Australian Government

DOHERTY INSTITUTE MODELLING BY JURISDICTION SIZES

On the 1st of October 2021, the Doherty Institute provided to the National Cabinet updated COVID-19 outbreak and health system capacity scenario modelling for each jurisdiction.

It should be noted that:

1. Severity parameters used in Doherty Institute ICU and ward admission modelling are regularly updated, and the figures that follow reflect COVID-19 Delta variant severity parameters as of September 2021 (documented in Table S1). The estimates presented in this modelling anticipated more severe clinical outcomes than were in both the initial Doherty Institute threshold modelling and in further work released in November 2021. Doherty Institute work released in November 2021 incorporates more recent updates to severity parameters, which are available at: https://www.doherty.edu.au/uploads/content_doc/AttachmentF_ParameterUpdates.pdf.
2. Other than population sizes for each jurisdiction, demography parameters used are National parameters, and do not account for intra-jurisdictional differences including population densities (city/regional/remote) and vaccination coverage. The model also does not account for inter-jurisdictional patient flows.
3. Jurisdictions continue to revise their Surge and Living with COVID hospital capacities, and the figures that follow use capacities confirmed by jurisdictions as of 24th September 2021. Updates may have occurred to these capacities after 24th September 2021.
4. COVID-19 Vaccination rates across some jurisdictions have increased substantially since the modelling was conducted. Further, the modelling does not consider the impact of COVID-19 vaccination booster doses.

Key messages

As anticipated, smaller jurisdictions are more likely to experience acute clinical load stress, including periods of time where surge capacity may be exceeded. These challenges are exacerbated when transition (at either 70 or 80% 2-dose vaccinated) occurs at higher initial case numbers.

Larger jurisdictions may also exceed "living with COVID" capacity at the height of epidemic activity, particularly when initial case numbers are higher, although surge capacity is unlikely to be challenged.

Definitions

- **PHSM** – Public health and social measures
- **Baseline PHSM** – No stay-at-home-orders, low density requirements, no retail restrictions, schools open.
- **Low PHSM** – As per baseline PHSM, but with capacity limits on recreational activities, limits on retail group sizes and restrictions on workplace capacity.
- **Medium PHSM** – Stay-at-home except for work, study and essential purposes, retail and cafes/restaurants open subject to density restrictions, working from home if possible with density restrictions in workplaces. Indoor recreational venues closed, small numbers of household visitors allowed. Closed or graduated return to schools.
- **TTIQ** – Test, trace, isolate, quarantine
- **Partial TTIQ** – The observed reduction in transmission (43%) resulting from test-trace-isolate-quarantine responses at the height of the Victorian 'second wave' in 2020 when case numbers were in the hundreds per day and the system was under strain resulting in delays.
- **Daily new infections at time of achieving threshold** – The initial number of daily cases present in the population at a given vaccination threshold.
    - **Low** – ranging from 30–100 cases per day
    - **Medium** – ranging from 300–1000 cases per day
    - **High** – ranging from 1,000–4,500 cases per day

Background

On the 1st of October 2021, National Cabinet considered advice from the Department of Health with supporting evidence from the Doherty Institute on anticipated per jurisdiction clinical outcomes associated with epidemic simulations under the National Plan to Transition Australia's National COVID Response.

For each jurisdiction, we have identified the most likely initial case numbers and corresponding possible response strategies (Table 1). Results are provided in the accompanying jurisdiction-by-jurisdiction data appendices.

Limitations

These analyses adjust for jurisdiction population size and anticipated initial case numbers. However, they do not adjust for a number of factors that we anticipate to be important, including:

- demography and the associated age-distribution of vaccine coverage at the time of achieving the threshold coverage (70 or 80% 2-dose vaccinated); and
- anticipated differences in the initial transmission potential by jurisdiction; and
- anticipated differences in the achievable reduction in transmission potential of the suite of PHSMs that may be enacted in response to transmission.

These factors, as well as emerging and updated evidence on clinical severity and vaccine efficacy, are only able to be accounted for through continued situational assessment and real-time epidemiological surveillance.

Table 1. Scenarios considered in this report.

Jurisdiction	Pop size ('000)	Daily new infections at time of achieving threshold	Vaccine coverage threshold (%)	Level of PSHM and TTIQ
NSW	8176.4	Medium = 300–1000	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
		High = 1000–4500	70	Med/Low + Partial
Victoria	6648.6	Medium = 300–1000	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
		High = 1000–4500	70	Med/Low + Partial
Queensland	5206.4	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
		Medium = 300–1000	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
Western Australia	2675.8	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
South Australia	1771.7	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
Tasmania	542.0	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial

Jurisdiction	Pop size ('000)	Daily new infections at time of achieving threshold	Vaccine coverage threshold (%)	Level of PSHM and TTIQ
ACT	431.8	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
		Medium= 300–1,000	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial
NT	247.0	Low = 30–100	70	Baseline + Partial
				Low + Partial
			80	Baseline + Partial
				Low + Partial

Table S1. Disease severity assumptions for unvaccinated individuals

Parameter	Description	Source	Value(s)
Wildtype severity parameters			
Pr(symptoms|wt)	Probability of symptomatic disease given wildtype infection	Davies et al. Nature Medicine (2020) [1] Clinical fractions estimated for 10-year age groups.	Age group: Symptomatic fraction 0–9: 0.28 10–19: 0.20 20–29: 0.26 30–39: 0.33 40–49: 0.40 50–59: 0.49 60–69: 0.63 70+: 0.69
Pr(hosp|symptoms)	Probability of hospital admission given symptomatic wildtype infection	Knock et al. Pre-print [2]. Prepared for UK roadmap modelling by Imperial group. UK data first wave.	Age-specific. See Tables S6 and S8 of Knock et al.
Pr(ICU|hosp)	Probability of ICU admission given hospital admission	Same as above.	Same as above.
Pr(death|ward)	Probability of death for ward patients (no ICU stay)	Same as above.	Same as above.
Pr(death|ICU)	Probability of death for ICU patients	Same as above.	Same as above.
Pr(death|post-ICU ward)	Probability of death for post-ICU patients	Same as above.	Same as above.

Parameter	Description	Source	Value(s)
Alpha severity parameters (versus wildtype)			
Pr(symptoms|alpha)	Probability of symptomatic disease given Alpha infection	A number of studies using UK data suggest that the probability of reporting symptoms is consistent for wildtype and Alpha Walker et al. Pre-print [3]. Graham et al. Lancet Public Health (2021) [4].	RR=1
Pr(hosp|alpha)	Probability of hospitalisation given Alpha infection	Bager et al. Lancet Infect Dis (2021) [5]. Denmark data.	OR=1.42
Pr(ICU|alpha)	Probability of ICU admission given Alpha infection	Patone et al. Lancet ID [6]. UK data.	HR=2.15
Pr(death|alpha)	Probability of death given Alpha infection	Davies et al. Nature (2021) [7]. UK data.	HR=1.61
Delta severity parameters (versus Alpha)			
Pr(hosp|delta)	Probability of hospitalisation given Delta infection	Bager et al. Lancet ID (2021) [8]. Denmark data.	RR = 3.01
Pr(ICU|delta	Probability of ICU admission given Delta infection	Fisman & Tuite. Pre-print [10]. Canada data.	OR = 1.86
Pr(death|delta)	Probability of death given Delta infection	Fisman & Tuite. Pre-print [10]. Canada data.	OR = 1.51

References

Davies NG et al. Age-dependent effects in the transmission and control of COVID-19 epidemics. *Nat Med*. 26, 1205–11 (2020). https://doi.org/10.1038/s41591-020-0962-9

Knock ES et al. The 2020 SARS-CoV-2 epidemic in England: key epidemiological drivers and impact of interventions. *medRxiv* (2021). https://doi.org/10.1101/2021.01.11.21249564

Walker AS et al. Increased infections, but not viral burden, with a new SARS-CoV-2 variant. *medRxiv* (2021). https://doi.org/10.1101/2021.01.13.21249721

Graham MS et al. Changes in symptomatology, reinfection, and transmissibility associated with the SARS-CoV-2 variant B.1.1.7: an ecological study. *Lancet Public Health* 2021; 6: e335–45. https://doi.org/10.1016/S2468-2667(21)00055-4

Bager P et al. Risk of hospitalisation associated with infection with SARS-CoV-2 lineage B.1.1.7 in Denmark: an observational cohort study. *Lancet Infect Dis* 2021. S1473-3099(21)00290-5. https://doi.org/10.1016/S1473-3099(21)00338-8

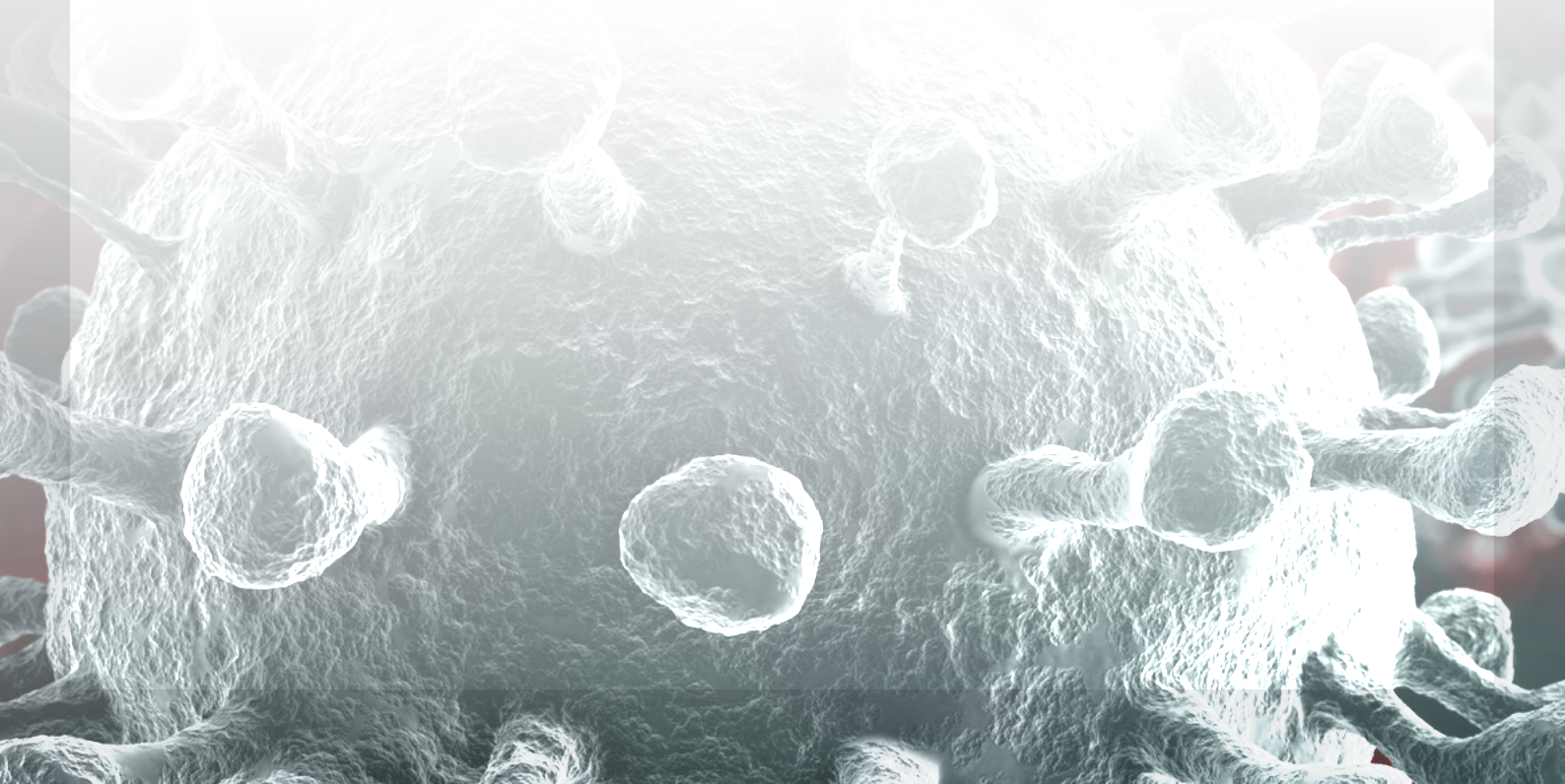
Patone M et al. Mortality and critical care unit admission associated with the SARS-CoV-2 lineage B.1.1.7 in England: an observational cohort study. *Lancet Infect Dis* 2021. https://doi.org/10.1016/S1473-3099(21)00318-2

Davies NG et al. Increased mortality in community-tested cases of SARS-CoV-2 lineage B.1.1.7. *Nature*. 2021. https://doi.org/10.1038/s41586-021-03426-1

Bager P, et al. Hospitalisation associated with SARS-CoV-2 delta variant in Denmark. *Lancet Infect Dis* (2021). https://doi.org/10.1016/S1473-3099(21)00580-6

Twohig KA, et al. 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 Infect Dis* (2021). https://doi.org/10.1016/S1473-3099(21)00475-8

Fisman DN & Tuite AR. Progressive increase in virulence of novel SARS-CoV-2 variants in Ontario, Canada. *medRxiv* (2021). https://doi.org/10.1101/2021.07.05.21260050



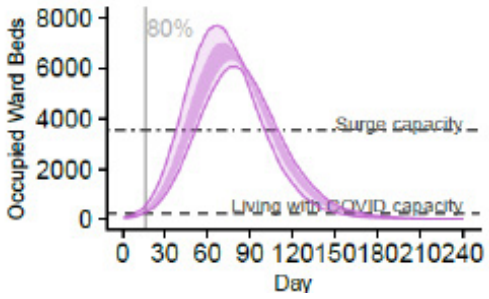
New South Wales

Population size 8,176,400

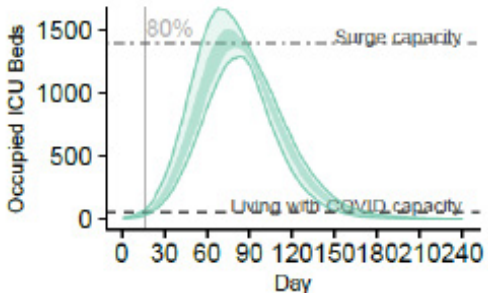
NSW Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial

Ward Occupancy



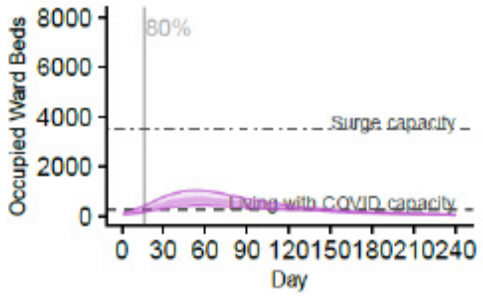
ICU Occupancy



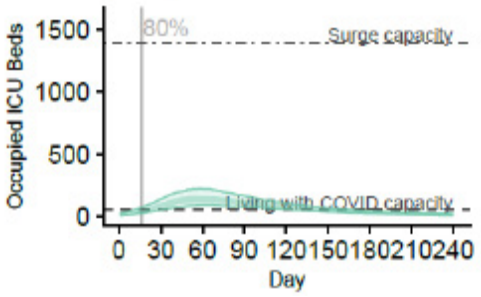
NSW Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial

Ward Occupancy



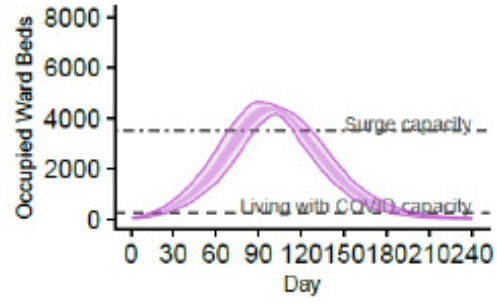
ICU Occupancy



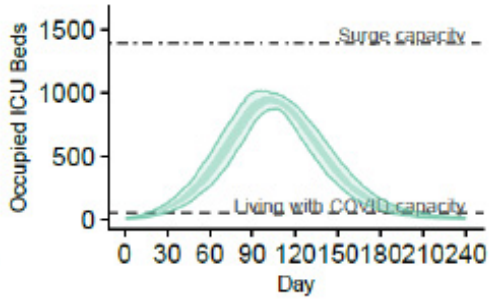
NSW Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial

Ward Occupancy



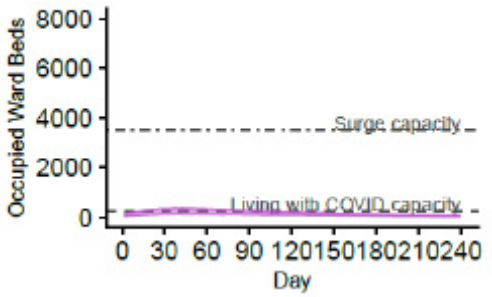
ICU Occupancy



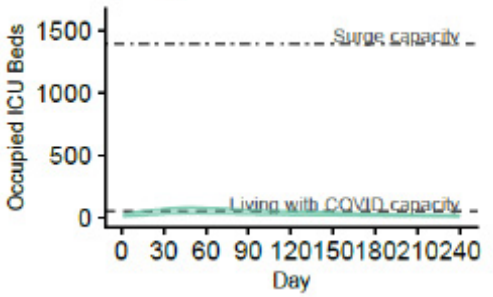
NSW Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial

Ward Occupancy



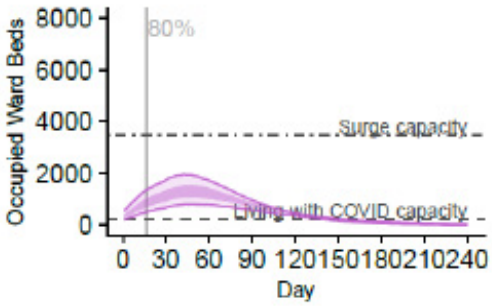
ICU Occupancy



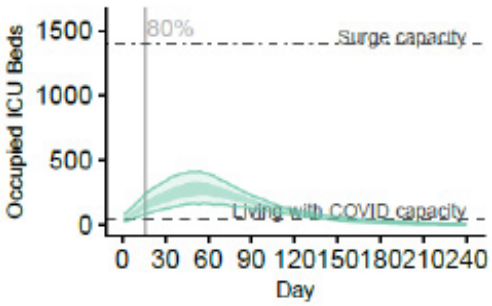
NSW Scenario 5:

Vaccination	70%	PHSM	Medium, shifting to Low at 80% vaccination
Daily infections at transition	High 1000–4500	TTIQ	Partial

Ward Occupancy



ICU Occupancy



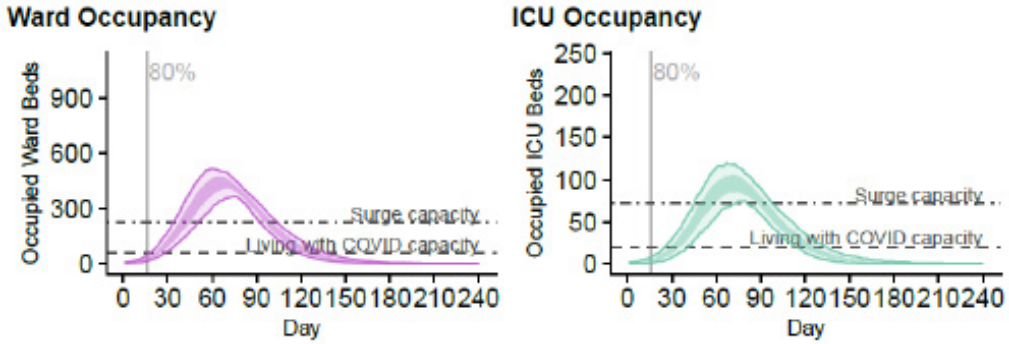
Australian Capital Territory

Population size 431,800

Note: ACT Health also serves significant parts of NSW and the true health system demand population size is therefore greater than 431,800.

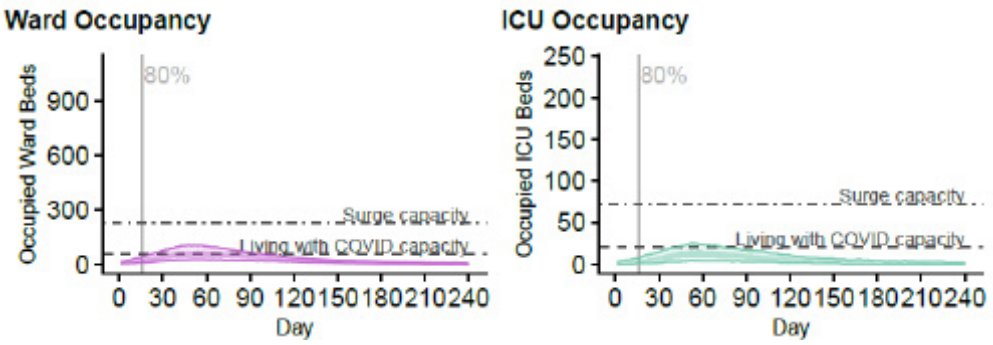
ACT Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



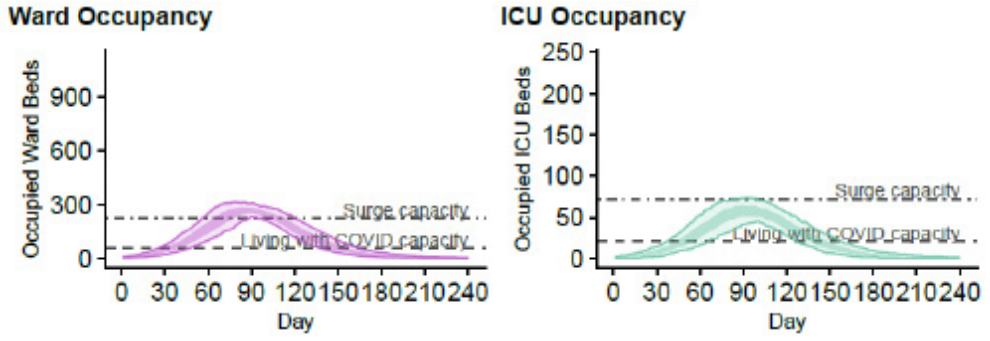
ACT Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



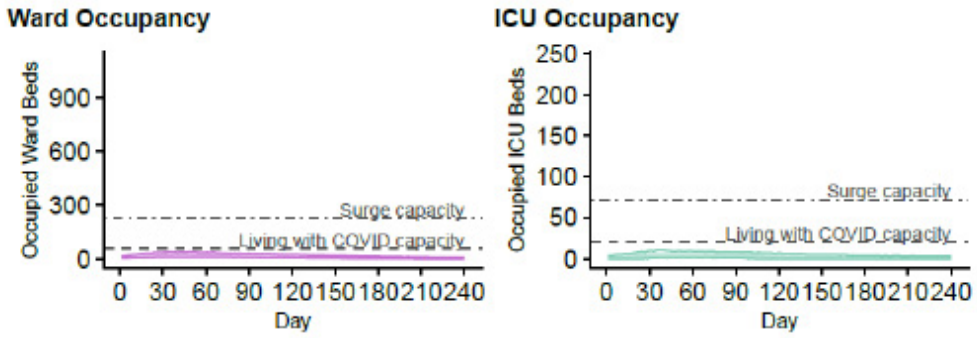
ACT Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



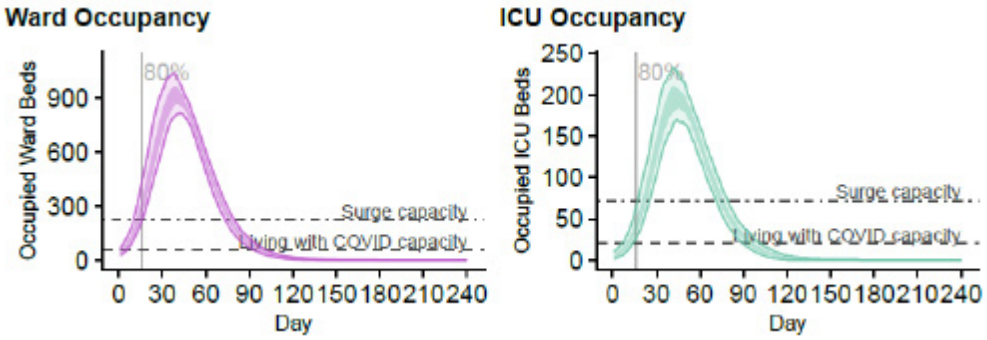
ACT Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



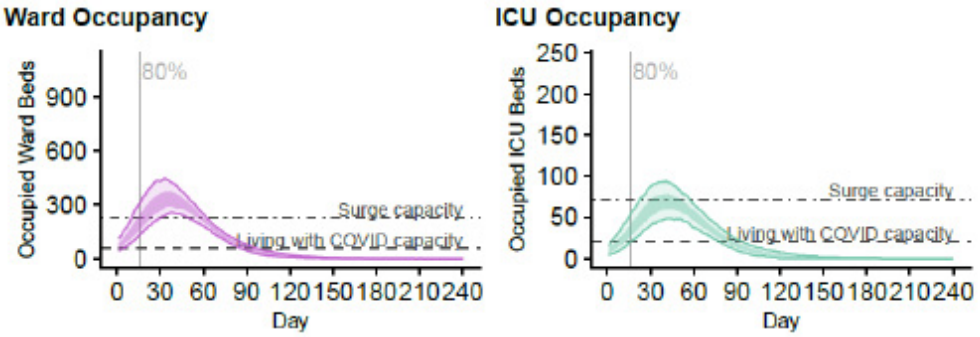
ACT Scenario 5:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



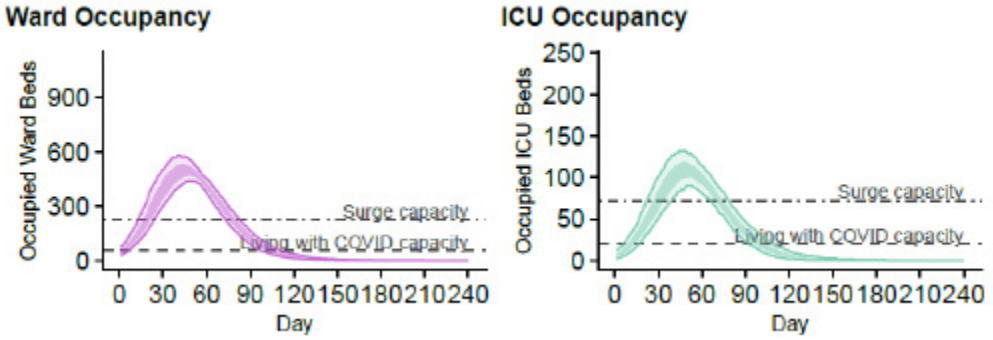
ACT Scenario 6:

Vaccination	70%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial



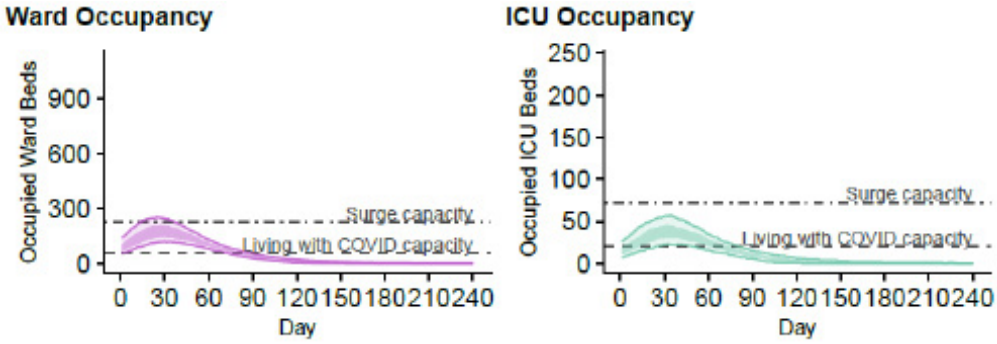
ACT Scenario 7:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



ACT Scenario 8:

Vaccination	80%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial

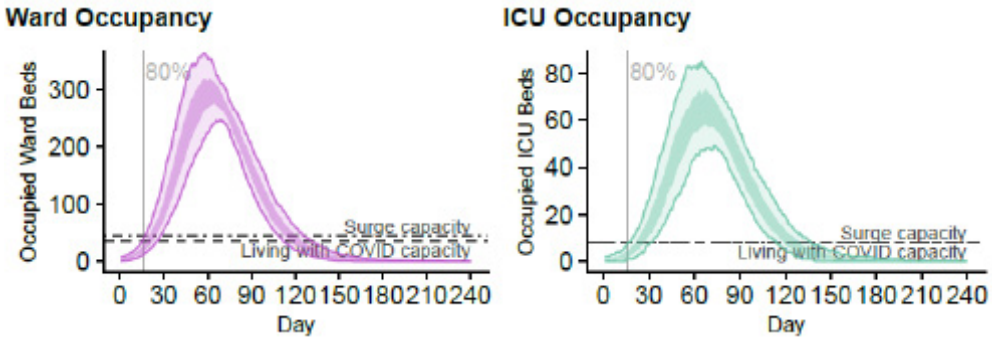


Northern Territory

Population size 247,000

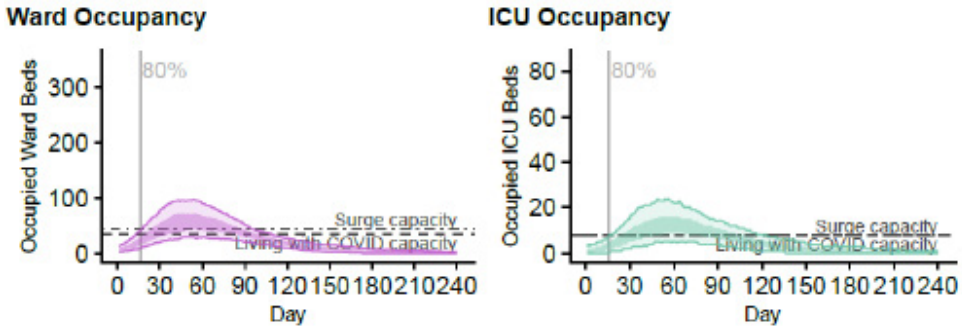
NT Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



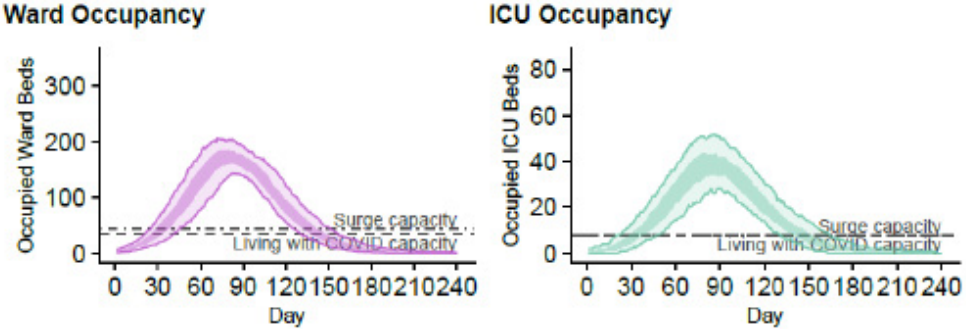
NT Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



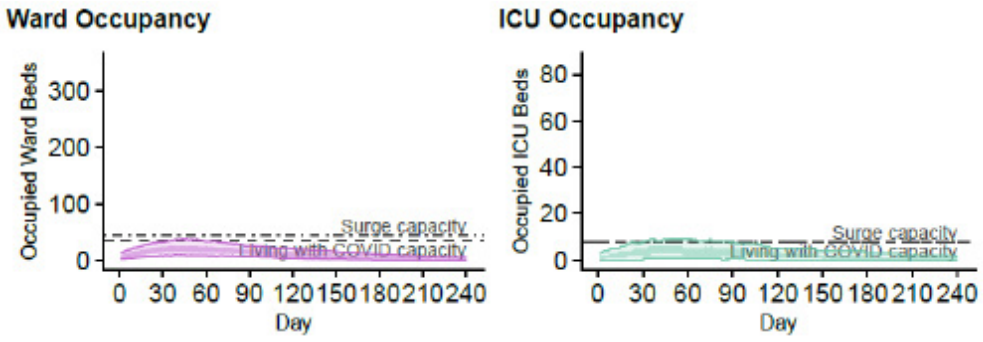
NT Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



NT Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial

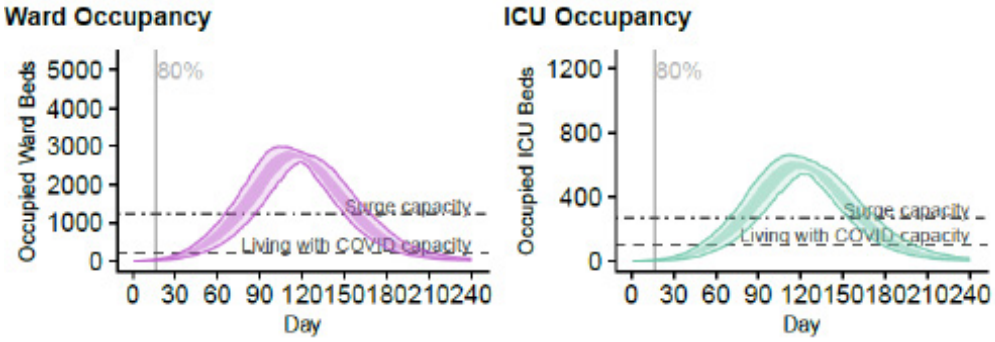


Queensland

Population size 5,206,400

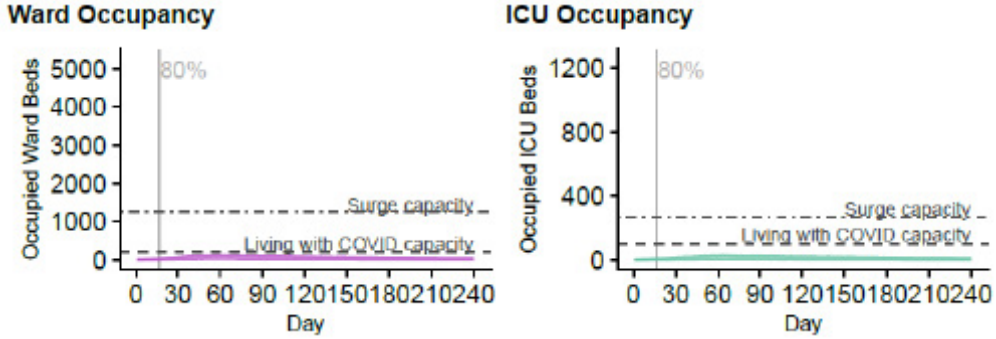
QLD Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



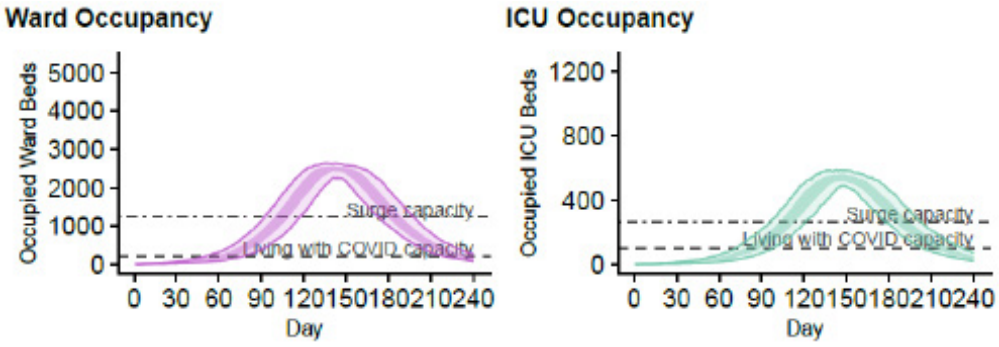
QLD Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



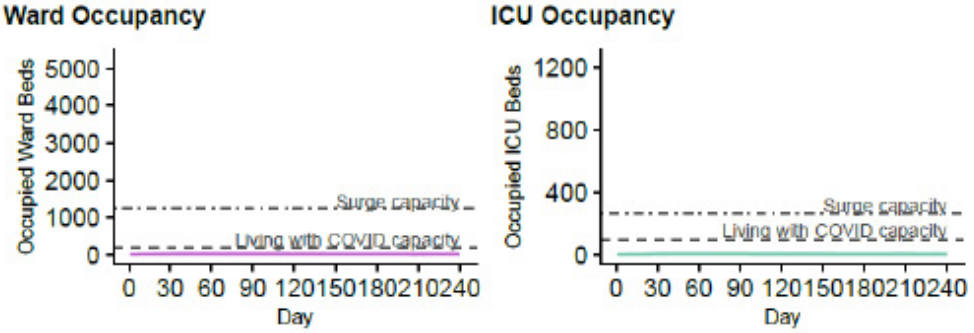
QLD Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



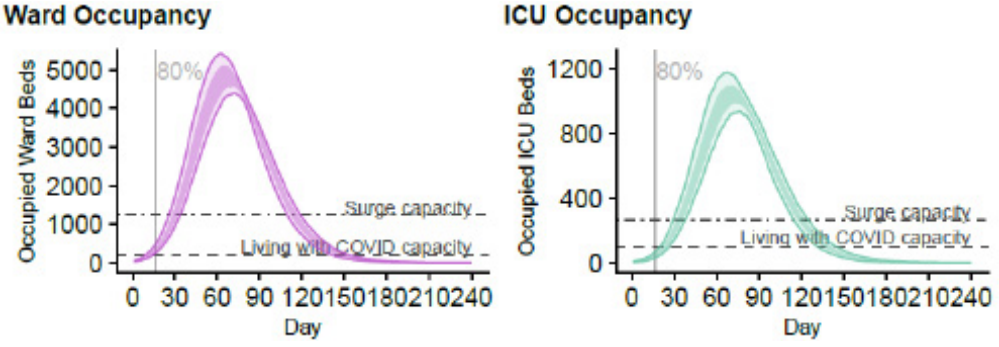
QLD Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



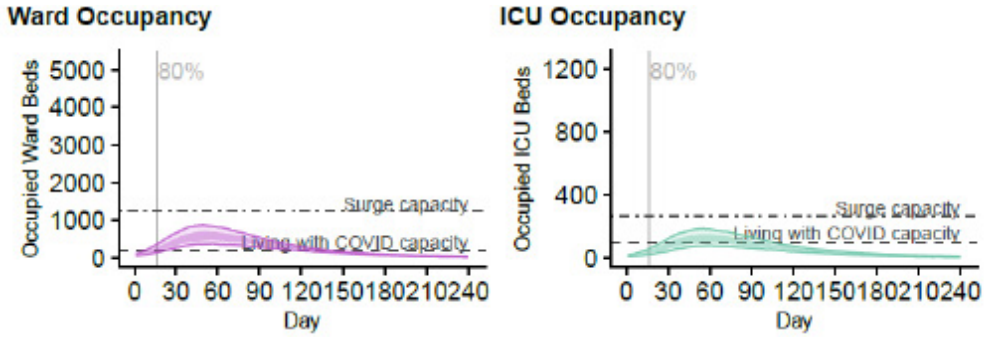
QLD Scenario 5:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



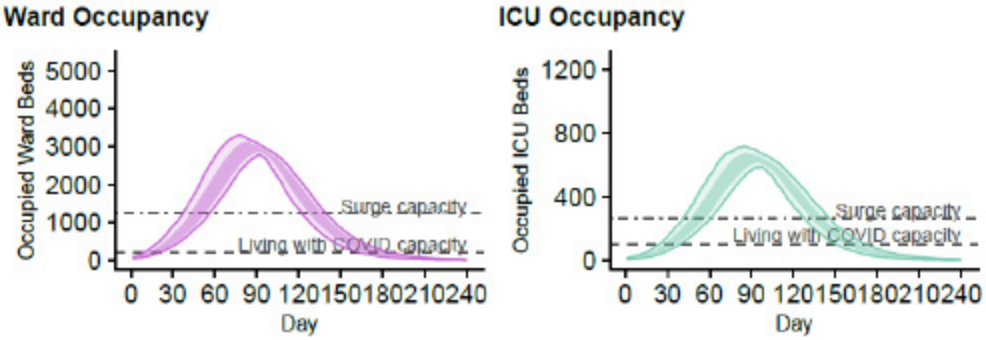
QLD Scenario 6:

Vaccination	70%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial



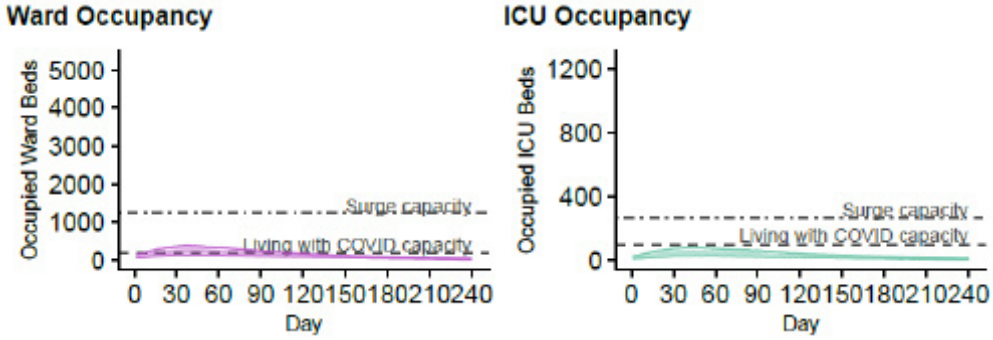
QLD Scenario 7:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



QLD Scenario 8:

Vaccination	80%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial

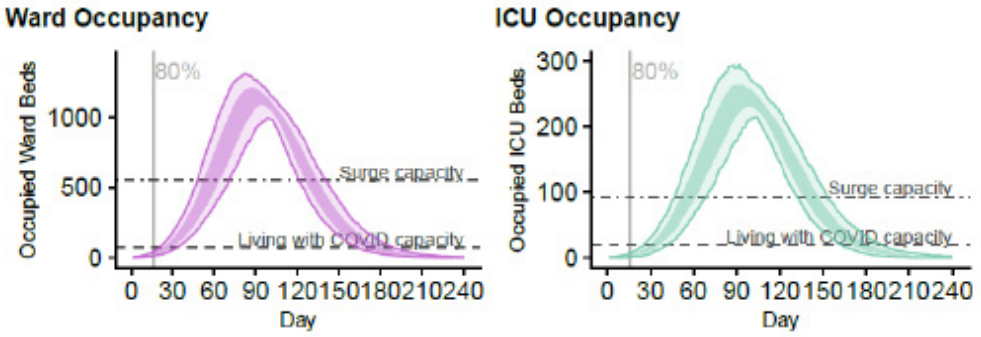


South Australia

Population size 1,771,700

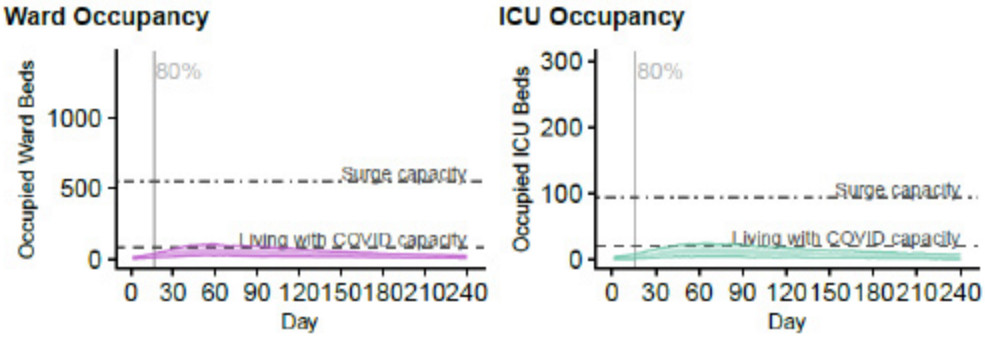
SA Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



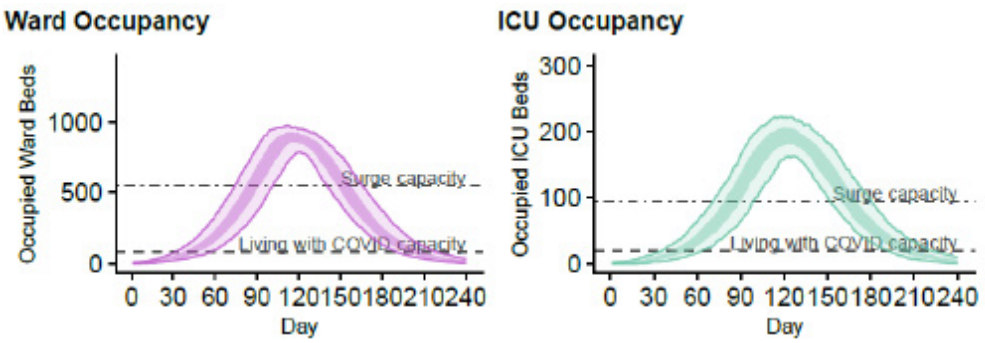
SA Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



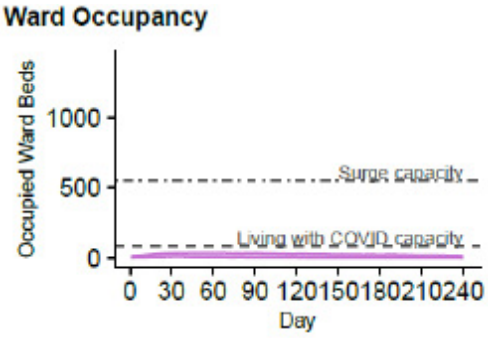
SA Scenario 3:

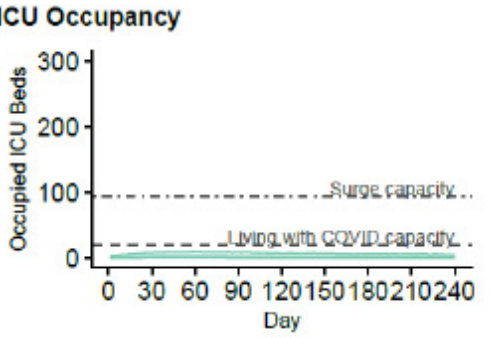
Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



SA Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial





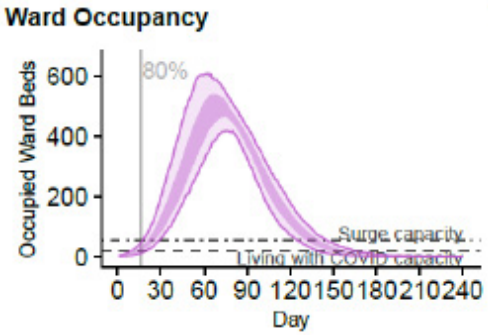
Tasmania

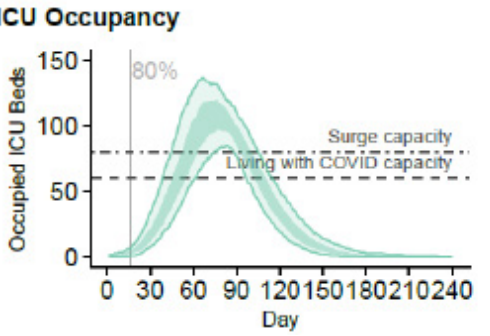
Population size 542,000

Note: Tasmania have indicated amendments will be made to capacities – particularly an increase in Surge capacity on Wards, since capacities were confirmed on 24th September 2021 for the production of these figures.

TAS Scenario 1:

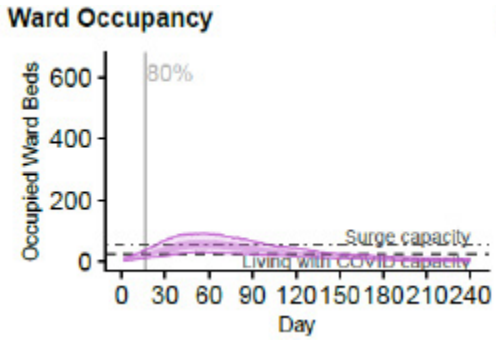
Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial

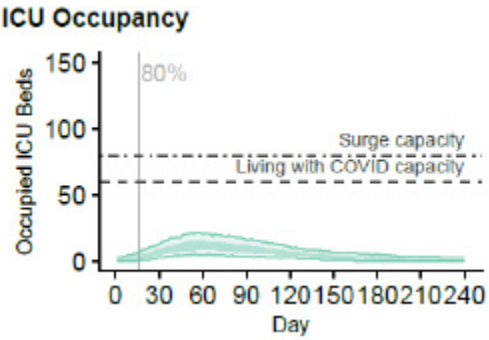




TAS Scenario 2:

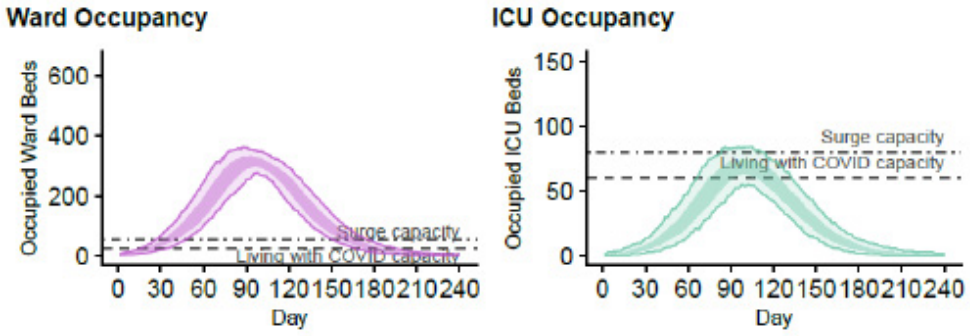
Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial





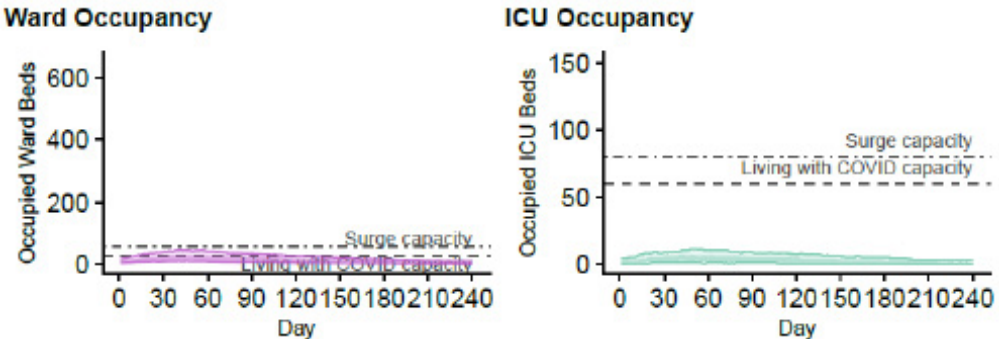
TAS Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



TAS Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial

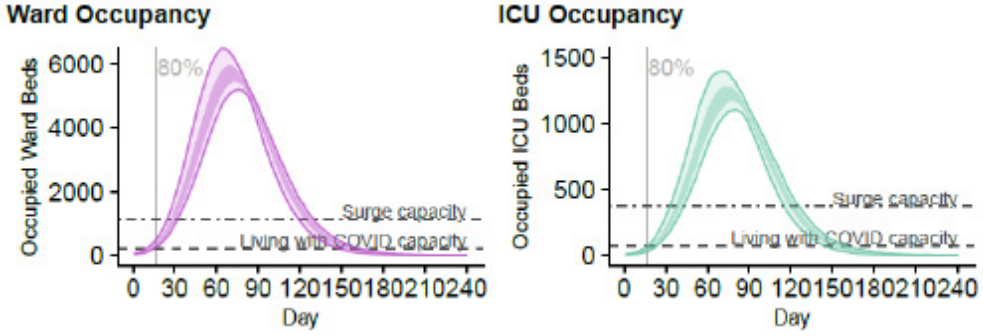


Victoria

Population size 6,648,600

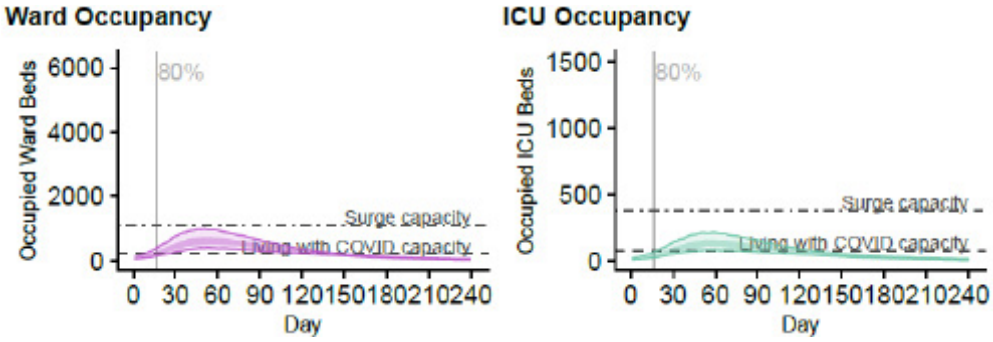
VIC Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



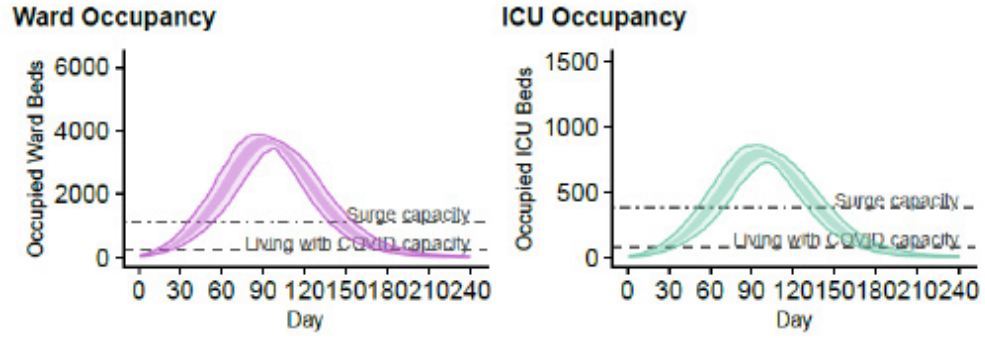
VIC Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial



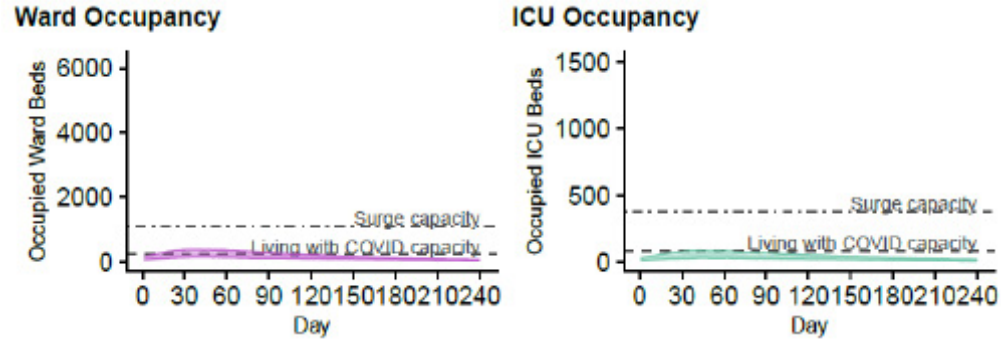
VIC Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Medium 300–1000	TTIQ	Partial



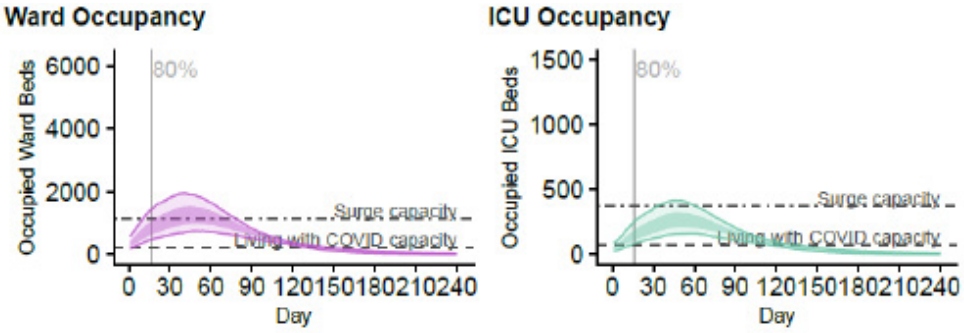
VIC Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Medium 300–1000	TTIQ	Partial



VIC Scenario 5:

Vaccination	70%	PHSM	Medium, shifting to Low at 80% vaccination
Daily infections at transition	High 1000–4500	TTIQ	Partial

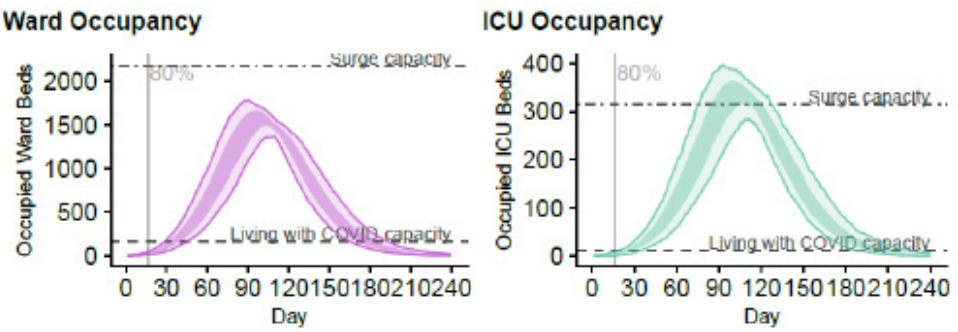


Western Australia

Population size 2,675,800

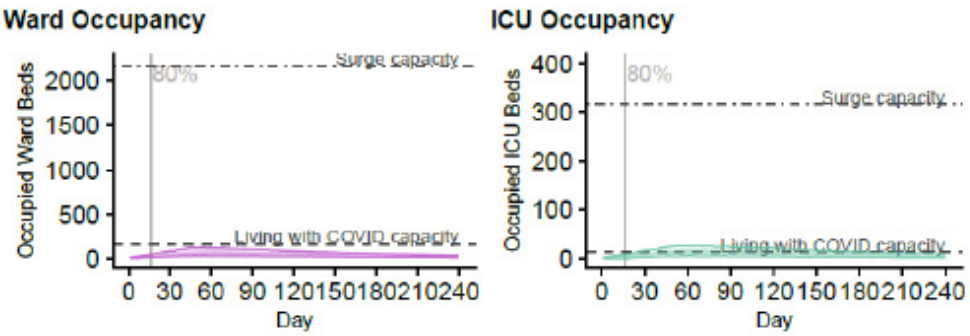
WA Scenario 1:

Vaccination	70%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



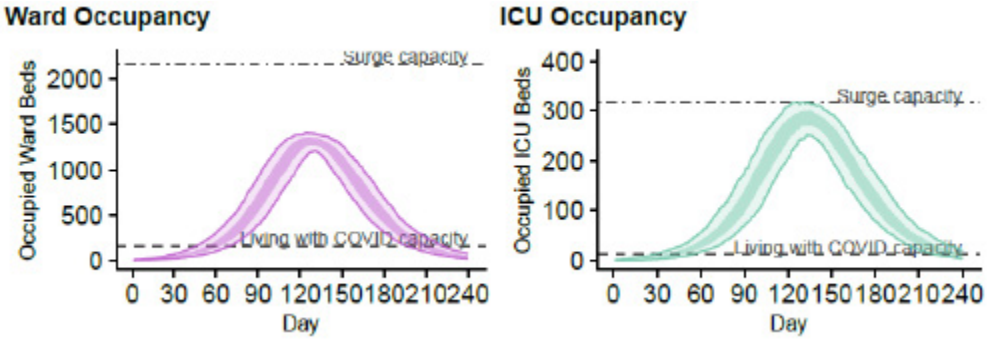
WA Scenario 2:

Vaccination	70%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial



WA Scenario 3:

Vaccination	80%	PHSM	Baseline
Daily infections at transition	Low 30–100	TTIQ	Partial



WA Scenario 4:

Vaccination	80%	PHSM	Low
Daily infections at transition	Low 30–100	TTIQ	Partial