ADDENDUM TO DOHERTY MODELLING REPORT REVISED 30TH AUGUST 2021

This is a consolidated final version that incorporates previous errata and corrections to data mapping. While some individual data items have changed from previous versions, the conclusions have not changed. Text relating to PHSMs has been amended for precision and clarity.

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Executive summary

- Models of COVID-19 infection and vaccination were used to define a target level of vaccine coverage for transition to Phase B of the National Plan. The model was based on the simplifying assumption of a single national epidemic, with COVID-19 transmission, severity and vaccine effectiveness as for the Delta variant.
- Our report for 30th July 2021 National Cabinet considered hypothetical age-based vaccine allocation scenarios underpinning coverage targets of 50, 60, 70 and 80%, to explore the population level impacts of strategies focused either primarily on direct protection or transmission reduction.
- From the starting point of age-based coverage in Australia as of 12 July 2021, an 'All adults' allocation strategy that achieved high coverage in key transmitting populations (20-39 years) resulted in greatest reductions in harms across all age groups, regardless of vaccination status.
    - This hypothetical scenario was mapped to an *implementable strategy consistent with the national COVID-19 immunisation programme*, under which vaccines would be opened up to 30-39 year olds on 31 August 2021, and 16-29 years olds from 11 October, called 'Transmission reducing';
    - This strategy captured the benefits achieved under the previous preferred strategy, achieving a slightly lower TP by 70% coverage, and equivalence at 80%;
    - Epidemic dynamics assuming baseline restrictions and partial TTIQ were very similar to the 'all adults' strategy;
    - Corresponding clinical outcomes were similar or improved at coverage of 60% or above.

- Our main report highlighted the importance of maintaining optimal TTIQ responses in the context of ongoing public health and social measures (PHSMs) to minimise rapid epidemic growth and escalation of severe disease outcomes, even in a highly immunised population;
    - This report compared epidemic dynamics and clinical outcomes for the 'Transmission reducing' strategy assuming 'baseline PHSM' with either 'partial TTIQ' or 'optimal TTIQ';
    - Infections and corresponding adverse consequences were reduced by several orders of magnitude, assuming baseline measures and sustained highly effective public health response capacity;
    - The ability to deliver this capacity is greatly assisted by the more even distribution of reported cases over the 6 months time window of reporting, given an absence of rapid epidemic escalation.

- *As in our previous report, the contingency of these outcomes on population behaviours including vaccine acceptance, co-operation with behavioural restrictions and active engagement and compliance with public health responses is critically important for achieving programmatic outcomes.*

- *Our models assume a point source outbreak as the key initiating event for transmission. Given the low caseloads achieved under the 'optimal TTIQ' scenario and considered desirable in Phase B, the influence of imported infections on local epidemic dynamics merits further exploration in the next phase of modelling.*

Exploring vaccine thresholds for transition to Phase B of the National Plan

Our report for 30th July 2021 National Cabinet considered hypothetical age-based vaccine allocation scenarios underpinning coverage targets of 50, 60, 70 and 80%, to explore the population level impacts of strategies focused either primarily on direct protection or transmission reduction. From the starting point of age-based coverage in Australia as of 12 July 2021, an 'All adults' allocation strategy that achieved high coverage in key transmitting populations (20-39 years) resulted in greatest reductions in harms across all age groups, regardless of vaccination status. This hypothetical scenario was mapped to an *implementable strategy consistent with the national COVID-19 immunisation programme*, under which vaccines would be opened up to 30-39 year olds on 31 August 2021, and 16-29 year olds from 11 October, called 'Transmission reducing'.

Defining the transmission reducing strategy

The 'transmission reducing' strategy is defined in relation to previously modelled vaccination allocation scenarios in Table 1.1.

Table 1.1: Vaccine allocation strategies by age, assuming current recommendations for Astra Zeneca vaccine age eligibility (60+ years) and dosing interval (12 weeks)

Strategy	Allocation sequence
Oldest first	Vaccinations are prioritised from oldest to youngest. Specifically, prioritization occurs in the following order: 80+, 70-79, 60-69, 50-59, 40-49, 30-39, 20-29, 16-19
40+ years first	Vaccinations are prioritised from 40+ upwards, then 16+. Specifically, prioritization occurs in the following order: 40-49, 50-59, 60-69, 70-79, 80+, 16-19, 20-29, 30-39
All adults	Vaccinations are not prioritised in any particular order by age
Transmission reducing	As for national program, under which all individuals 40+ are currently eligible. Within the simulation timeframe, the 30-39 years cohort becomes eligible from 30 August, and 16-29 year olds on 11 October.

Timeliness of achieving coverage targets by vaccine allocation scenario

The indicative dates of achieving differing coverage thresholds for the 'transmission reducing' strategy are shown relative to the previously explored scenarios in Table 1.2. Under the revised scenario, there is an anticipated one-week delay to achieving the 70% coverage threshold, but all other target dates are unchanged. Not that achievement of any of these thresholds by the given date is contingent on population acceptance.

Table 1.2: Date of achieving a given vaccine coverage threshold by allocation strategy, assuming a start date and population completed doses (AIR) as of 12th July 2021, assuming Astra Zeneca is recommended only for 60+ years and delivered at a 12 week interval

	Coverage threshold			
Strategy	**50%**	**60%**	**70%**	**80%**
Oldest/40+ first and All ages	4 October	18 October	1 November	22 November
Transmission reducing	4 October	18 October	**8 November**	22 November

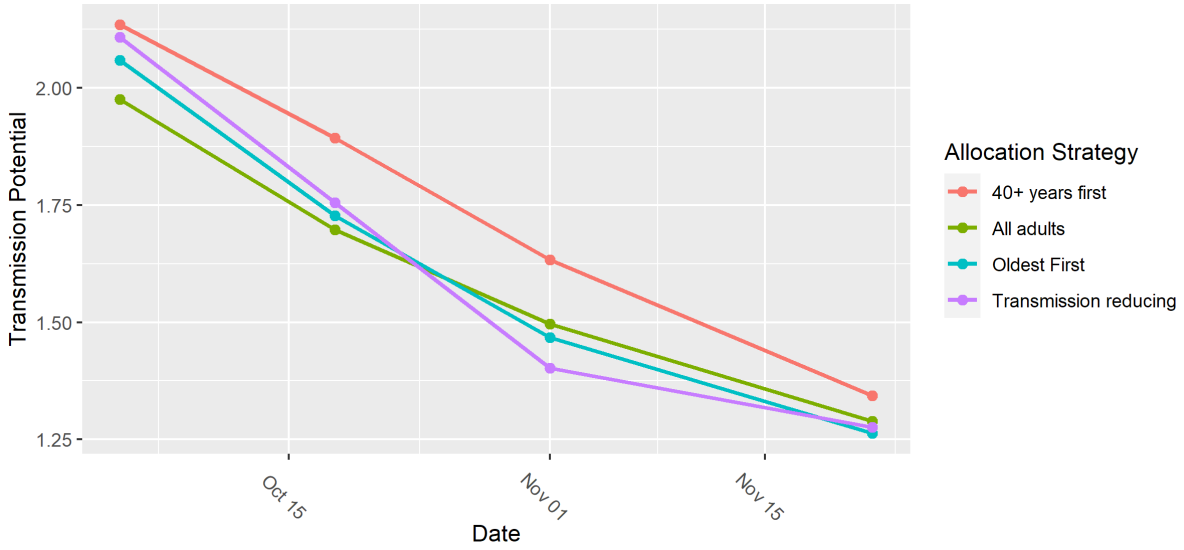
Transmission potential (TP) by vaccine coverage and allocation strategy

The reduction in TP achieved for each strategy by the coverage threshold is shown in Table 2.1 and Figure 1. As shown in the static table, the greatest gains of the transmission reducing strategy relative to others is demonstrable at the 70% coverage threshold, by which point it outperforms the 'all adults' strategy.

Table 2.1: Scaled values of Delta variant transmission potential (TP) for 50%, 60%, 70% and 80% population coverage for each allocation strategy, assuming AZ is delivered to individuals aged 60+ years, with a 12-week dosing interval. We use a starting TP of 3.6.

	Eligible population coverage (16+)			
Allocation Strategy	**50%**	**60%**	**70%**	**80%**
Oldest first	2.1	1.7	1.5	1.3
40+ years first	2.1	1.9	1.6	1.3
All adults	2	1.7	1.5	1.3
Transmission reducing	2.1	1.8	1.4	1.3

Figure 1: Rate of change in TP over time, by vaccine allocation strategy



Impact of public health response and bundled social measures on TP

Figure 2.1: Combined effects of vaccination and PHSM scenarios on COVID-19 transmission potential under the 'Transmission reducing' vaccination scenario assuming only *partial TTIQ effectiveness*, due to high caseloads. Standard age (60+) and dosing interval (12 weeks) recommendations are assumed for the AZ vaccine.

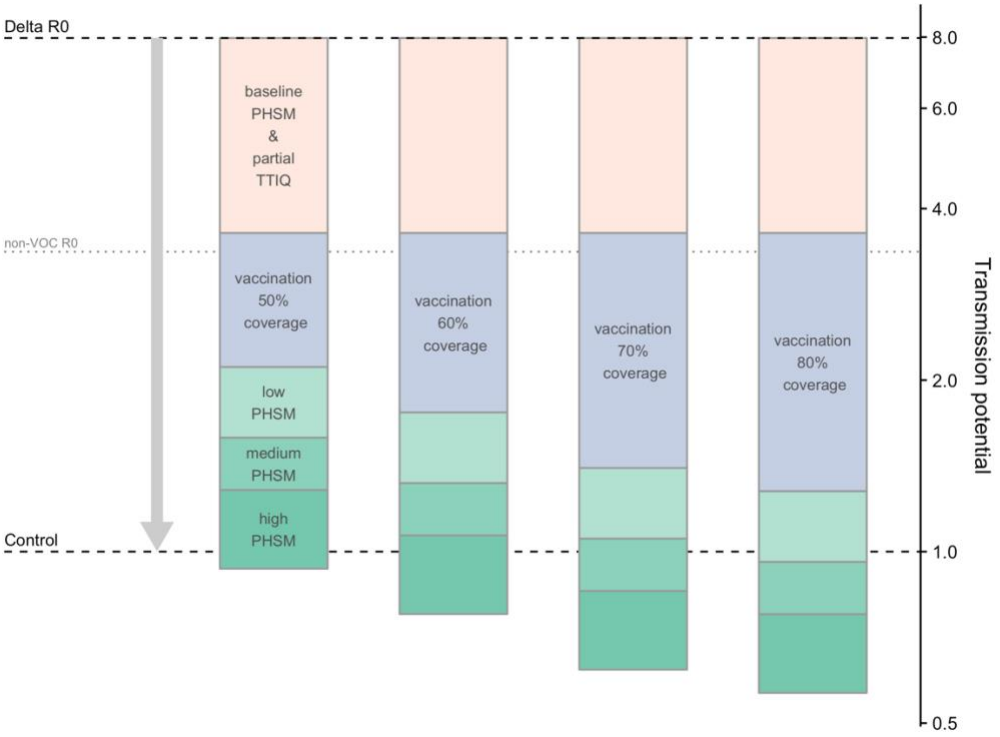
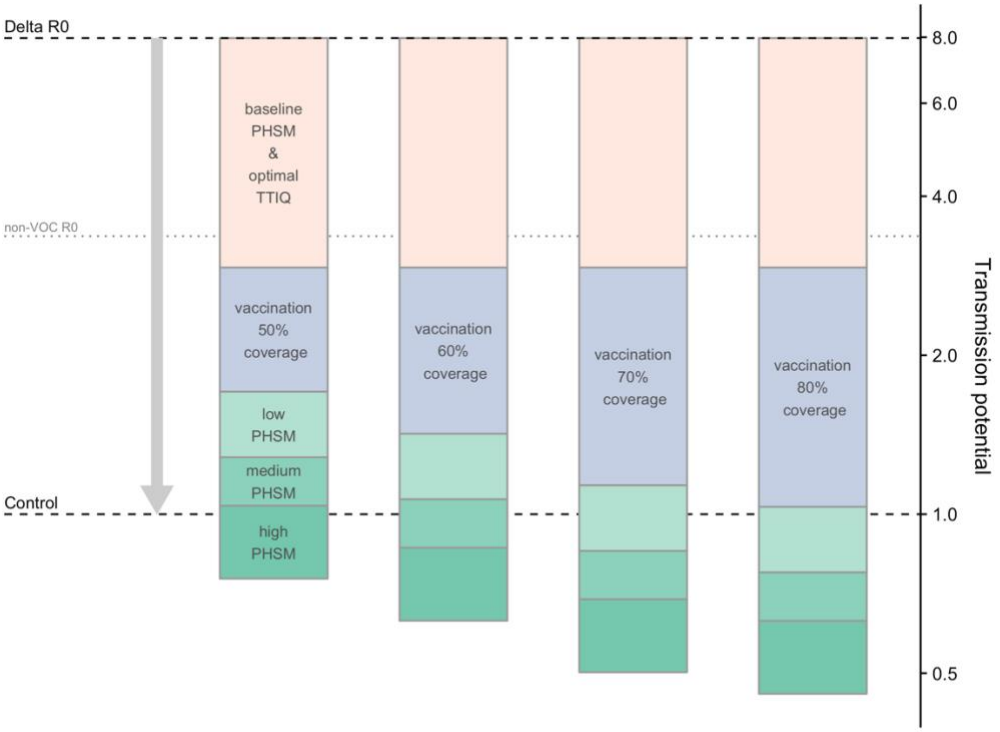


Figure 2.2: As for Figure 2.1 but assuming *optimal TTIQ effectiveness*



Anticipated requirements for social measures, by coverage scenario

Table 3.1: Percentage of time high PHSM would need to be in place for long-term control, with reversion to low PHSM at other times, for 50%, 60%, 70% and 80% population coverage achieved under the three age-based allocation strategies. These scenarios assume *partial* TTIQ effectiveness, under high caseloads. Standard age (60+) and dosing interval (12 weeks) recommendations are assumed for AZ vaccine.

Strategy	Eligible population coverage (16+)			
	50%	**60%**	**70%**	**80%**
Oldest first	82%	49%	18%	0%
Middle years first	89%	67%	39%	2%
All adults	75%	46%	22%	0%
Transmission reducing	87%	52%	10%	0%

Table 3.2: As for Table 4.1 but assuming *optimal* TTIQ effectiveness, given low caseloads

Strategy	Eligible population coverage (16+)			
	50%	**60%**	**70%**	**80%**
Oldest first	42%	9%	0%	0%
Middle years first	49%	27%	0%	0%
All adults	35%	6%	0%	0%
Transmission reducing	47%	12%	0%	0%

More detailed breakdowns of the level of time likely required under differing degrees of social restrictions for the various coverage thresholds and allocation strategies are shown in Tables S2.2 and 2.3 (assuming partial/optimal TTIQ), and S2.4 and 2.5 (for both levels of TTIQ in the context of low PHSM).

Dynamics and consequences given timing of transition to Phase B

Epidemic simulations assume a population size of 24 million. Infection outputs reflect the range of results observed across 20 separate model runs for each scenario. We assume that a single outbreak involving 30 individuals initiates community transmission at the time of transition to Phase B once target vaccine coverage is achieved. Each simulation is run for 180 days after this initiating date. As immunisation rollout is ongoing, achievement of future vaccine targets is indicated as relevant, in relation to evolving epidemics. Outputs assume baseline PHSM and are compared for partial and optimal TTIQ.

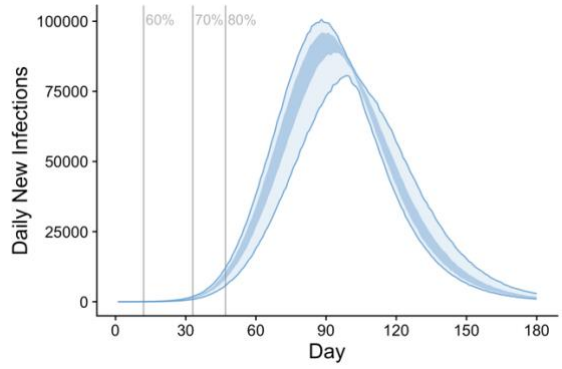
In all figures, dark banding represents the central 50% credible interval (i.e., from the 25th to 75th centile) for simulations. The light banding represents the central 90% credible interval (i.e., from the 5th to 95th centile) for simulations.

Early epidemic growth given established transmission, for Transmission reducing strategy

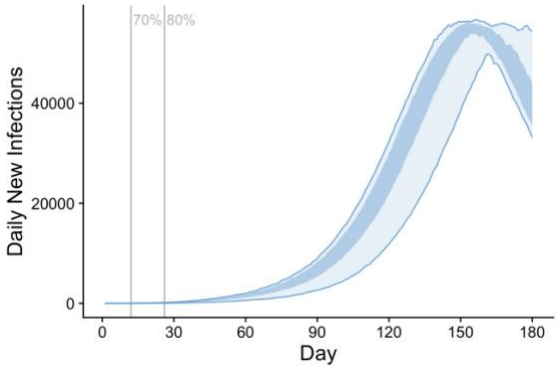
Figures 3.1-3.2 demonstrate the rate of increase in all infections over time, including those which are asymptomatic and regardless of subsequent clinical severity for the symptomatic proportion.

Figure 3.1: Epidemic growth to 180 days given transition to Phase B leading to established community transmission for the threshold coverage targets of 50, 60, 70 and 80%, assuming baseline PHSM and <u>partial TTIQ</u> (*note different y axes)

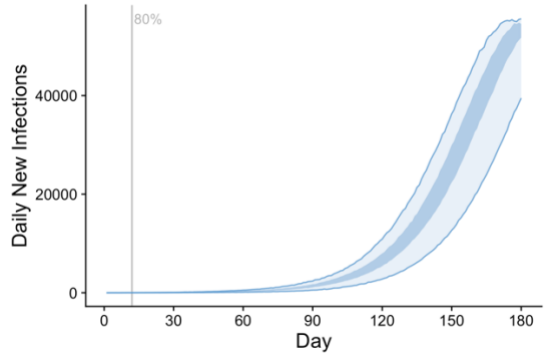
50% vaccine coverage



60% vaccine coverage



70% vaccine coverage



80% vaccine coverage

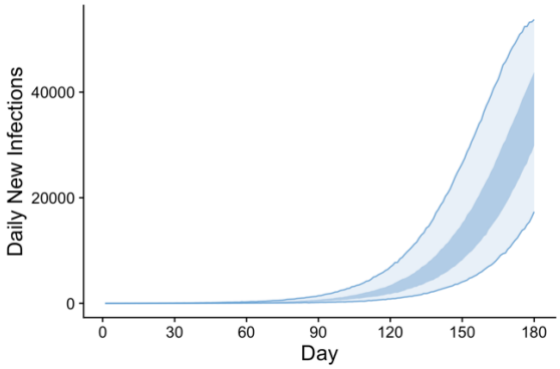
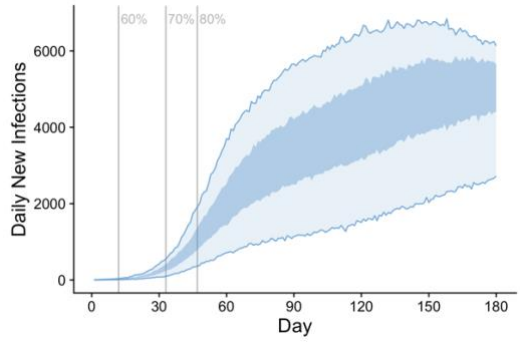
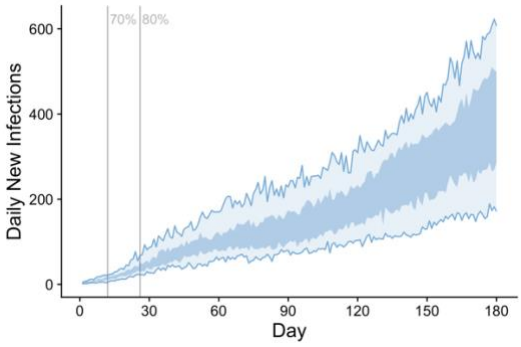


Figure 3.2: As for Figure 3.1, but for optimal TTIQ

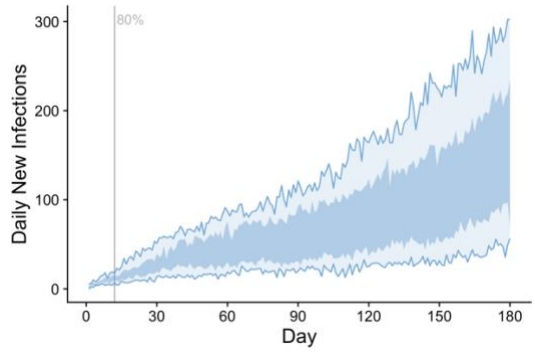
50% vaccine coverage



60% vaccine coverage



70% vaccine coverage



80% vaccine coverage

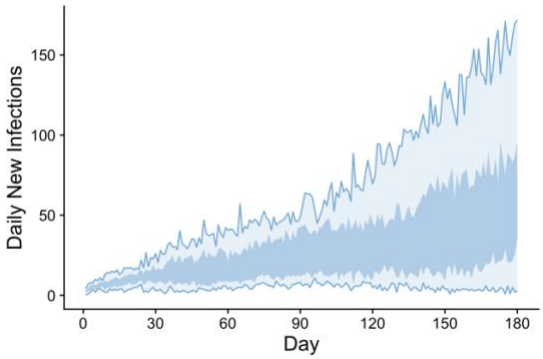
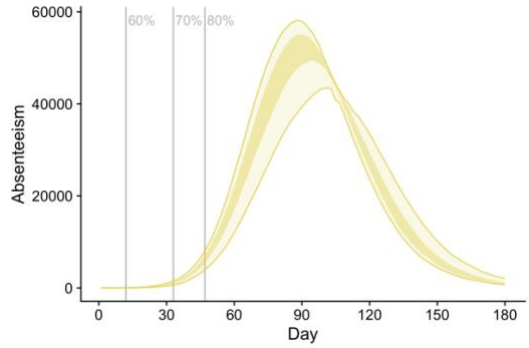
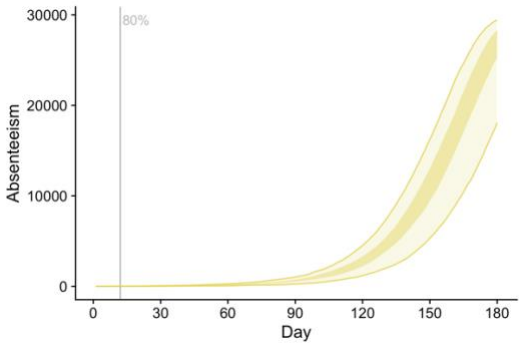


Figure 3.3: Prevalence of individuals absent from the workforce due to symptomatic infection and mandatory isolation (10 days) for the 50 and 70% coverage scenarios (*note y axes differ)

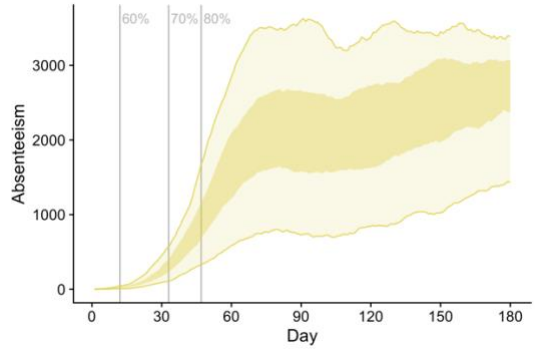
50% coverage, partial TTIQ



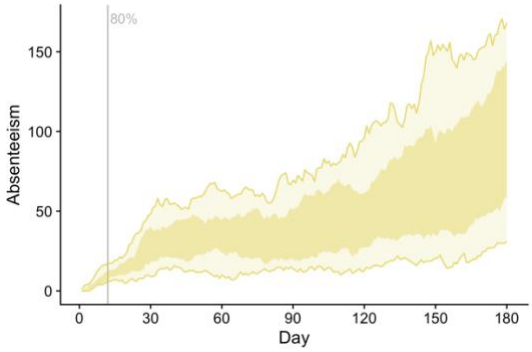
70% coverage, partial TTIQ



50% coverage, optimal TTIQ



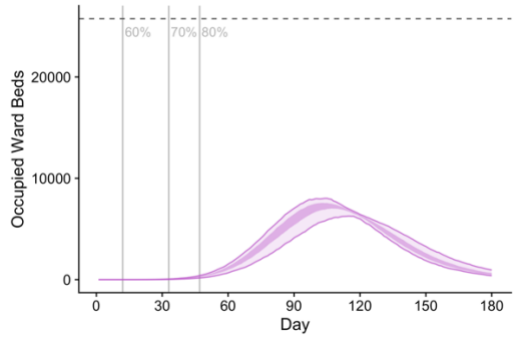
70% coverage, optimal TTIQ



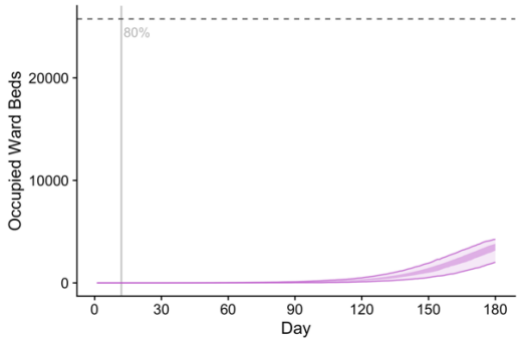
Associated health impacts of transmission, relative to health sector capacity

Figure 4.1: Occupied hospital ward beds over the course of the epidemic, in relation to stated national capacity, which represents 50% of the total. Scenarios shown are for 50% achieved coverage at epidemic onset. All scenarios assume baseline PHSM.

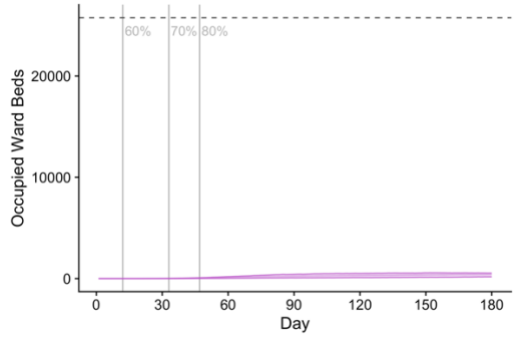
50% coverage, partial TTIQ



70% coverage, partial TTIQ



50% coverage, optimal TTIQ



70% coverage, optimal TTIQ

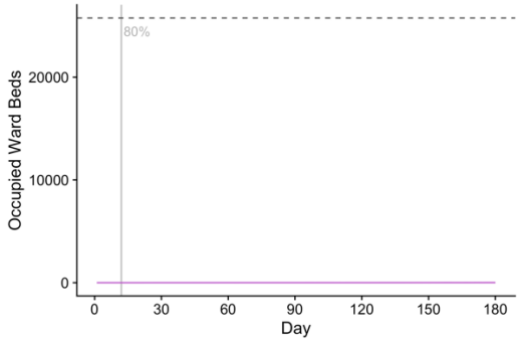
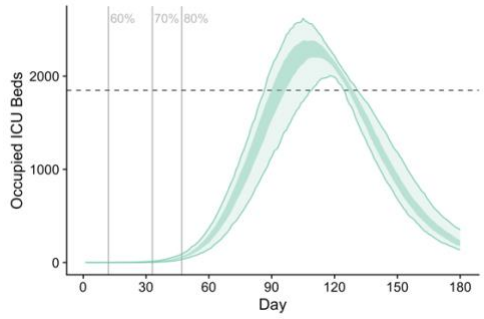
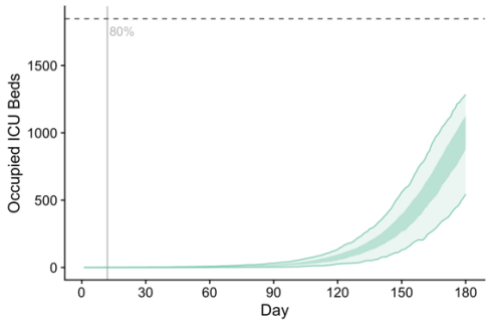


Figure 4.2: As for Figure 3.1 but for occupied ICU beds in relation to national capacity

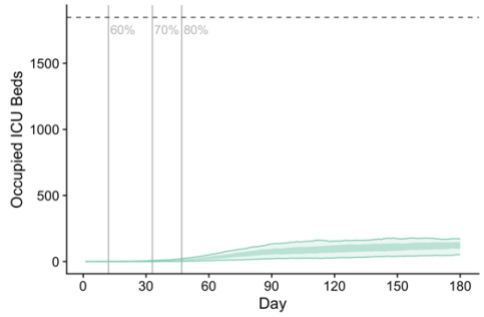
50% coverage, partial TTIQ



70% coverage, partial TTIQ



50% coverage, optimal TTIQ



70% coverage, optimal TTIQ

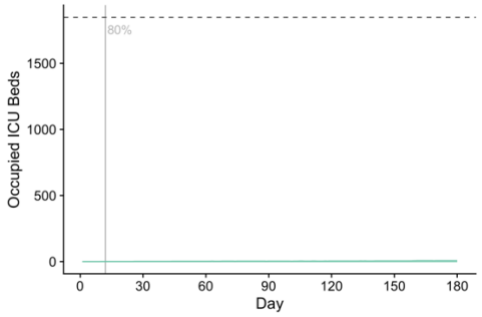
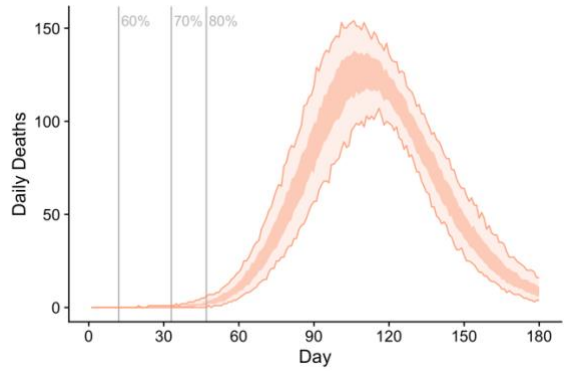
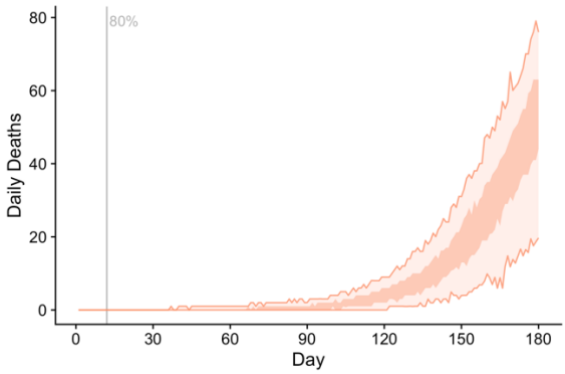


Figure 4.3: As for Figure 3.1 but reporting daily deaths (*note y axes differ)

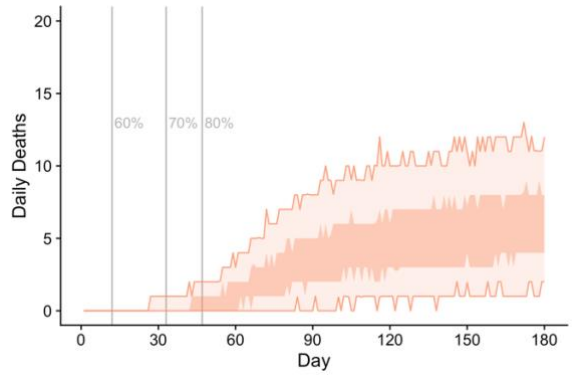
50% coverage, partial TTIQ



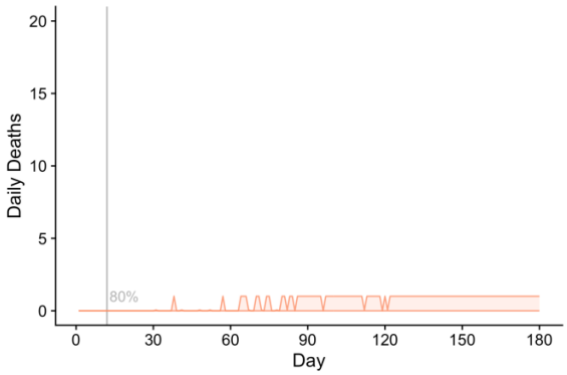
70% coverage, partial TTIQ



50% coverage, optimal TTIQ



70% coverage, optimal TTIQ



Health impacts by age group and vaccine status

Central estimates of these health impacts over the first 180 days following established community transmission are provided in the tables below, for ease of comparison across coverage thresholds, vaccination status and age group. Note that given epidemic stochasticity and uncertainty, these estimates are drawn from a broader range of possible values as demonstrated by the Figures above. **All scenarios assume baseline PHSM and are compared for 'partial' and 'optimal' TTIQ effectiveness.**

Table 4.1 Cumulative outcomes of interest over the first 180 days by achieved coverage threshold prior to transmission, for the 'Transmission reducing vaccine allocation strategy with baseline PHSM and <u>partial TTIQ</u>

	Vaccine Coverage			
	50%	**60%**	**70%**	**80%**
Symptomatic infections	1,109,597	695,075	385,983	227,702
Ward admissions	44,250	24,719	12,337	6,951
ICU admissions*	10,903	5,785	2,733	1,505
Deaths	8,032	3,591	1,457	761

**ICU admissions are reported here and below assuming unconstrained capacity, even when national thresholds are anticipated to be reached or exceeded, so reflect 'true' requirements*

Table 4.2 As for Table 4.1 but for <u>optimal TTIQ</u>

	Vaccine Coverage			
	50%	**60%**	**70%**	**80%**
Symptomatic infections	112,430	6,489	2,737	1,149
Ward admissions	3,760	207	88	37
ICU admissions*	885	48	21	8
Deaths	567	30	13	6

Table 4.3: Cumulative symptomatic infections, ward admissions, ICU admissions and deaths over the first 180 days for coverage thresholds of 50%, 60%, 70% and 80% achieved assuming baseline PHSM and either partial or optimal TTIQ, broken down by vaccination status#

	Partial TTIQ		Optimal TTIQ*	
Achieved eligible population coverage	**Vaccinated**	**Unvaccinated**	**Vaccinated**	**Unvaccinated**
50%				
Symptomatic infections	204,523	905,074	16,259	96,170
Ward admissions	12,686	31,564	966	2,794
ICU admissions	3,529	7,374	259	626
Deaths	2,615	5,417	174	393
60%				
Symptomatic infections	105,943	589,132	867	5,622
Ward admissions	6,874	17,845	51	155
ICU admissions	1,828	3,956	14	34
Deaths	1,153	2,438	9	21
70%				
Symptomatic infections	53,982	332,001	361	2,376
Ward admissions	3,320	9,017	22	66
ICU admissions	838	1,895	6	15
Deaths	465	992	4	9
80%				
Symptomatic infections	30,528	197,174	144	1,005
Ward admissions	1,837	5,114	9	28
ICU admissions	453	1,052	2	6
Deaths	240	521	1	4

**At high caseloads as anticipated in the 50% scenario, consistent maintenance of 'optimal TTIQ' is deemed highly unlikely*

 # Note that in the case of emergence of a 'vaccine escape' variant, both the total number of infections and the proportion of severe cases occurring in fully immunised individuals would increase dramatically.

As can be seen from Tables 4.4 and 4.5 (and the corresponding pair 4.6 and 4.7), the transmission reducing strategy's effectiveness at reducing symptomatic infections and severe outcomes across all age groups is markedly enhanced by maintenance of optimal TTIQ in the presence of baseline restrictions.

Table 4.4: Cumulative symptomatic infections, ward admissions, ICU admissions and deaths over the first 180 days for the coverage threshold of 70% assuming baseline PHSM and partial TTIQ, broken down by vaccination status and age

	<16 yrs		16-39 yrs		40-59 yrs		60+ yrs		70+ yrs	
	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac
Denominator population*	0	5,075,816	4,599,519	3,930,112	5,505,295	917,528	5,161,851	506,030	2,736,171	224,478
Symptomatic infections	0	226,084	21,032	64,770	20,775	35,837	12,175	5,309	3,337	1,043
Ward admissions	0	1,983	478	2,125	1,151	3,108	1,691	1,801	743	618
ICU admissions	0	164	85	369	333	896	420	465	131	103
Deaths	0	46	13	84	86	338	365	524	207	245

**Note that 'denominator population' refers to numbers of persons at the time when 70% threshold coverage is achieved – vaccination continues during the simulations to 80% threshold values*

Table 4.5: As for table 4.4, assuming optimal TTIQ

	<16 yrs		16-39 yrs		40-59 yrs		60+ yrs		70+ yrs	
	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac
Denominator population*	0	5,075,816	4,599,519	3,930,112	5,505,295	917,528	5,161,851	506,030	2,736,171	224,478
Symptomatic infections	0	1,606	149	487	137	250	75	33	19	6
Ward admissions	0	14	3	17	8	23	11	12	4	4
ICU admissions	0	1	1	3	3	7	3	3	1	1
Deaths	0	0	0	1	1	3	3	4	2	2

**Note that 'denominator population' refers to numbers of persons at the time when 70% threshold coverage is achieved – vaccination continues during the simulations to 80% threshold values*

Table 4.6 Cumulative symptomatic infections, ward admissions, ICU admissions and deaths over the first 180 days for the coverage threshold of 80% assuming baseline PHSM and partial TTIQ, broken down by vaccination status and age

	<16 yrs		16-39 yrs		40-59 yrs		60+ yrs		70+ yrs	
	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac
Denominator population	0	5,075,816	5,847,392	2,682,239	5,656,653	766,170	5,269,008	398,730	2,783,769	176,800
Symptomatic infections	0	135,408	11,943	37,803	11,724	20,931	6,861	3,031	1,875	587
Ward admissions	0	1,128	265	1,218	634	1,762	937	1,006	408	340
ICU admissions	0	93	46	208	180	496	228	255	70	54
Deaths	0	25	6	45	44	176	190	276	107	128

Table 4.7: As for table 4.6, assuming optimal TTIQ

	<16 yrs		16-39 yrs		40-59 yrs		60+ yrs		70+ yrs	
	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac	Vacc'd	Unvac
Denominator population	0	5,075,816	5,847,392	2,682,239	5,656,653	766,170	5,269,008	398,730	2,783,769	176,800
Symptomatic infections	0	687	57	199	56	105	31	14	8	3
Ward admissions	0	6	1	7	3	10	4	5	2	2
ICU admissions	0	1	0	1	1	3	1	1	0	0
Deaths	0	0	0	0	0	1	1	2	1	1

TECHNICAL APPENDIX

Vaccine allocation scenario

Table S1.1: Distribution of vaccination coverage by age band by achievement of the 70% vaccination coverage threshold (1st November) for standard AZ dosing indications (60+, 12 week interval between doses) and the three age-based allocation strategies.

Age band	Eligible population	Oldest first	40+ years first	All adults	Transmission reducing
16-19	1190616	4.2%	86.1%	57.1%	34.3%
20-29	3577491	18.9%	52.6%	58.8%	38.4%
30-39	3761524	74.8%	16.6%	60.6%	74.9%
40-49	3295699	90.4%	90.6%	69.0%	84.4%
50-59	3127124	92.1%	92.0%	74.6%	87.1%
60-69	2707232	87.3%	93.8%	84.0%	89.6%
70-79	1897838	96.1%	93.3%	89.4%	93.1%
80+	1062811	95.2%	83.0%	86.3%	91.2%

**Note that for the first three allocation scenarios, the date on which 70% coverage is achieved in the simulation is 1st November, compared with the 'transmission reducing' strategy for which that date is 8th November*

Table S1.2: As for Table S3.1 but for an 80% achieved coverage threshold (16+ years population)

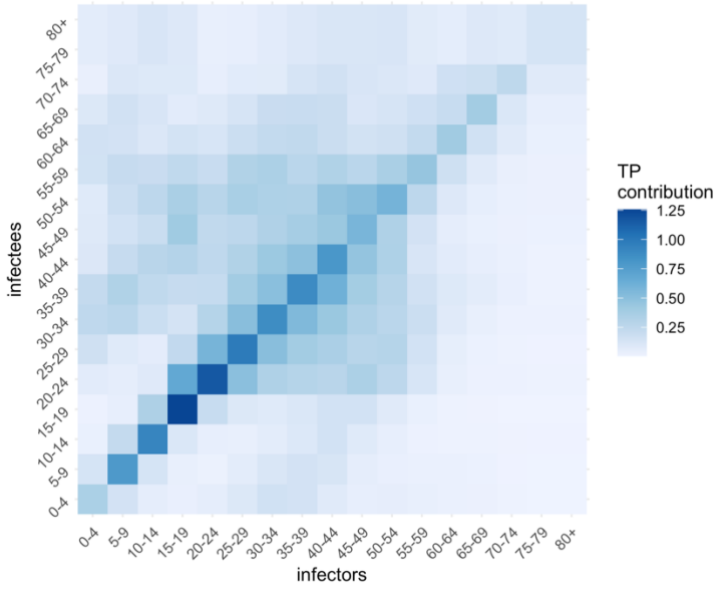
Age band	Eligible population	Oldest first	40+ years first	All adults	Transmission reducing
16-19	1190616	8.6%	86.9%	73.5%	57.1%
20-29	3577491	64.1%	87.1%	74.6%	59.7%
30-39	3761524	88.1%	41.4%	75.6%	80.6%
40-49	3295699	90.5%	90.6%	80.8%	87.0%
50-59	3127124	92.1%	92.0%	84.2%	89.2%
60-69	2707232	91.7%	94.2%	90.0%	91.8%
70-79	1897838	96.2%	95.9%	93.4%	94.6%
80+	1062811	95.2%	89.2%	91.4%	93.0%

**This coverage threshold is achieved by 22 November across all allocation strategies*

Population mixing assumptions

Population mixing within and between age groups is configured based on widely accepted social contact matrices published by Prem et al (PLoS Computational Biology 2017)(Figure S2.1). It has been expanded to include an 80+ age class (assumed to have the same mixing rates as 75-79 years). Age-specific susceptibility and transmissibility estimates from Davies et al. (Nature Medicine 2020) are used and transmission rates have been calibrated to our baseline population-wide TP (here denoted R) of 3.6. Of note, the greatest mixing intensities are anticipated between individuals aged from 15-24 years, remaining high through adults of working age. While intense school-based mixing is anticipated between children aged 5-14, the transmission matrix accounts for the relatively low observed infectiousness of this age group, associated with a high proportion of asymptomatic infections.

Figure S1.1: Age-based transmission matrix derived from Prem et al (2017)



The key message of Figure S2.1 is that in the absence of vaccination, individuals of different ages do not contribute equally to the spread of infection in the population.

The impact of vaccination on overall transmission will therefore be substantially influenced by the rate of vaccine uptake achieved **within distinct population age cohorts.** Table S3.2 shows the range of values for achieved coverage by age group underpinning 80% 'age eligible coverage' for our three hypothetical vaccine allocation strategies.

Figures S1.2-S1.5 provide a visual demonstration of the reduction in transmission achieved for each age band depending on the rollout scenario. Light grey bars show the contribution of each age group to transmission potential given different numbers of contacts and age differences in both susceptibility and infectiousness, in the absence of vaccination. Dark grey bars show the contribution of each age group to transmission potential for that vaccine allocation strategy and coverage. The 'all ages' strategy consistently produces the greatest proportional reductions in infectiousness across peak transmitting age groups.

Figure S1.2: Impact of the four different allocation strategies on TP by age category, resulting in the overall TP achieved by 50% age eligible population coverage

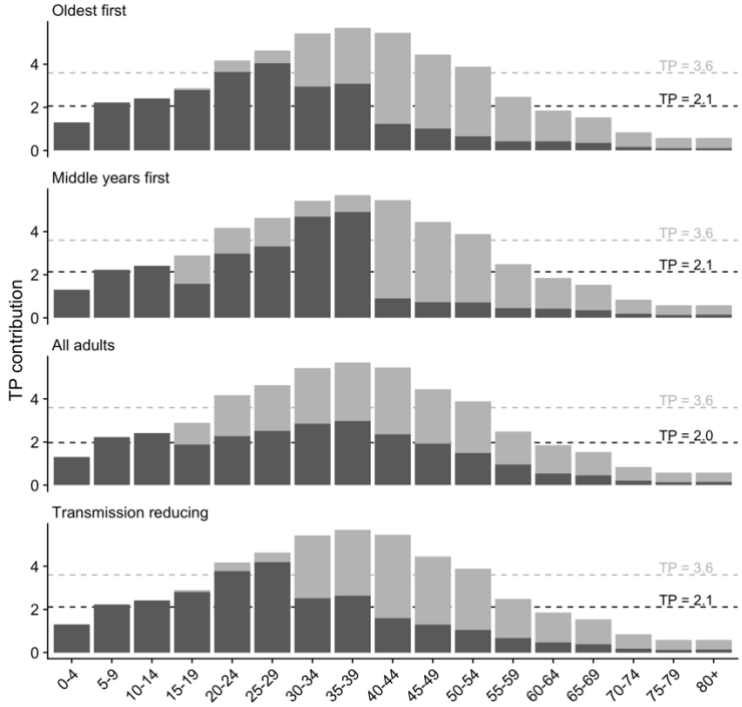


Figure S1.3: As for Figure S1.2, but for 60% age eligible population coverage

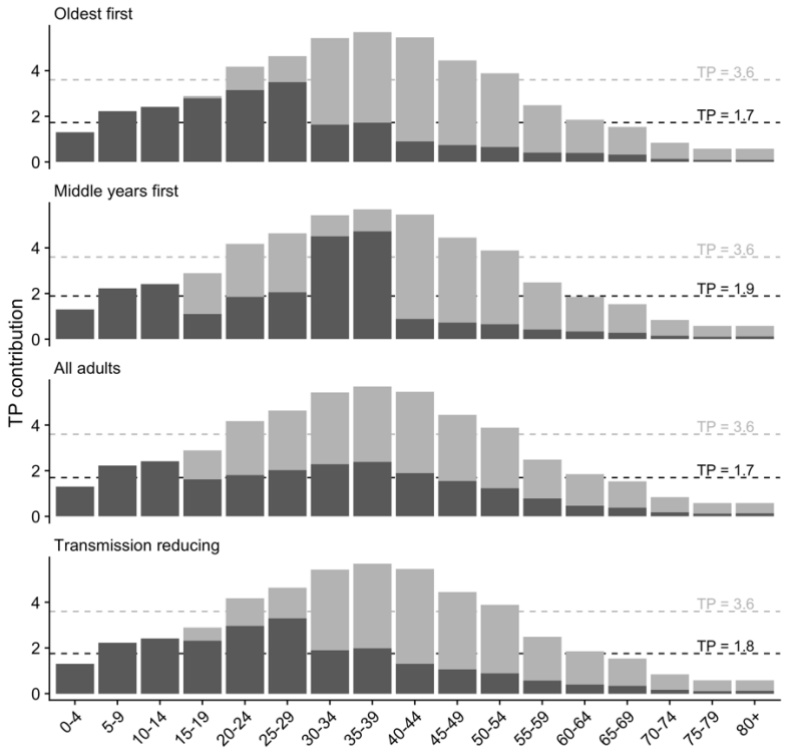


Figure S1.4: As for Figure S1.2, but for 70% age eligible population coverage

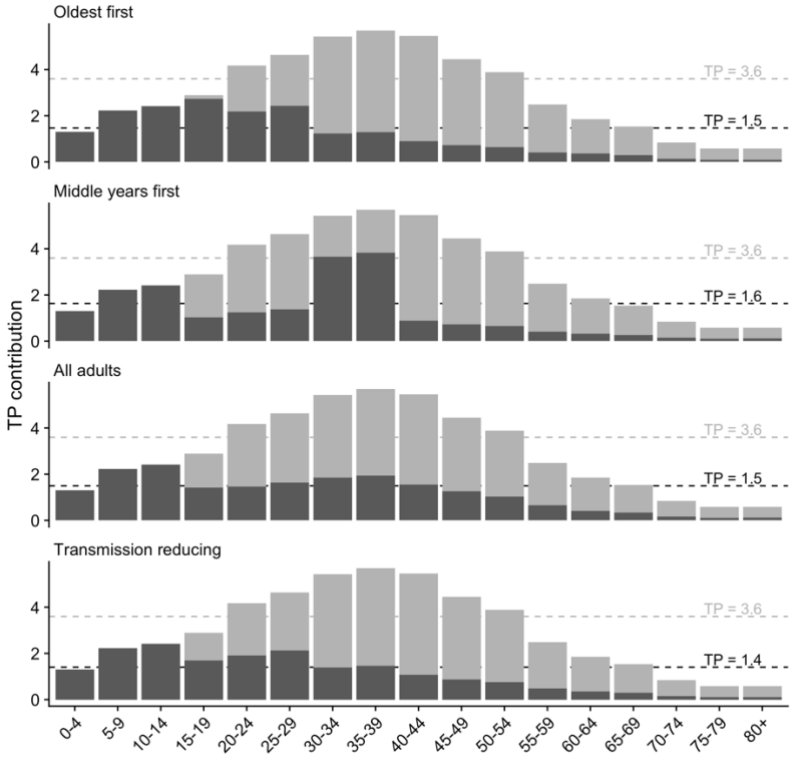
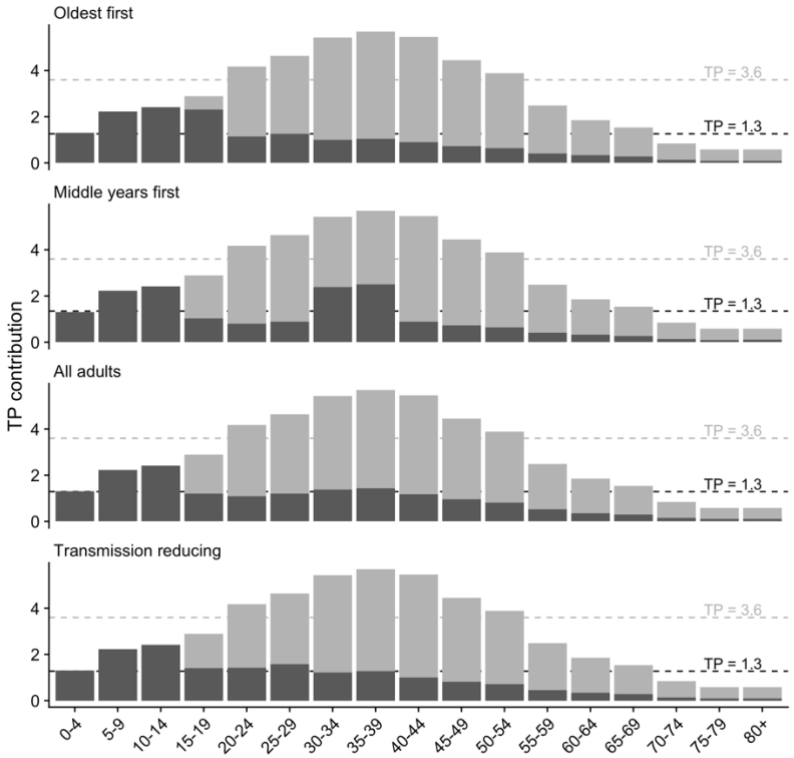


Figure S1.5: As for Figure S1.2, but for 80% age eligible population coverage



Impact of public health response and bundled social measures on TP

Table S2.2: Proportion of time lockdowns are needed to constrain transmission when the TTIQ public health response is only *partially effective,* due to high caseloads

Vaccine coverage	Allocation scenario	Low PHSMs	Medium PHSMs	High PHSMs
50%	Oldest first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	89%
	40+ years first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	93%
	All adults	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	84%
	Transmission reducing	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	92%
60%	Oldest first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	67%
	40+ years first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	78%
	All adults	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	65%
	Transmission reducing	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	69%
70%	Oldest first	Not possible to constrain outbreak with light restrictions	77%	47%
	40+ years first	Not possible to constrain outbreak with light restrictions	99%	60%
	All adults	Not possible to constrain outbreak with light restrictions	81%	49%
	Transmission reducing	Not possible to constrain outbreak with light restrictions	68%	41%

80%	Oldest first	82%	47%	29%
	40+ years first	Not possible to constrain outbreak with light restrictions	59%	36%
	All adults	89%	51%	31%
	Transmission reducing	85%	49%	30%

Table S2.3: As for Table S2.2, but for an *optimally effective* TTIQ response

Vaccine coverage	Allocation scenario	Low PHSMs	Medium PHSMs	High PHSMs
50%	Oldest first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	63%
	40+ years first	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	67%
	All adults	Not possible to constrain outbreak with light restrictions	94%	58%
	Transmission reducing	Not possible to constrain outbreak with light restrictions	Not possible to constrain outbreak with moderate lockdown	66%
60%	Oldest first	Not possible to constrain outbreak with light restrictions	67%	41%
	40+ years first	Not possible to constrain outbreak with light restrictions	86%	52%
	All adults	Not possible to constrain outbreak with light restrictions	64%	39%
	Transmission reducing	Not possible to constrain outbreak with light restrictions	71%	43%
70%	Oldest first	60%	34%	21%
	40+ years first	97%	56%	34%
	All adults	67%	38%	23%
	Transmission reducing	44%	25%	15%

80%	Oldest first	7%	4%	3%
	40+ years first	29%	17%	10%
	All adults	15%	8%	5%
	Transmission reducing	11%	6%	4%

Table S2.4: Proportion of time lockdowns are needed to constrain transmission when the TTIQ public health response is only *partially effective,* due to high caseloads, and where low PHSMs are always in place.

Vaccine coverage	Allocation scenario	Medium PHSMs	High PHSMs
50%	Oldest first	Not possible to constrain outbreak with moderate lockdown	82%
	40+ years first	Not possible to constrain outbreak with moderate lockdown	89%
	All adults	Not possible to constrain outbreak with moderate lockdown	75%
	Transmission reducing	Not possible to constrain outbreak with moderate lockdown	87%
60%	Oldest first	Not possible to constrain outbreak with moderate lockdown	49%
	40+ years first	Not possible to constrain outbreak with moderate lockdown	67%
	All adults	Not possible to constrain outbreak with moderate lockdown	46%
	Transmission reducing	Not possible to constrain outbreak with moderate lockdown	52%
70%	Oldest first	46%	18%
	40+ years first	97%	39%
	All adults	55%	22%
	Transmission reducing	25%	10%
80%	Oldest first	0%	0%
	40+ years first	4%	2%
	All adults	0%	0%
	Transmission reducing	0%	0%

Table S2.5: As for Table S2.4, but for an *optimally effective* TTIQ response

Vaccine coverage	Allocation scenario	Medium PHSMs	High PHSMs
50%	Oldest first	Not possible to constrain outbreak with moderate lockdown	42%
	40+ years first	Not possible to constrain outbreak with moderate lockdown	49%
	All adults	87%	35%
	Transmission reducing	Not possible to constrain outbreak with moderate lockdown	47%
60%	Oldest first	23%	9%
	40+ years first	66%	27%
	All adults	15%	6%
	Transmission reducing	31%	12%
70%	Oldest first	0%	0%
	40+ years first	0%	0%
	All adults	0%	0%
	Transmission reducing	0%	0%
80%	Oldest first	0%	0%
	40+ years first	0%	0%
	All adults	0%	0%
	Transmission reducing	0%	0%

Table S2.5: Description of measures implemented under PHSM 'bundles'

	High PHSM	Medium PHSM	Low PHSM	Baseline PHSM
Reference period	VIC 23 August 2020	NSW 1 July 2021	NSW 23 August 2020	NSW March 2021
Stay at home orders	• Stay-at-home except essential purposes	• Stay-at-home except for work, study and essential purposes	• No stay-at-home orders	• No stay-at-home orders
Density restrictions	• 4 sqm rule	• 2 sqm rule	• 2 sqm rule	• 2 sqm rule
Retail trade	• Non-essential retailers and venues closed to public. • Take away and home delivery only.	• Increased retail activity, subject to density restrictions • Seated dining for small groups at cafes/restaurants	• Social distancing rules apply • Larger groups allowed	• Social distancing rules apply •
Work	• Only workplaces categorised as permitted work allowed to operate on-site and subject to restrictions	• Work from home if possible, capacity limits and restrictions on office space apply	• Return to work, but social distancing and capacity restrictions on office space apply	• 1.5 sqm rule
Schools and childcare	• Closed – remote learning only	• Closed or graduated return	• Open	• Open
Capacity restrictions	• No gatherings - Non-essential venues etc closed.	• Indoor venues closed. • Capacity limits restricted to small groups outdoors	• Recreational activities allowed and venues open but social distancing and capacity limits apply	• Large sporting venues to operate at 70 per cent capacity
Travel restrictions	• Essential movements only within 5 or 10 km radius • No intra- or inter-state travel	• Non-essential travel limited – no intra or inter-state travel •	• No travel restrictions • Interstate travel allowed	• No travel restrictions • Interstate travel allowed
Other	• Curfew • No household visitors and 2-person limit on exercise	• 5 visitors to household and limited outdoor gatherings e.g., 10 people	• Requirements for record keeping, COVID-safe plans etc	•