Estimating cases for COVID-19 in South Africa Update: 19 May 2020

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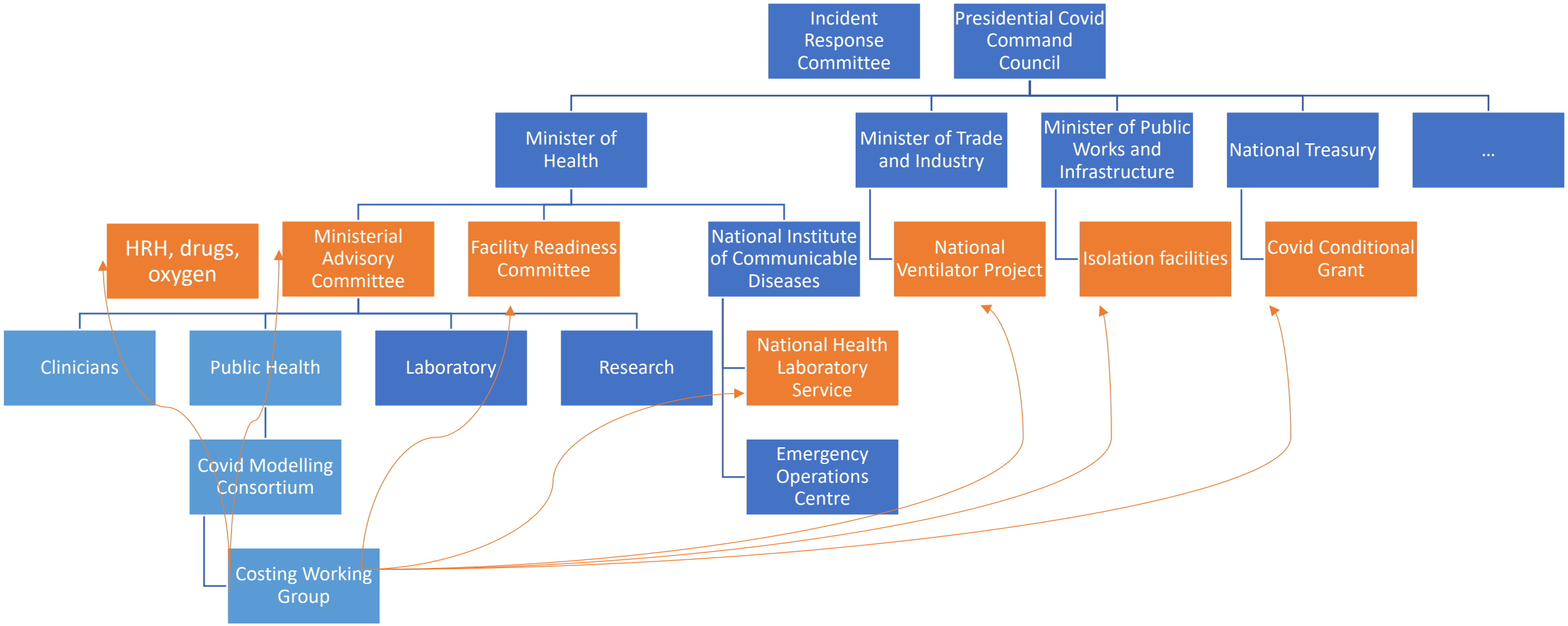
Introduction

- South African COVID-19 Modelling Consortium
- Uncertainty regarding both the true scale and spatial distribution as a result of PUI criteria and testing coverage
- Models developed by MASHA, SACEMA and HE2RO in conjunction with the NICD
- Extensive and ongoing input from clinicians, virologists, intensivists and epidemiologists to refine key model assumptions and parameters
- Projections will be updated weekly

Projections in Context

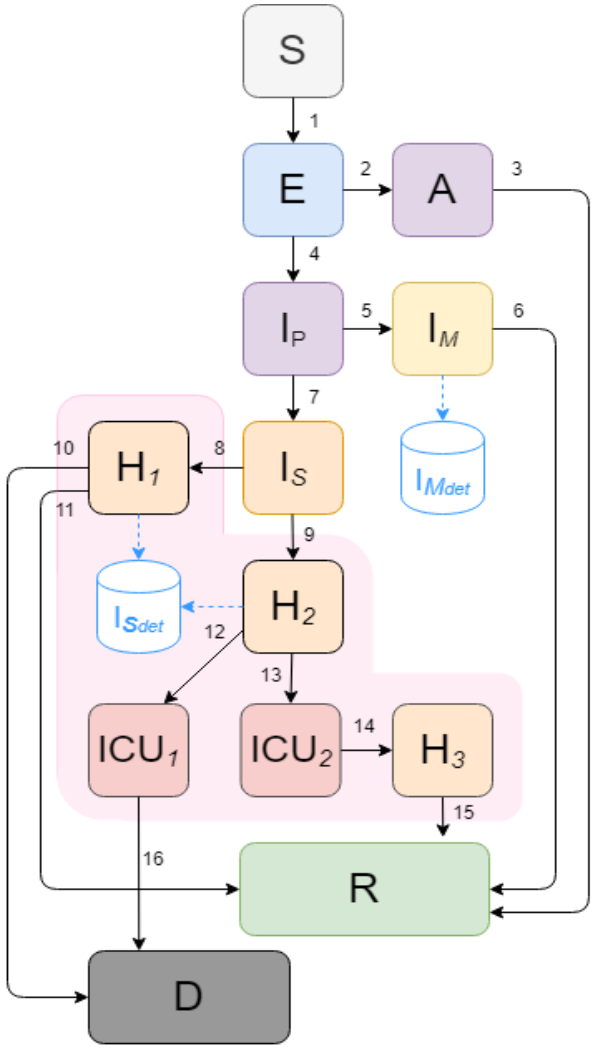
- Projections at a population level do not capture clustering of cases
  - E.g. Sharp increases in cases in the Eastern Cape
  - A spatial model with additional granularity is required (forthcoming)
- Models project total need for hospital beds and ICU beds
  - Do not account for stricter criteria to entry and existing capacity
- Population behaviour/response to mortality
  - Lessons from Ebola epidemic (adaptive behaviour to decrease mortality)
- Projections will improve with new data
  - Hospitalisation (public and private)
  - Length of stay
- Short term vs Long term Projections

Users of model outputs



National COVID Models

- National COVID-19 Epi Model
  - Generalised SEIR model
  - Disease severity (asymptomatic, mild, severe, critical)
  - Treatment pathway (outpatients, non-ICU, ICU)
- National COVID-19 Cost Model
  - Inputs from a range of resources to represent the type, number and price of ingredients to cost response
- Inform resource requirements and predict where gaps may arise based on available resources



Susceptible

Exposed (not infectious)

Infected, asymptomatic (A)

Infected, pre-symptomatic (Ip)

Infected, mild

Infected, severe, untreated

Hospitalised

- Infected, severe, general ward (H_1)
- Infected, severe, general ward pre-ICU (H_2)
- Infected, critical, high care/ICU (ICU_1 & ICU_2)
- Infected, severe, general ward post-ICU (H_3)

Removed (non-infectious/discharged)

Died

Detection (laboratory confirmed cases)

1. Force of infection
2. Latent period till asymptomatic infectiousness
3. Duration of asymptomatic infectiousness
4. Latent period till pre-symptomatic infectiousness
5. Mild cases
6. Duration of infectiousness (mild cases)
7. Severe cases
8. Hospitalisation of severe cases
9. Hospitalisation of critical cases (prior to ICU)
10. Mortality (severe, hospitalised cases)
11. Duration of hospitalisation (severe cases)
12. Progress from severe to critical (ICU admission)
13. Progress from severe to critical (ICU admission)
14. Duration of ICU stay for survivors
15. Duration of hospitalisation post-ICU
16. Mortality (critical, ICU cases)

Two scenarios

Assumption: Level 4 continues until 31 May followed by social distancing measures

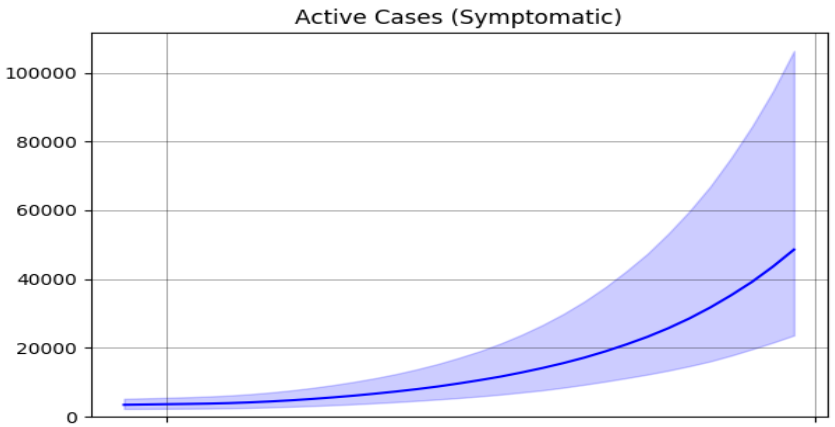
Optimistic scenario

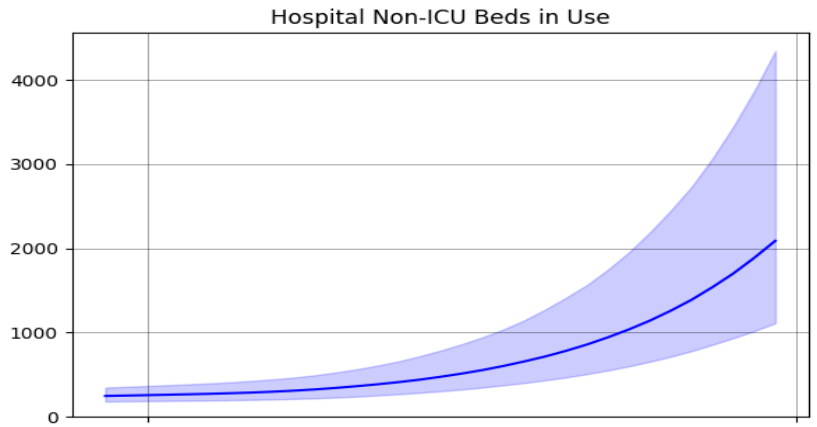
- Lockdown reduced transmissibility by **60%**
- Level 4 from 1 May to 31 May: **35%**
- Social distancing measures after 31 May reduces transmissibility by **20%**

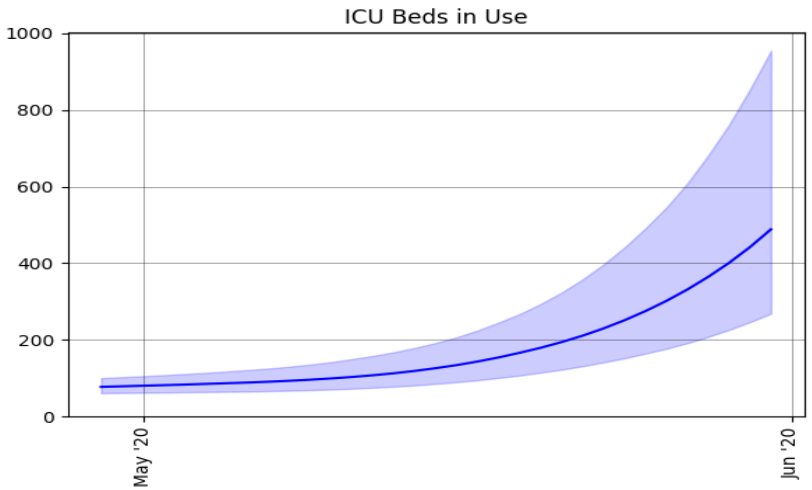
Pessimistic scenario

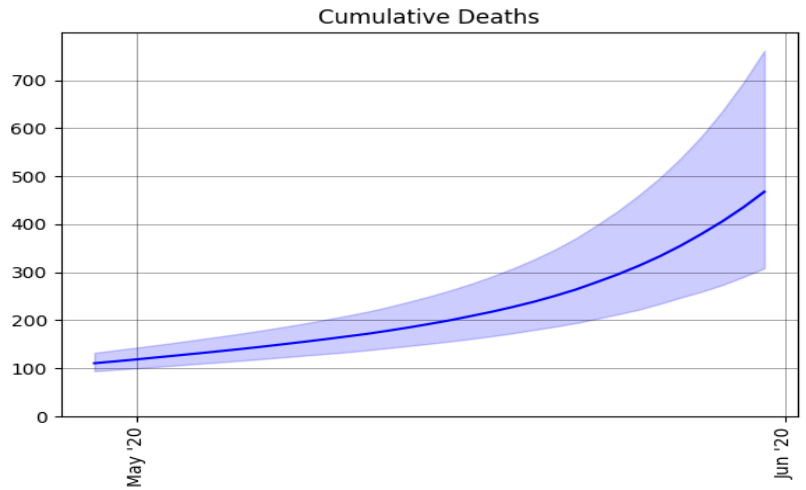
- Lockdown reduced transmissibility by **40%**
- Level 4 from 1 May to 31 May: **25%**
- Social distancing measures after 31 May reduces transmissibility by **10%**

Short-term projections









Detected Cases:
30, 433 (18,710, 54,540)

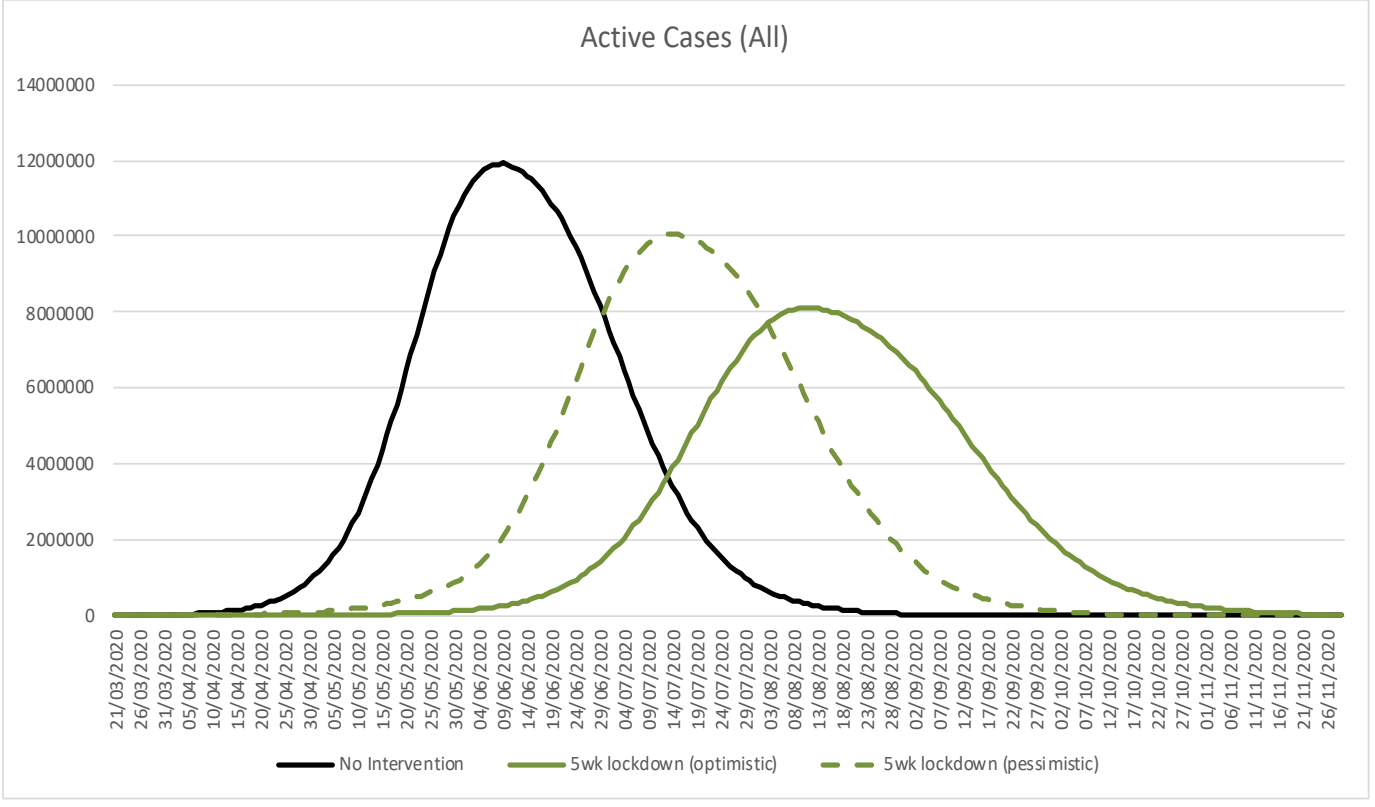
ICU bed threshold (~3,300 beds)

Long-term projections

NATIONAL

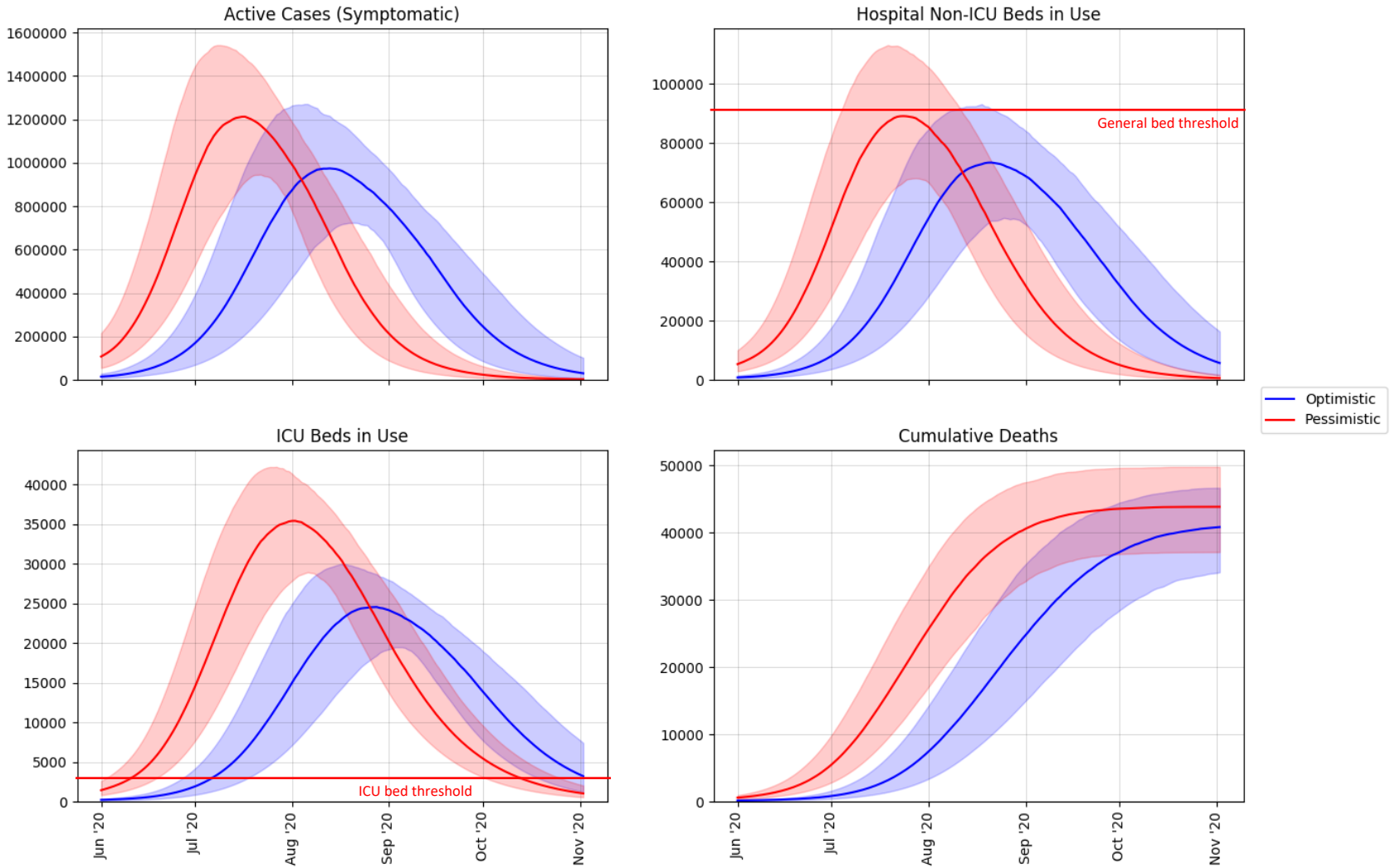
Long-term projections: Impact of lock-down

- Greater uncertainty
- Lockdown has flattened the curve and pushed the peak later



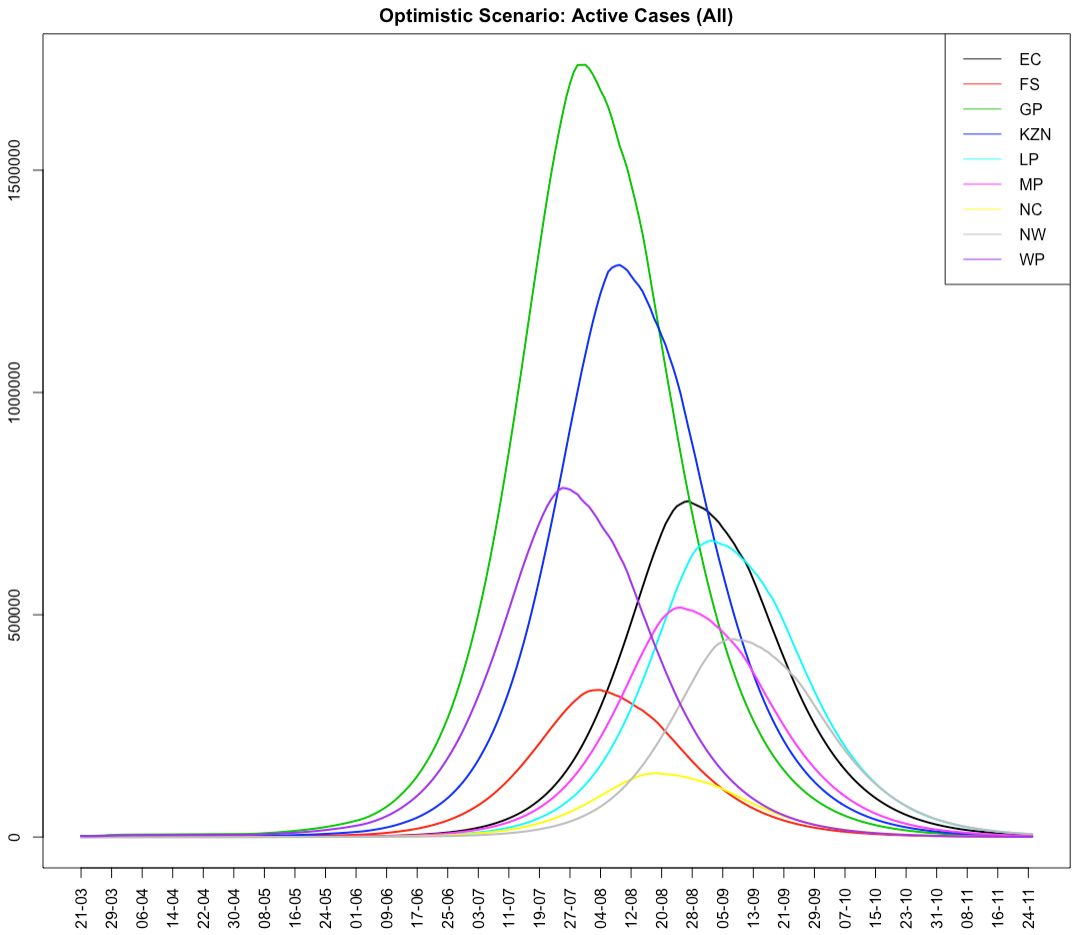
Key Assumption: Asymptomatic proportion of cases: **75%**

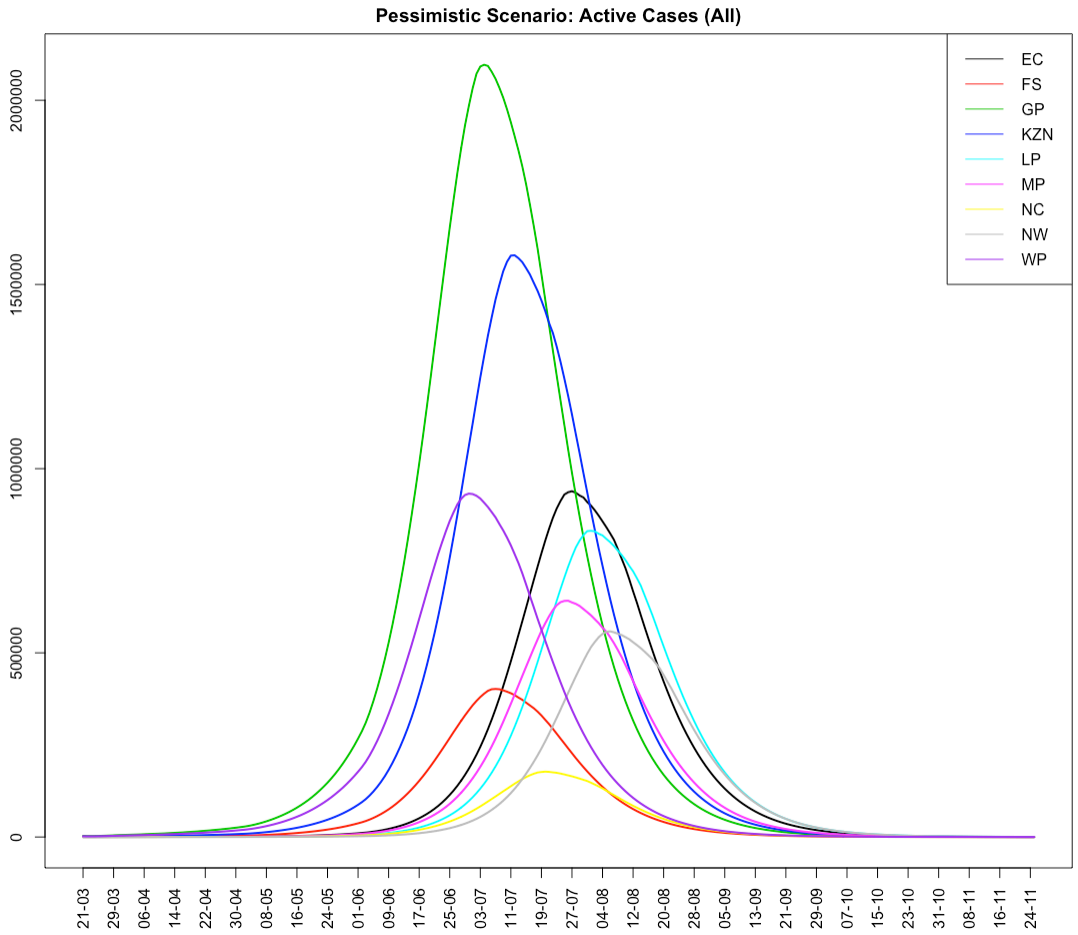
Long term projections: National



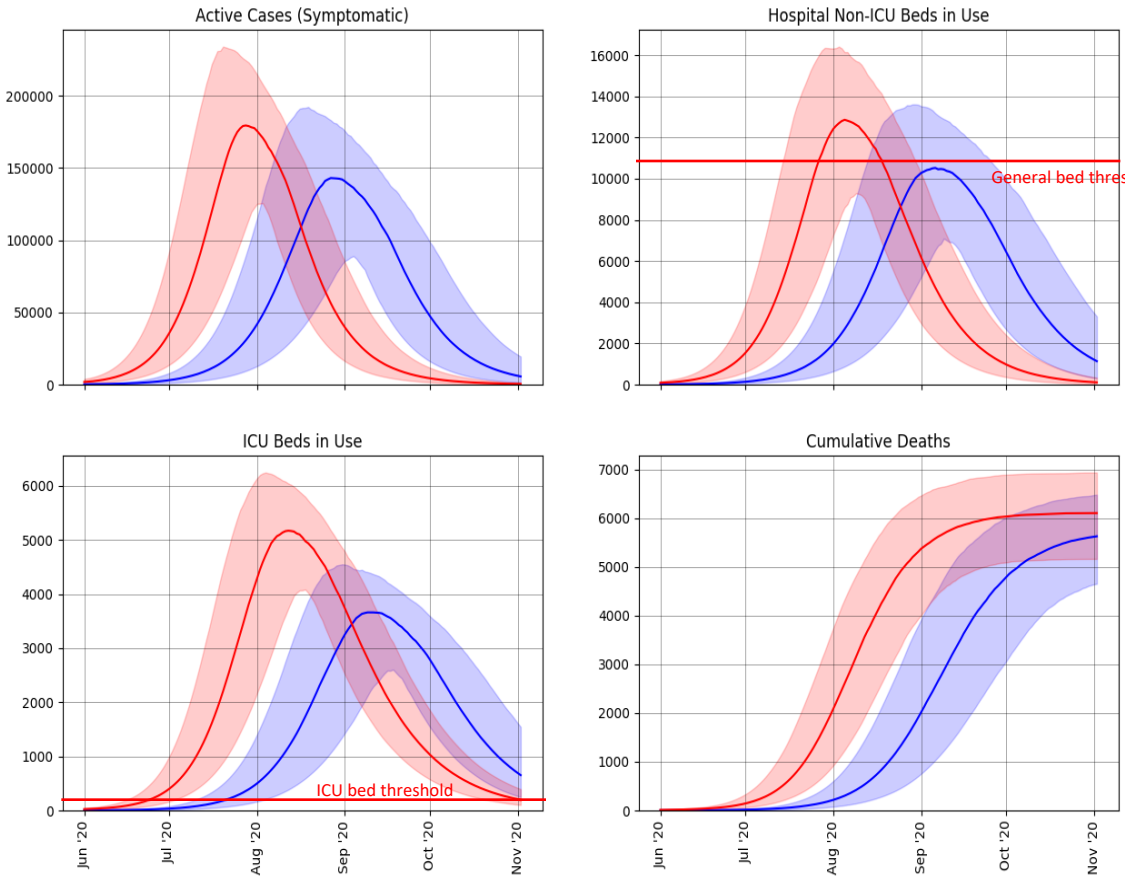
Current trajectory of **detected** cases: Optimistic

Provincial Projections



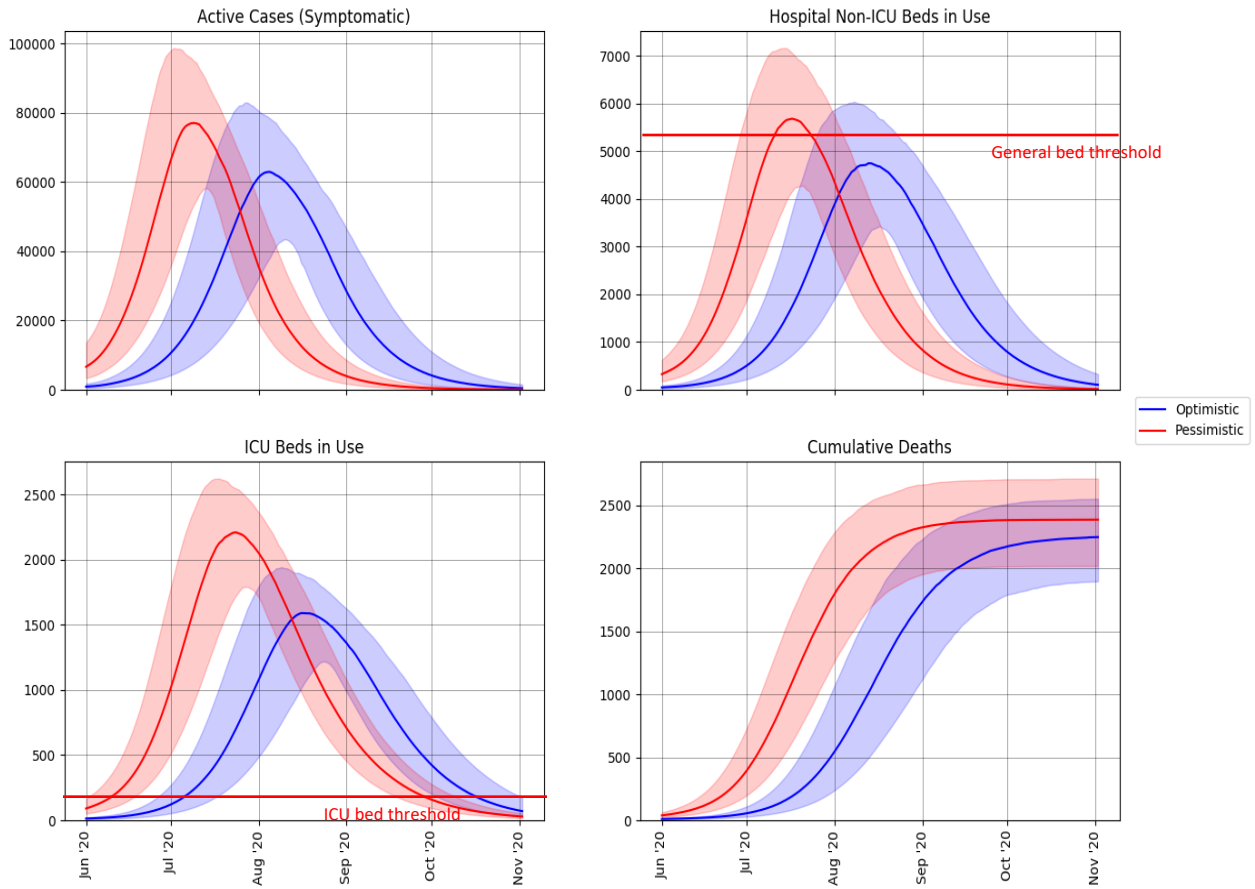


Eastern Cape



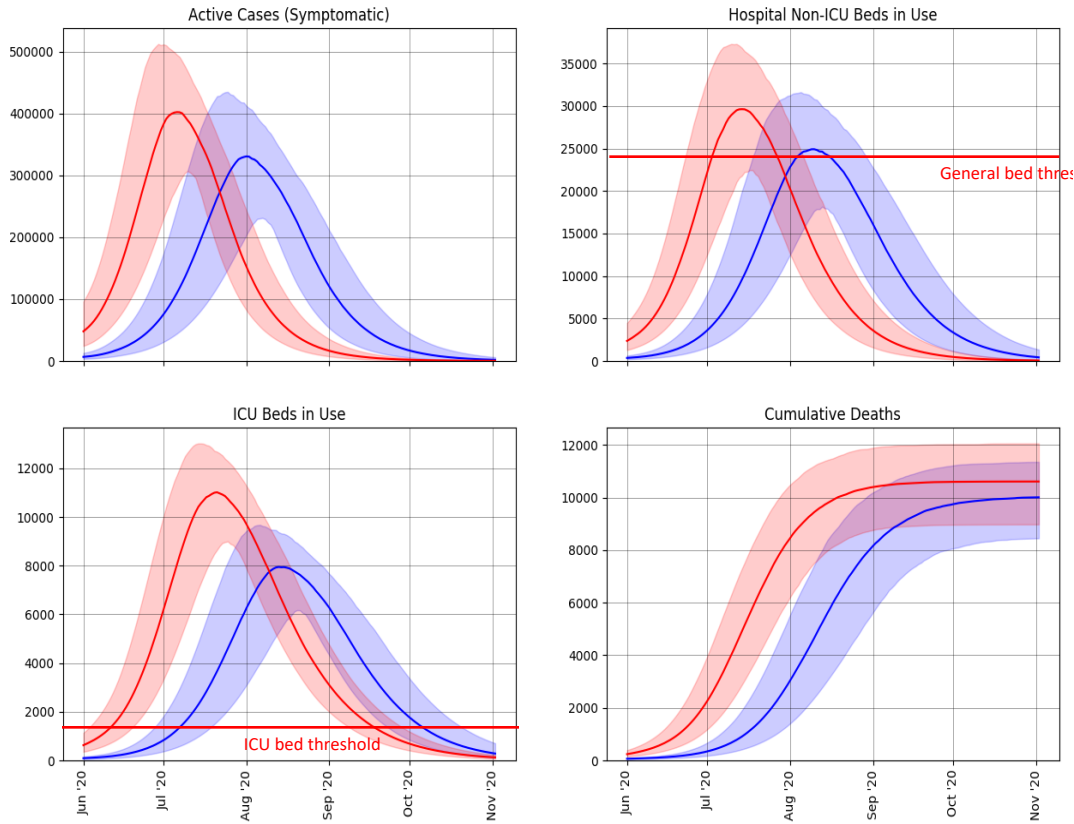
Current trajectory of **detected** cases: Pessimistic

Free State



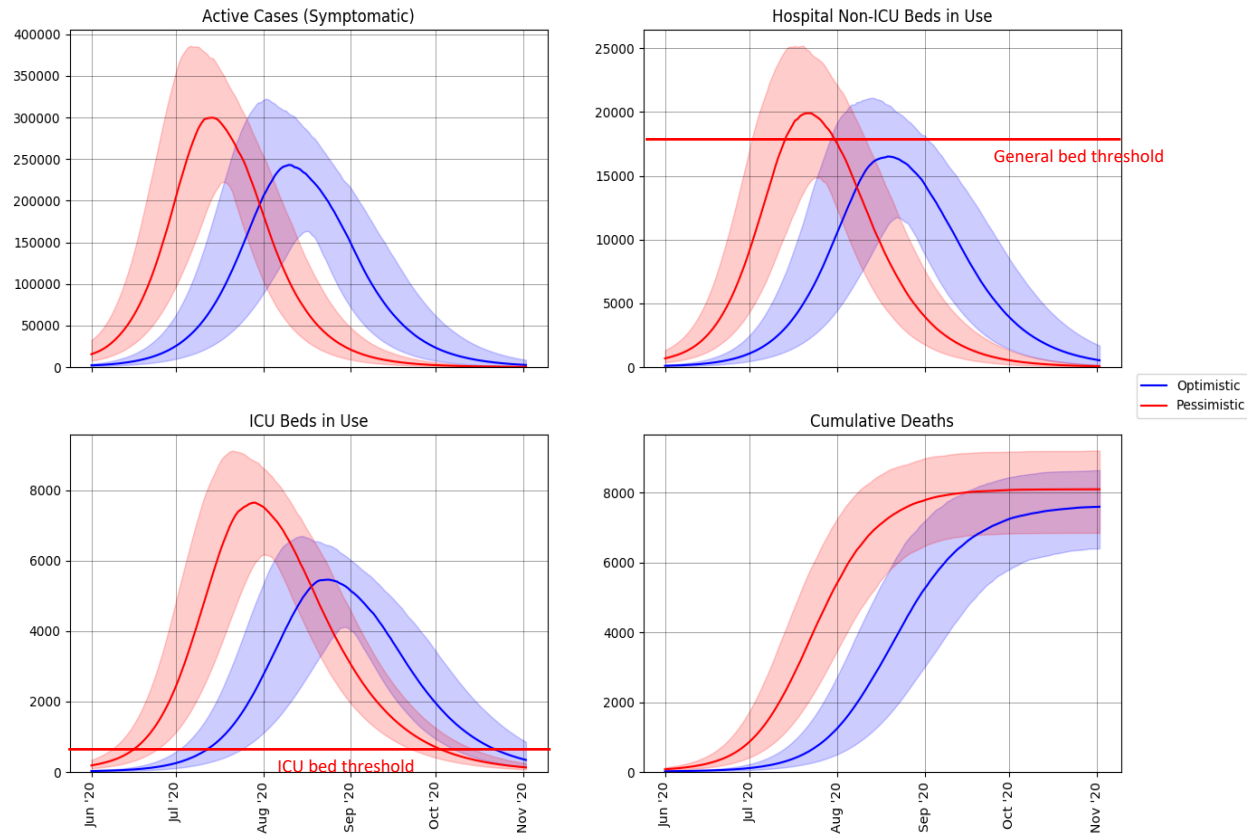
Current trajectory of **detected** cases: Better than optimistic

Gauteng



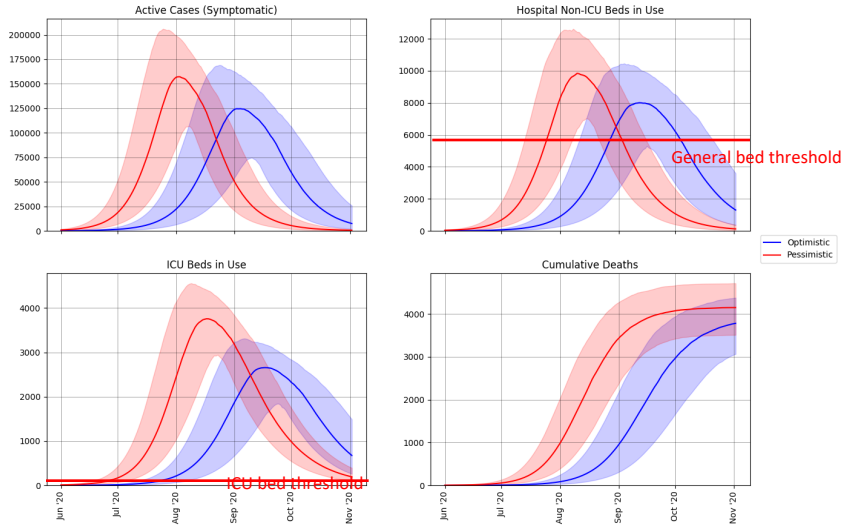
Current trajectory of **detected** cases: Optimistic

Kwa-Zulu Natal

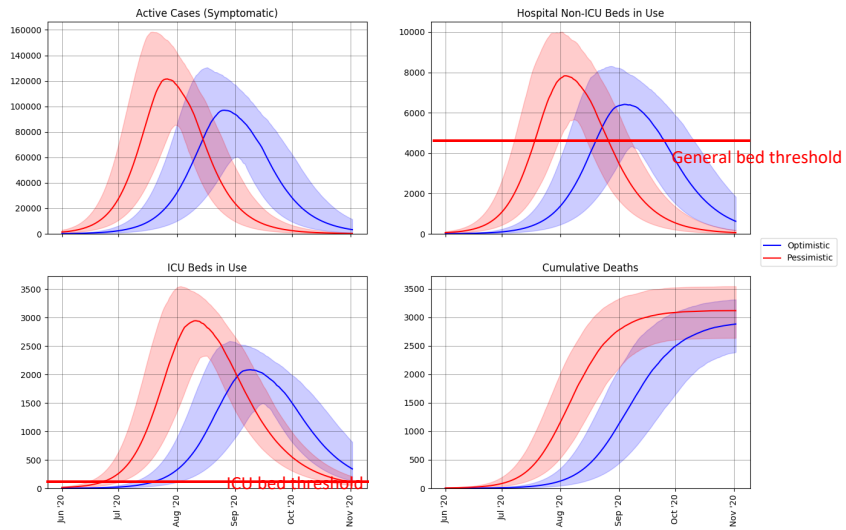


Current trajectory of **detected** cases: Optimistic

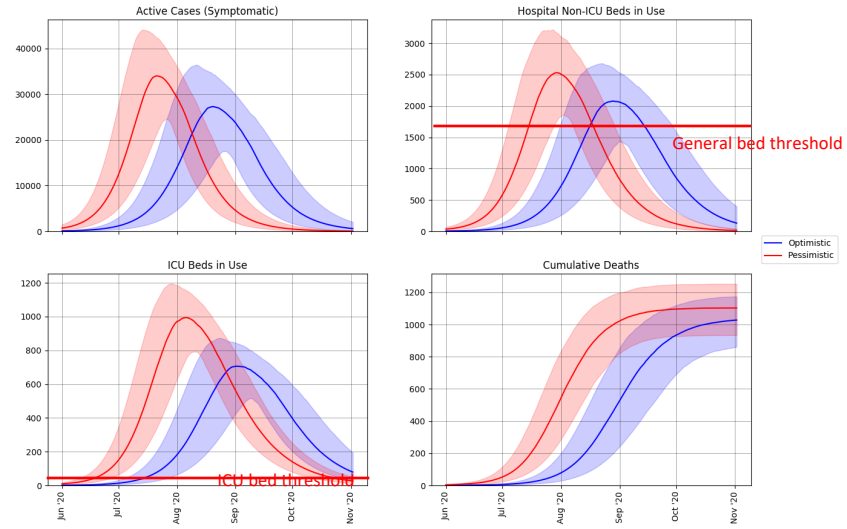
Limpopo



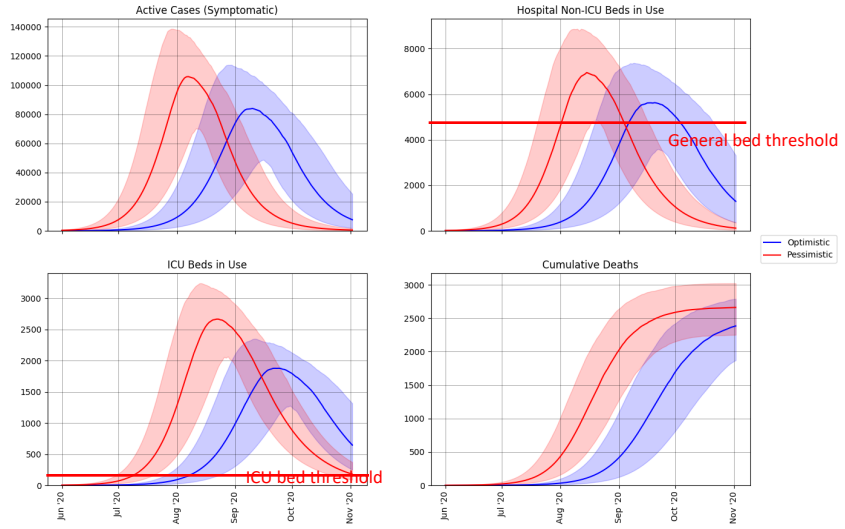
Mpumalanga



Northern Cape

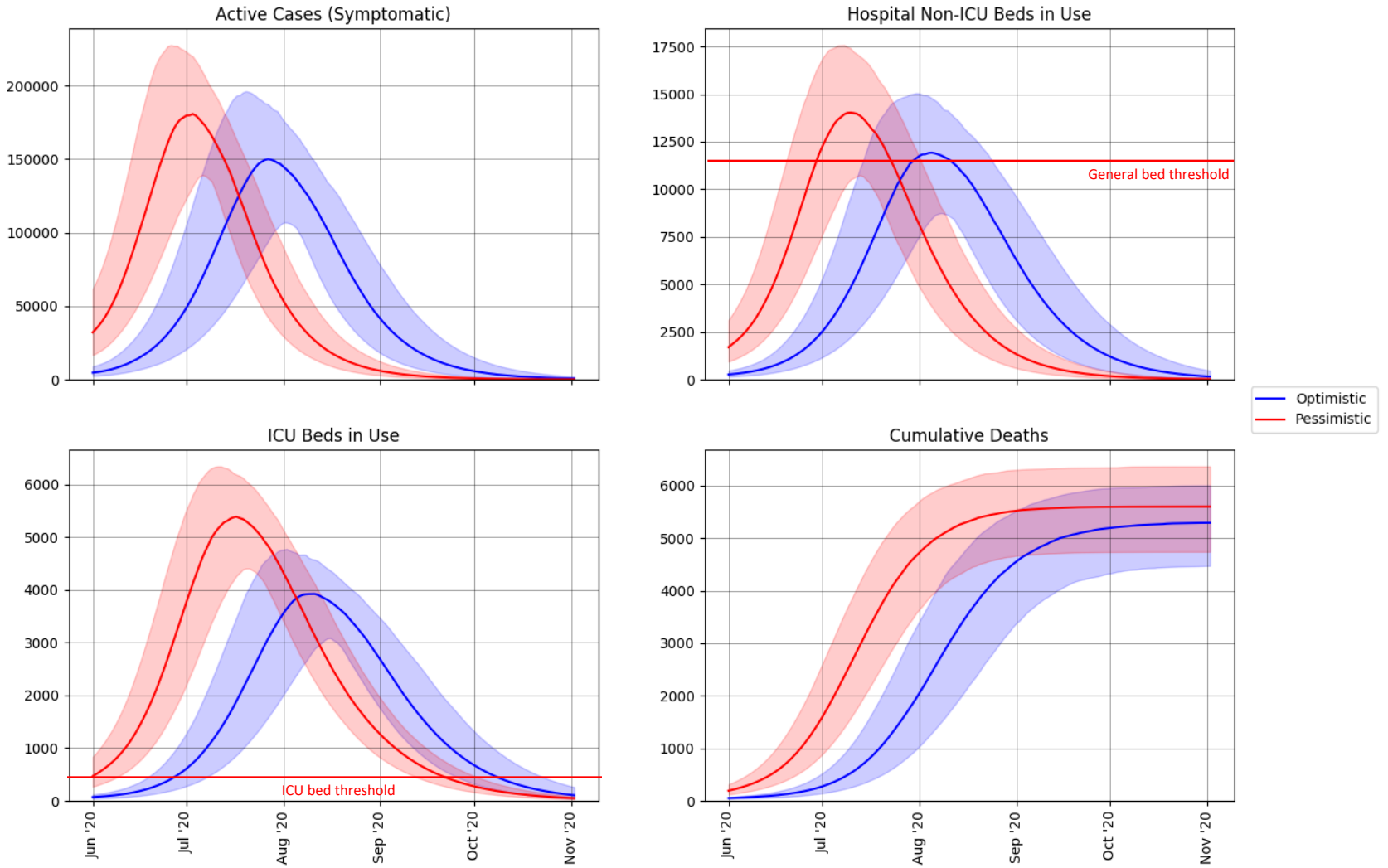


North West



Current trajectory of **detected** cases: Optimistic

Western Cape



Current trajectory of **detected** cases: Pessimistic

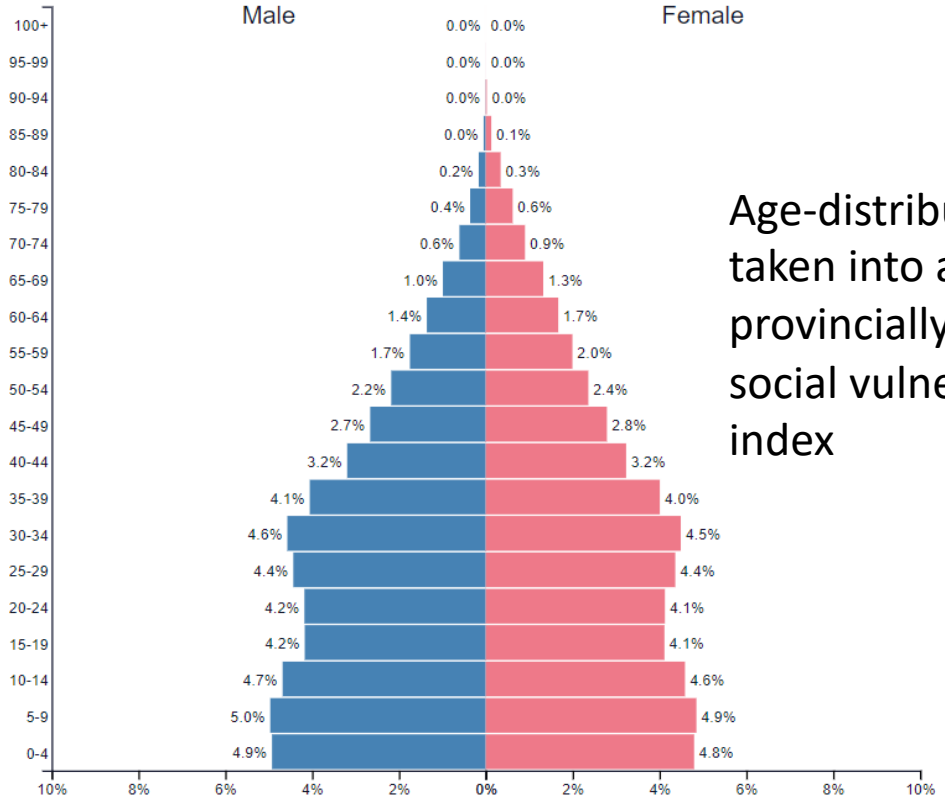
Conclusions

- The initial social distancing and lockdown measures have worked:
  - Epidemic curve has flattened and peak been delayed
  - Extension of lockdown to 5 weeks bought us critical additional time to ramp up community testing and prepare mitigation measures for the oncoming wave
- Peak in active cases likely between early July (pessimistic) and early Aug (optimistic). This will be affected by post-lockdown measures.
- Considerable variation in timing and scale of peaks between Provinces. Variation will be greater between districts and sub-districts.
- Under almost all scenarios hospital and ICU capacity will be exceeded though timing and extent is uncertain. Requires a flexible approach to resource acquisition with initial purchases now and additional orders as more information becomes available

Disease severity with age-specific adjustment for South Africa

	Severe cases (hospitalized) of confirmed cases	Critical (of severe)	Fatal (of critical)
0 to 9	2%	0%	0%
10 to 19	2%	0%	0%
20 to 29	10%	12%	5%
30 to 39	15%	16%	5%
40 to 49	21%	19%	7%
50 to 59	25%	23%	17%
60 to 69	31%	25%	28%
70 to 79	40%	30%	34%
80+	47%	30%	83%

Source: Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — CDC COVID-19 Response Team, United States, February 12–March 16, 2020



Age-distribution taken into account, provincially and by social vulnerability index

Of those with symptomatic infection

~96%	Mild
~2.8%	Severe
~1.2%	Critical

Key Model Parameters

	Parameter	Value*(range)	Sources
Infection severity**	Proportion of cases that are asymptomatic	75%	[1], [2], [3]
	Mild to moderate cases among the symptomatic	(95.64%, 96.78%)	[5]
	Severe cases among the symptomatic	(2.46%-3.64%)	
	Critical cases among the symptomatic	(1.16%-1.45%)	
	Proportion of cases that are fatal	(0.30%, 0.412%)	[4], [5]
Timeframes & treatment durations	Time from infection to onset of infectiousness	4 days (2·0-9·0)	[4], [6], [7], [8], [9], [10] with input from analysis of NICD data.
	Time from onset of infectiousness to onset of symptoms	2 days (1·0-4·0)	
	Duration of infectiousness from onset of symptoms	5 days	
	Time from onset of mild symptoms to testing	4 days (2.0-4.0)	
	Time from onset of symptoms to hospitalisation	5 days (4·0–8·0)	
	Time from onset of symptoms to ICU admission	9 days (8·0–17·0)	
	Duration of hospital stay	12 days (7·0–16·0)	
	Duration from ICU admission to discharge	18 days (14·0–18·0)	
	Duration from ICU admission to death	5 days (4.0-7.0)	

* Parameter values have been selected for use by an expert panel of clinicians on the SA Covid-19 Modelling Consortium. Ranges are informed by sources.
** Accounts for population age structure in South Africa [11].

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