case it is assumed to reduce infections by 70 percent, and transmissions by 50 percent, for an overall reduction in the transmission rate of 85 percent. Serious illnesses and deaths are reduced by 94 percent. The impact of higher and lower assumptions are also examined. The assumptions tend to err on the conservative side, given the evidence.

[1] TPM used an estimate of 2.5 in their document 'Suppression and Mitigation Strategies for Control of

Required vaccination rate

The impact of the vaccine is to reduce the effective reproduction rate R_{eff}. For example, with a R_o of 4.5 the effective rate falls to 0.675 (4.5 x 0.15), with a 100 percent vaccination rate, assuming no behavioural changes or policy interventions. TPM's required vaccination modelling scenarios calculate the vaccination rates that would be required to reduce R_{eff} to below 1.

The standout conclusion presented in the executive summary is that with the Delta variant assumed to have an R_o of 6.0, the vaccination rate would need to be 97 percent.

And if coverage is below the threshold*, "relaxing controls completely would risk serious health impacts, including thousands of fatalities'*. As a 97 percent vaccination rate is probably not achievable, this sets the scene for a very conservative approach to border control easings.

The full set of results is in table 1.

Table 1. Required vaccination rate % of eligible

Vaccine effectiveness	Baseline	Low effectiveness	High effectiveness
Ro 3.0	71	94	62
Ro 4.5	83	Not possible	77
Ro 6.0	97	Not possible	81

No contact tracing

The key issue with the analysis is that it is assumed that testing, contact tracing and isolation (TTI) will be abandoned. This makes a substantial difference to the results as we illustrate in table two. It is not explained why this highly unlikely assumption was adopted, but if pressed TPM might have said that there would be so many imported cases with an open economy that the TTI system would be overwhelmed. So for longer-term modelling TTI could be safely ignored. However, the presumption was not backed by any analysis. We are just told.

It is extremely unlikely that the contact tracing would perform at the level required if there were a large number of imported cases that triggered multiple concurrent outbreaks, which was the situation New Zealand faced in March 2020.

Arguably TTI did make a reasonable contribution to the rapid suppression of the epidemic in March/April 2020. The TPM use an effectiveness rate of 0.44 in their outbreak modelling, based on the empirical evidence from 2020.

Importantly, TTI will be employed in an environment where the population is substantially vacinated, which will significantly reduce the transmission rate of even the Delta variant, giving TTI a much better chance of success. Further, it would not be necessary to expend resources to track down the last case if the strategy was suppression rather than elimination.

The Danes have recently abandoned population based controls altogether, even with cases running at several hundred a day. They expressed confidence in their TTI system to keep numbers under control.

Other assumptions

There are a couple of other assumptions that will overstate the required vaccination rate, that are questionable. First, only 16 year-olds and overs are assumed to be vaccinated. TPM's supplementary information paper reported that R_{eff} fell from 1.47 to 1.22 when the vaccination age threshold was reduced to 12.

Second, children were assumed to be nearly infectious as adults, which does not seem to be consistent with most understandings that children are significantly less infectious.

Table two provides estimates of the effect of an assumption that R_{eff} wii be reduced by 44 percent, roughly adjusting for some TTI effectiveness, vaccinating 12 years and above and lower infectivity in children.

Table two: Vaccination thresholds Ro=4.5, with and without adjustments

Proportion vaccinated %	**R_{eff} no TTI**	**R_{eff} with TTI**
50	2.59	1.44
60	2.21	1.23
70	1.82	1.02
80	1.44	0.80
90	1.06	0.59

Our conclusion is that the TPM's analysis has overstated the vaccination thresholds required to keep R_{eff} below one. A rate of about 80 percent, which is in keeping with many overseas targets, seems to be about right, when consideration is given to further increases in the rate post the target being met.

A sole focus on the overall population vaccination rate distracts from the really important number, the vulnerable community vaccination rate. Getting this up to a very high rate will have a substantial impact on deaths and serious illness. A high population vaccination rate keeps the case numbers down and slows transmission, but has only a moderate impact on serious outcomes. It is difficult to achieve high population vaccination rates because, amongst other things, younger people know that they are not seriously at risk and don't have a strong self-interest in being vaccinated. A 'vulnerable community rate' should be defined and targeted.

Risk of death by age

It is useful to have some understanding of deaths by age group to assess the economic and social costs and benefits of border restrictions. We have produced the age-based hospitalisation and death rates used in the TPM paper in table three. Deaths are heavily concentrated amongst the elderly. For anyone below 50, of normal weight and health the risk is very small. We have adjusted these death rates for the impact of vaccinations (column 3) and expressed the results in odds terms (column 4). A 20-24 year old, for example, has a one in 100,000 chance of dying, if they get infected. The odds at 75+ are 1:300.

Table three: Hospitalisation and death rates by age group

Age group	1 Hospitalisations % of infections	2 Deaths % of infections	3 Deaths % of infections vaccinated	4 Deaths Ex. Vaccination odds
0-4	0	0	0	NA
5-9	.01	.003	.00015	1:666,6667
10-14	.03	.006	.00030	1:333,333
15-19	.29	.010	.00050	1:200,000
20-24	.79	.020	.001	1:100,000
25-29	1.64	.040	.002	1:50,000
30-34	2.83	.070	.0035	1:28,671
35-39	3.64	.100	.005	1:20,000
40-44	4.05	.140	.007	1:14,286
45-49	5.23	.270	.0135	1:7407
50-54	7.18	.490	.0245	1:4082
55-59	9.07	.930	.0465	1:2151
60-64	10.89	1.600	.08	1:1250

65-69	13.00	2.520	.126	1:793
70-74	15.40	3.690	.1845	1:542
75+	17.80	6.640	.3320	1:301

The Director General of Health, Ashley Bloomfield, has recently publicly said that we will have to reach a 90 percent vaccination rate before moving to alert level 1. Further, every ethnic group must meet the 90 percent target. This will be a demanding test. In general it will be difficult to convince the 20-34 age group that they are not safe when their risk of death if they are infected is .04 of one percent. The ethnic test provides another challenge. Maori and Pacific have younger populations and larger shares that are in the already safe groups. Figure three shows that Pacific vaccination rates are close to or exceed the non-Pacific and Maori vaccination rates in each age group but is only 84 percent of the broader rate for the overall population because of the age group effect.

Figure two: Vaccination rates by age

Cumulative vaccinations by age

Age	First dose administered	First doses per 1,000 people	Fully vaccinated	Fully vaccinated per 1,000 people
12 - 19 years	322,650	642	64,433	128
20 - 34 years	694,610	672	276,196	267
35 - 49 years	736,989	771	342,849	358
50 - 64 years	784,993	846	534,215	576
65 and over	727,554	923	648,138	822
Total	**3,266,796**	**776**	**1,865,831**	**443**

Accessed 30 Sept

Figure three: Relative vaccination rates by age group

		Māori						Pacific Peoples					
DHB	Dose number	65+	50-64	35-49	20-34	12-19	All ages	65+	50-64	35-49	20-34	12-19	All ages
National	Dose 1	0.96	0.87	0.69	0.53	0.58	0.66	0.91	0.97	0.95	0.82	0.83	0.85
	Dose 2	0.95	0.93	0.72	0.51	0.67	0.60	0.90	1.14	1.26	0.96	1.24	0.84

Open border scenarios

The modeling of the open border scenarios assumes that there are five imported, unvaccinated cases a day and that no interventions are made to control the epidemic beyond vaccination. It is also assumed that under 15 years olds are not vaccinated and nearly as infectious as the general population. The 15 year and over population vaccination rate is 90 percent, and the vaccination rate is the same for each age cohort.   As noted above a more realistic assumption could have had a higher vaccination rate for the oldest cohort and lower rates for the younger. This would have had a material impact on serious illness and death rates. If it was assumed that the over 65 had a vaccination rate of 97 percent and the 50-64 group rate was 95 percent, this could reduce covid deaths by a factor of around three.

The 90 percent vaccination assumption means that a likely peak vaccinated population (excluding under 15s) is being modelled.   The results are as good as it gets from vaccination, not the consequences of prematurely opening up as suggested in the executive summary discussion.

Finally, the model is run for two years so there are the 3650 unvaccinated seedings.

The outputs are shown in figure four below.

Figure four: Outcomes of border openings

$R_0 = 3.0$	**Baseline**	**Lower Effectiveness**	**Higher Effectiveness**
Vaccine Effectiveness	$e_I = 70\%, e_T = 50\%$	$e_I = 50\%, e_T = 40\%$	$e_I = 90\%, e_T = 50\%$
R_v	0.98	1.24	0.90
Infections	150,000 (44%)	1,100,000 (61%)	25,000 (18%)
Hospitalisations	2,000 (35%)	15,000 (47%)	310 (15%)
Fatalities	230 (35%)	1,800 (47%)	37 (15%)
Peak in hospital	N/A	990 (after 210 days)	N/A
$R_0 = 4.5$	**Baseline**	**Lower Effectiveness**	**Higher Effectiveness**
R_v	1.47	1.86	1.35
Infections	1,300,000 (44%)	2,200,000 (58%)	690,000 (18%)
Hospitalisations	17,000 (35%)	30,000 (47%)	8,800 (15%)
Fatalities	2,200 (35%)	4,100 (47%)	1,100 (15%)
Peak in hospital	2,000 (after 140 days)	5,200 (after 100 days)	750 (after 174 days)
$R_0 = 6.0$	**Baseline**	**Lower Effectiveness**	**Higher Effectiveness**
R_v	1.96	2.48	1.80
Infections	1,800,000 (44%)	2,700,000 (58%)	1,100,000 (19%)
Hospitalisations	25,000 (35%)	37,000 (47%)	15,000 (15%)
Fatalities	3,400 (35%)	5,300 (47%)	2,000 (15%)
Peak in hospital	4,700 (after 90 days)	8,900 (after 70 days)	2,400 (after 110 days)

The critical driver of the results is the effective reproduction rate. If it is below one as in the R_o=3, baseline and high effectiveness scenarios, hospitalisations and deaths are low. There are 2000 hospitalisations and 230 deaths over two years (compared to about 65,000 normal deaths). But with the more realistic R_o= 4.5 scenario, R_{eff} is above one and the number of cases blows out to 1,300,000 with 2200 deaths. The number in hospitals peaks at 2000 after 140 days.

However, these results are critically dependent on the modelling assumptions.

No TTI assumed
No account is taken of TTI. It is unlikely that this would be abandoned, especially if it could be critical to reducing R_o below one. It would not have to be as intensive as in the elimination regime, because it is not important to track down every last case. Rather frequent testing and isolation of identified cases would reduce the effective reproduction rate. A reduction of, say, 25 percent, would drastically reduce case numbers if R_{eff} fell to close to one.

Children assumed to be unvaccinated and infectious
As noted above the assumption that under 15s are nearly as infectious as adults and are not vaccinated, is a critical driver of the results. Extending vaccination to 12 years olds and revisiting the infectiousness assumption, would have a material impact on $R_{eff.}$

Number of imported cases
There is no justification for the five unvaccinated daily cases assumption, which is described by TPM as just an 'arbitrary' number. With a high R_{eff} the number of imported cases becomes irrelevant.   An R_{eff} of 1.47 will generate 100,000 cases a day after 30 cycles (about 5 months). The conclusion that might be drawn is that it would be unsafe to open up to the world at all. However, in more realistic scenarios with a R_{eff} around one, the number of imported cases becomes relevant but no attempt was made to consider what a realistic and relevant number of imported cases would be with different border opening assumptions. So we have no idea of what a realistic reopening could look like.

A credible estimate would require a detailed assessment of the demand for travel; the infection rates in source countries; and the impact of border controls such as testing and vaccination requirements.

The problem with the TPM analysis was that the modelling was incomplete. The analysis that would give some meaning to the results had not been done, and the claims that there would be thousands of deaths lacked analytical support. However, It appears that the Skegg Committee were impressed by the TPM results even if it didn't really address the reopning issue.

Even if we took the 2200 deaths estimate as some sort of worst case in the longer term, it should be put in context. The deaths are for a two year period, so the annual rate is 1100. University of Otago research[2] puts the annual death rate from the ordinary flu at around 500.

And the TPM death estimates are based on estimates of death rates for China in January/February 2020[3], which put the average infection fatality rate at 0.656 percent. Subsequent serology based estimates[4] have suggested rates of perhaps half that, and as treatments have substantially improved since the first onset of the virus, it is possible that New Zealands 'true' outcome could be significantly less than the 1100 deaths per year estimate. Perhaps not much different than the flu estimate.

Peak hospitalisations

A significant worry for many is that the hospital system could be overwhelmed by even a moderate incrase in cases. While the TPM model produced peak hospitalisation numbers and their timing, there was no discussion in their papers of the inputs into their model, so we were unable to assess whether they were reasonable or not.

Outbreak sizes and control

The third set of scenarios focuses on the vaccination levels required to ensure that border outbreaks are bought under control assuming a functioning TTI system.

The analysis is complex, and the scenarios considered are not always the most interesting ones. The take-outs, other than the obvious one that vaccination rates help, are not always clear.

Our take-out, in terms of the consequences of infections, is that high rates of vaccination across the board do not necessarily help very much. Figure two shows the total number of hospitalisations in an outbreak, assuming a Ro of 4.5, with different detection speeds shown by the coloured lines. Most of the benefits are secured with a vaccination rate of 30 percent. Going beyond 50 percent reduces the hospitalization number by only one or two. This outcome is obvious. The younger and healthier have a low probability of being hospitalised, so vaccination does not make much difference.

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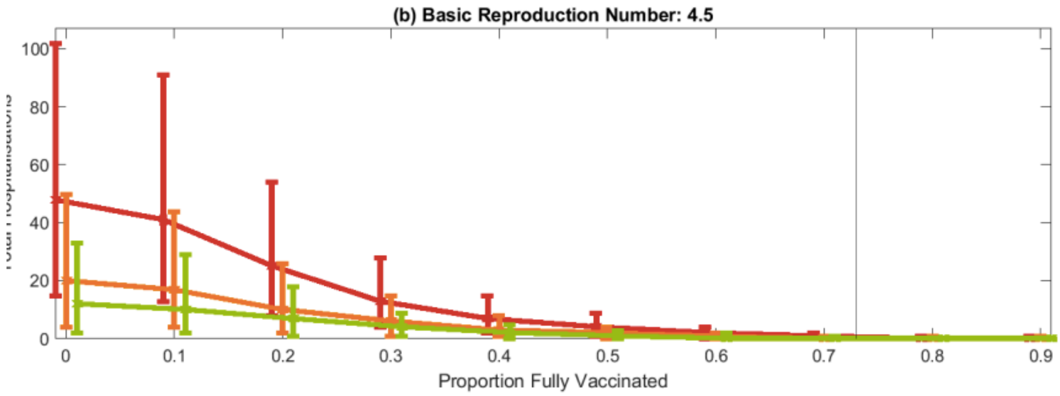
[2] University of Otago Magazine no. 45

[3] Verity, R., et al., Estimates of the severity of coronavirus disease 2019: a model-based analysis. The Lancet Infectious Diseases, 2020. 20(6): p. 669-677

[4] See for example . Ioannidis Reconciling estimates of global spread and infection fatality rates of COVID-19: An overview of systematic evaluations European Journal of Clinical investigation

Figure five: Hospitalisations and vaccination rates



The Updated TPM model

The results from the updated TPM modelling are presented in figures six and seven. The outcomes are easiest to read in the R_{eff} figure. R_{eff}s above one result in uncontrolled outbreaks and often more severe consequences.

The key consequence outputs are presented for both the over 12 and over 5 populations. This suggests that vaccinations of the latter group will be part of the Government's opening up strategy, when the vaccine becomes available.

With a 90 percent vaccination rate for the over 12s: moderate interventions, and the mean effectiveness assumptions, there are 972,000 cases; 30,000 hospitalisations; 3539 deaths; and a hospitalisation peak of 2300. An 80 percent vaccination rate generates 71,600 hospitalisations and 8886 deaths.

TPM's analysis suggest that opening up is only viable if 5-11 year olds are vaccinated, which could be some time off.

As in the first study the results entirely depend on some critical assumptions. We discuss these below.

Figure six: Reproduction rate estimates

Effective reproductive number

pVaxElig	R_{eff} with no mitigation			R_{eff} with baseline PH measures and limited TTIQ			R_{eff} with baseline PH measures and full TTIQ		
Over 12s	High VE	Cent VE	Low VE	High VE	Cent VE	Low VE	High VE	Cent VE	Low VE
70%	1.78	2.22	2.95	1.34	1.66	2.22	1.19	1.48	1.97
75%	1.63	2.04	2.79	1.22	1.53	2.09	1.09	1.36	1.86
80%	1.52	1.88	2.62	1.14	1.41	1.97	1.01	1.26	1.75
85%	1.44	1.75	2.47	1.08	1.31	1.85	0.96	1.16	1.65
90%	1.38	1.63	2.32	1.03	1.22	1.74	0.92	1.09	1.55
95%	1.33	1.54	2.18	1.00	1.15	1.64	0.89	1.03	1.46
Over 5s									
70%	1.53	2.05	2.85	1.15	1.54	2.14	1.02	1.37	1.90
75%	1.33	1.85	2.67	1.00	1.39	2.00	0.89	1.23	1.78
80%	1.15	1.66	2.50	0.87	1.25	1.87	0.77	1.11	1.67
85%	1.02	1.49	2.33	0.76	1.12	1.75	0.68	0.99	1.55
90%	0.93	1.33	2.17	0.70	1.00	1.63	0.62	0.89	1.45
95%	0.87	1.19	2.02	0.66	0.89	1.51	0.58	0.79	1.34

Figure seven: Consequence results with moderate interventions

Baseline public health measures and limited TTIQ

pVaxElig	Infections			Hospitalisations			Deaths			Peak beds occupied		
Over 12s	High VE	Cent VE	Low VE	High VE	Cent VE	Low VE	High VE	Cent VE	Low VE	High VE	Cent VE	Low VE
70%	1440522	2082185	2823390	94769	120339	149276	11844	15542	20102	13092	21113	33069
75%	1145338	1835476	2653898	68092	95426	126310	8307	12088	16792	7486	14642	26183
80%	835601	1570757	2475533	43224	71628	104065	5148	8886	13645	3491	9272	19990
85%	460831	1284468	2286397	19133	49483	82723	2218	6008	10688	1172	5136	14514
90%	78630	972073	2084118	2270	29768	62529	260	3539	7953	195	2316	9846
95%	12809	569508	1865801	218	12275	43815	26	1425	5481	13	752	6053
Over 5s												
70%	1051653	1747955	2577609	79738	109892	143037	9447	13669	18824	9371	17889	30732
75%	705384	1459872	2381811	49923	83670	119659	5681	10117	15482	4022	11423	23832
80%	193310	1143129	2174033	12203	58410	97075	1299	6838	12327	799	6215	17656
85%	5546	779614	1951199	311	34324	75511	33	3868	9392	10	2487	12292
90%	1454	171773	1709070	67	6030	55277	7	637	6719	2	438	7818
95%	708	7486	1441633	23	199	36822	3	21	4362	1	6	4328

Key assumptions

R_o

R_o was assumed to be 6.0. There was no modelling of other R_o assumptions or any discussion of why the mean assumption went from 4.5 in the June modelling to 6.0. The $R_o = 6$ is a critical driver of the results but the possibility that a lower rate could be used disappears from view.

We note that the Doherty Institute's report to the Australian Cabinet (cited by the second TPM report) had this to say on the transmissability of the Delta variant.

We use a starting TP (tranmission potential*) of 3.6 for the Delta variant based on averaged observations from NSW in March 2021, a period with minimal social restrictions and no major outbreaks.*

This suggest that the reproduction number used in the modelling might have been around 4.5.

In rough terms the impact of assuming a R_0 of 4.5 rather than 6 is to reduce an R_{eff} of 1.33 to 1.0.

Vaccination rates constant across age groups

The assumption that vaccination rates will be the same across age groups is highly implausible. It is possible that the vaccination rate for the over 65s could exceed 95 percent (the UK is already there) and similar rates could be achieved for the next riskiest groups, even if the overall rate was say 80 percent. This could reduce deaths by a factor of more than three and there would be a material reduction in hospitalisations.

Vaccine effectiveness

Vaccine effectiveness assumptions were the same as in the June modelling.

Hospitalisation ratios

Age-stratified hospitalisation rates are as in [10] with a hazard ratio of 2.26 representing the increased severity of the Delta variant.

We interpret this statement to mean that all of the hospitalisation rates were scaled up by a factor of 2.26. There are a number of issues here.

- The raw data in the study [5] showed that the hospitalisation rates for Delta were the same as for Alpha. The ratio was generated by the modelling of confounding influences. It is not clear whether this modelling was robust.
- The average age of hospitalisations was 31. There were no results by age group. It is not clear whether the scaling factor is applicable to older age groups where most of the risk sits.
- The raw hospitalisation rate was lower than the rate for the 30-34 age group used in the TPM modelling. There was no need to scale it up.
- There was insufficient data to produce reliable outputs for the vaccinated population.

[5] K. A. Twohig et al, 2021 “Hospital admission and emergency care attendance risk for SARS-CoV-2 delta (B.1.617.2) compared with alpha (B.1.1.7) variants of concern: a cohort study” Lancet

It appears that the scaling up was unwarranted and that hospitalisations might have been inflated by a factor of more than two.

Cross border seedings

Simulated outbreaks are seeded with an average of 1 case per day arriving at the border and entering the community. This approximately represents a situation where current tight border restrictions are relaxed, but strong border controls remain in place to limit the number of infectious travel-related cases entering the community.

A seeding rate of one is less than the five previously used but there is no evidence of a serious consideration of the likely imported case numbers and how this might interact with vaccination scenarios.

Hospital stay

Mean length of hospital stay = 8 days [11].

Testing, tracing, isplation and quarantine

Two scenarios for TTIQ performance are considered: 1. Baseline public health measures (17% reduction in transmission) and limited TTIQ (10% reduction in transmission), giving a combined 25% reduction in R_o. 2. Baseline public health measures (17% reduction in transmission) and full TTIQ (20% reduction in transmission), giving a combined 33% reduction in R_o

These estimates are better than the zeros assumed in the June paper, but there was no discussion of the evidence that supports these assumptions.

Limited discussion of other countries experience

As there is limited experience with the Delta variant in New Zealand it is important that evidence from other countries be considered. An Australian report by the Doherty institute was cited. It showed significantly lower esimates of deaths and hospitalisations than the TPM modelling. The results for an 80 percent adult vaccination coverage are shown in table four. There were 973 deaths, or about 200 for a population of 5 million. TPM’s estimate at the 80 percent vaccination rate was 8886, 45 times higher.

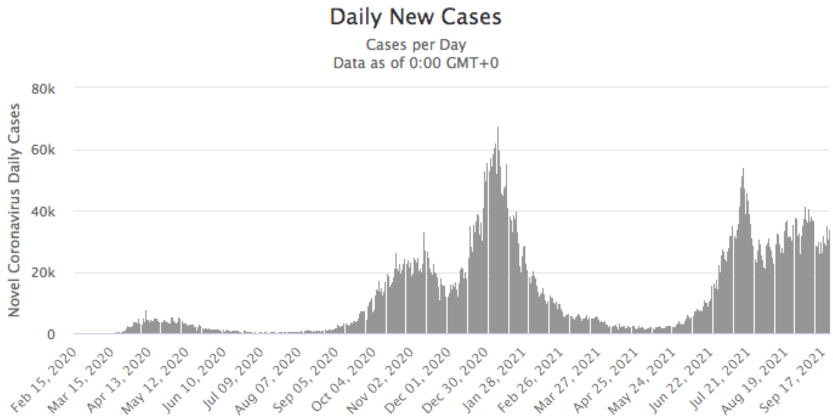
The main driver of the differences was probably the assumed $R_{o.}$

Table four: Doherty Institute model outputs 6 months 80% vaccination rate

	Vaccinated	Unvaccinated
Symptomatic infections	37,684	238,234
Hospitalisations	2308	6413
Deaths	306	673

A report from the UK Scientic Advisory Group for Emergencies (SAGE) [6] was also cited. The group argued, on the basis of their modelling, that there would be severe consequences, including hundreds of thousands of cases per day, if the UK 'freedom day' proceded. Several of the participants signed an open letter in Lancet in July against proceeding. The actual case numbers fell subsequent to 17 July and then stabilised.

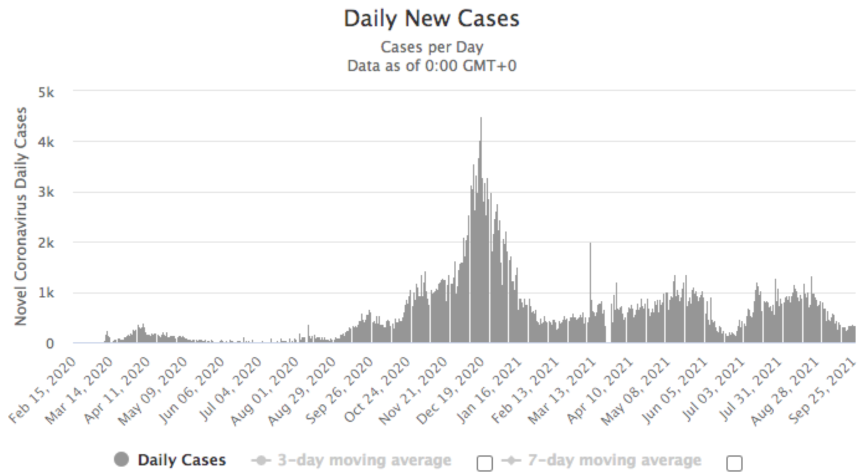
Figure eight: UK cases



Denmark's case numbers are presented in figure nine. Denmark has been progressively easing before the removal of all restrictions in early September and so far there is no evidence of an upturn in cases.

[6] Scientific Pandemic Influenza Group on Modelling, SPI-M-O: Summary of further modelling of easing restrictions – Roadmap Step 4. 2021

Figure nine: Denmark cases



No changes in behaviour and policy

It is assumed that there will be no change in the population behaviour even with rapidly increasing case numbers and serious illnesses. In reality there would be rush of vaccinations as case numbers grow, and people will be more assiduous in their social distancing. Overseas evidence suggests that case numbers tend to peak well short of the numbers predicted by simplistic no change models. Policy makers also have the option of ramping up TTC if case numbers and hospitalisation are unacceptably high.

To summarise, TPM's results are an artifact of their assumptions, which are heavily skewed to produce what many might regard as unacceptably high outcomes for the number of hospitalisations and deaths. These assumptions generally have a weak evidential basis.

A back of the envelope estimate of the costs and benefits of a continued elimination policy

As the Skeggs Committee did not seriously engage with the issue of the costs and benefits of continuing with the elimination strategy, we have set out a schematic framework below. Our numbers should be regarded as just placeholders, intended to give a sense of the magnitude of the costs and benefits of a year's delay in opening the border. If the restrictions go beyond a year the present value of the costs will naturaly increase, with the annual cost of suppressing the tourist industry increasing, as the international tourist industry recovers.

The key take out is that the direct benefits of elimination, in terms of avoided deaths hospitalisations and illness at $493 million, are relatively small relative to the costs. In subsequent years the ratio of costs are likely to increase as the costs to the tourist and education markets grow as international markets for these indutries recover.

Table five: Monetised costs and benefits

Benefits	**Annual $'m**	**Notes**
Avoided deaths	83	550 avoided deaths. TPM initial annual estimate divided by two. This likley to be on the high side. Average life years saved = 3 Value of life year $50,000 (NZ std)
Avoided Hospitisation costs	210	4200 hospitalisations. TPM annual estimate divided by 2 Cost of hospitalisation $50,000. (Financial and social)
Illness costs	200	Say 200,000 @ $1000
Reduction in insecurity due to infection risk	1,000	1,000,000 vulnerable and frightened people @ $1000 per head. This number will be a function of information on risks and messaging and would reduce if the population were well informed.
Total	**1493**	
Costs		
Tourist industry	1000	Assumes very moderate recovery of interntional travel. Opportunity cost of labour given low unemployment rate reduced the benefit. Note the low unemployment rate is driven by high terms of trade; a building boom and large fiscal injection. If these are not sustained the internationl tourist industry becomes more valuable. See Tailrisk 'The Road to level 4 and back tailrisk.co.nz/documentslist for a discussion.of some of the numbers
Education exports	1000	
Lockdowns	1000	Elimination strategy has a probablity of

		damaging lock down
Border management costs	500	
Business costs	1000	
NZ traveler costs	500	Direct costs and loss of consumer surplus
Lockdown insecurity costs	1000	Insecurity due to risk of lockdowns to enforce elimination
Threat to freedom	2000	Cost of living in a regime with no constraints on the exercise of government power if linked to covid Assumes the ethical position that people who like living in authoritarian regimes or imposing them on others should not have their preferences counted. It monetises the abrogation of rights expressed in the Bill Of Rights Act
Total	**8000**	

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