

Estimating cases for COVID-19 in South Africa

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on behalf of the South African COVID-19 Modelling Consortium

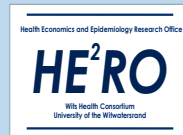
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COVID-19 STATISTICS IN SA

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

				
475071	16433	7298	286	918
TESTS CONDUCTED	POSITIVE CASES IDENTIFIED	RECOVERIES	DEATHS	NEW CASES

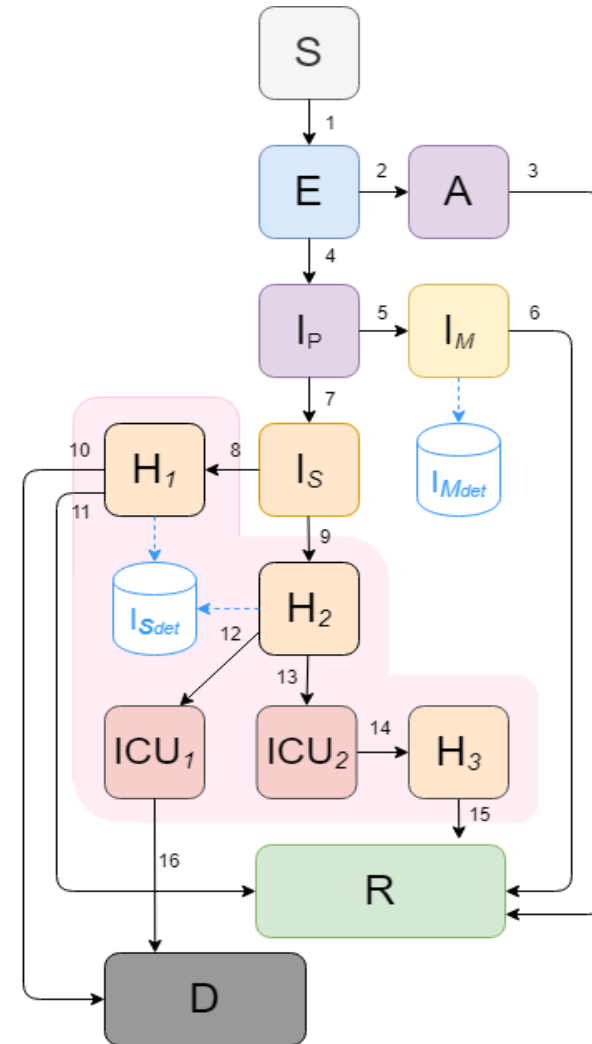


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NICD Hotline: 0800 029 999
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National COVID Models

- 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%**

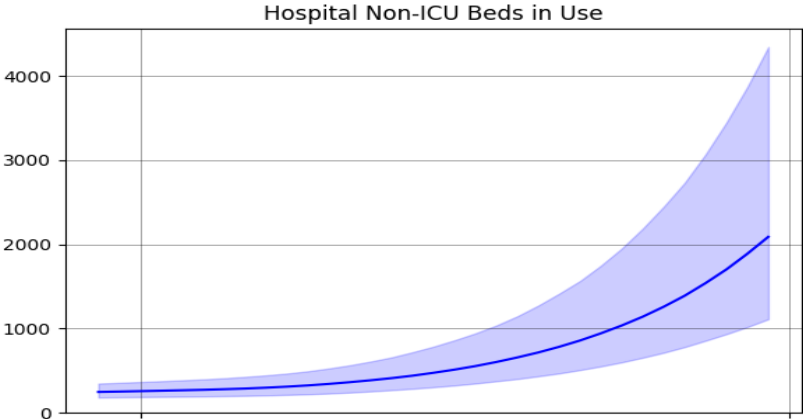
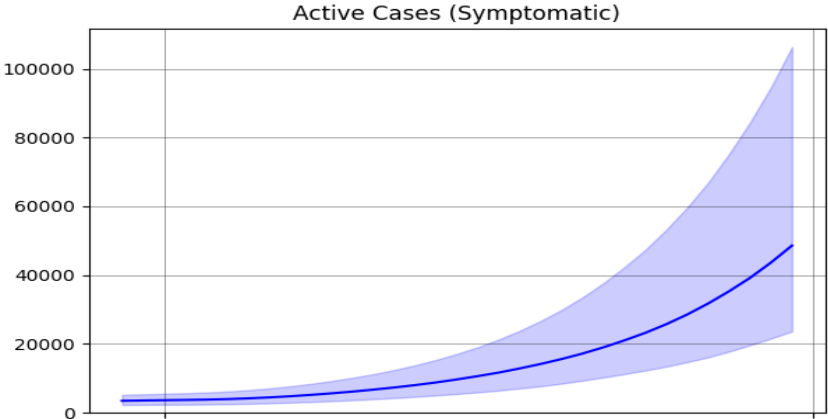
Pessimistic scenario

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

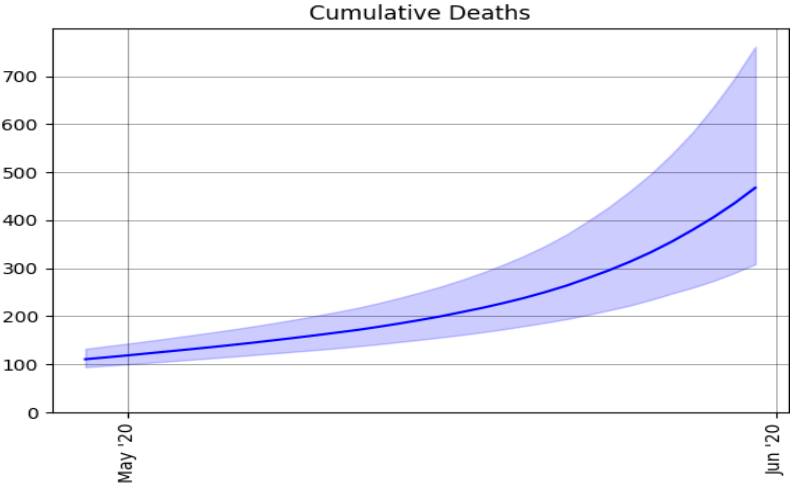
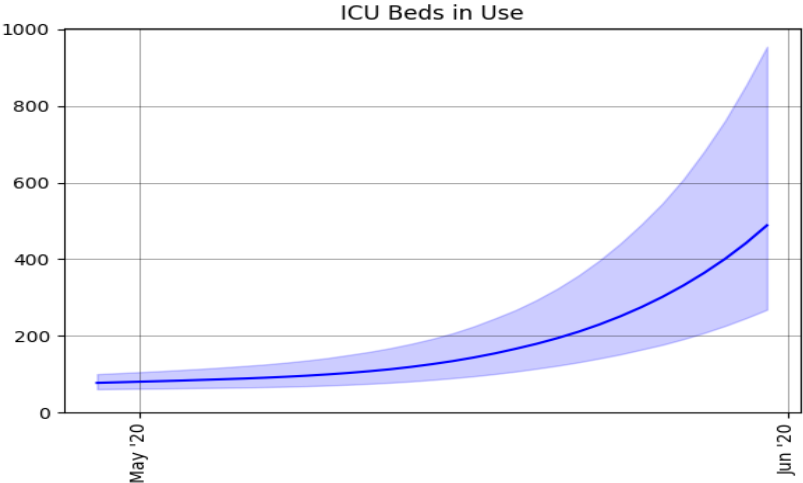
Projections in Context

- 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

Short-term projections



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



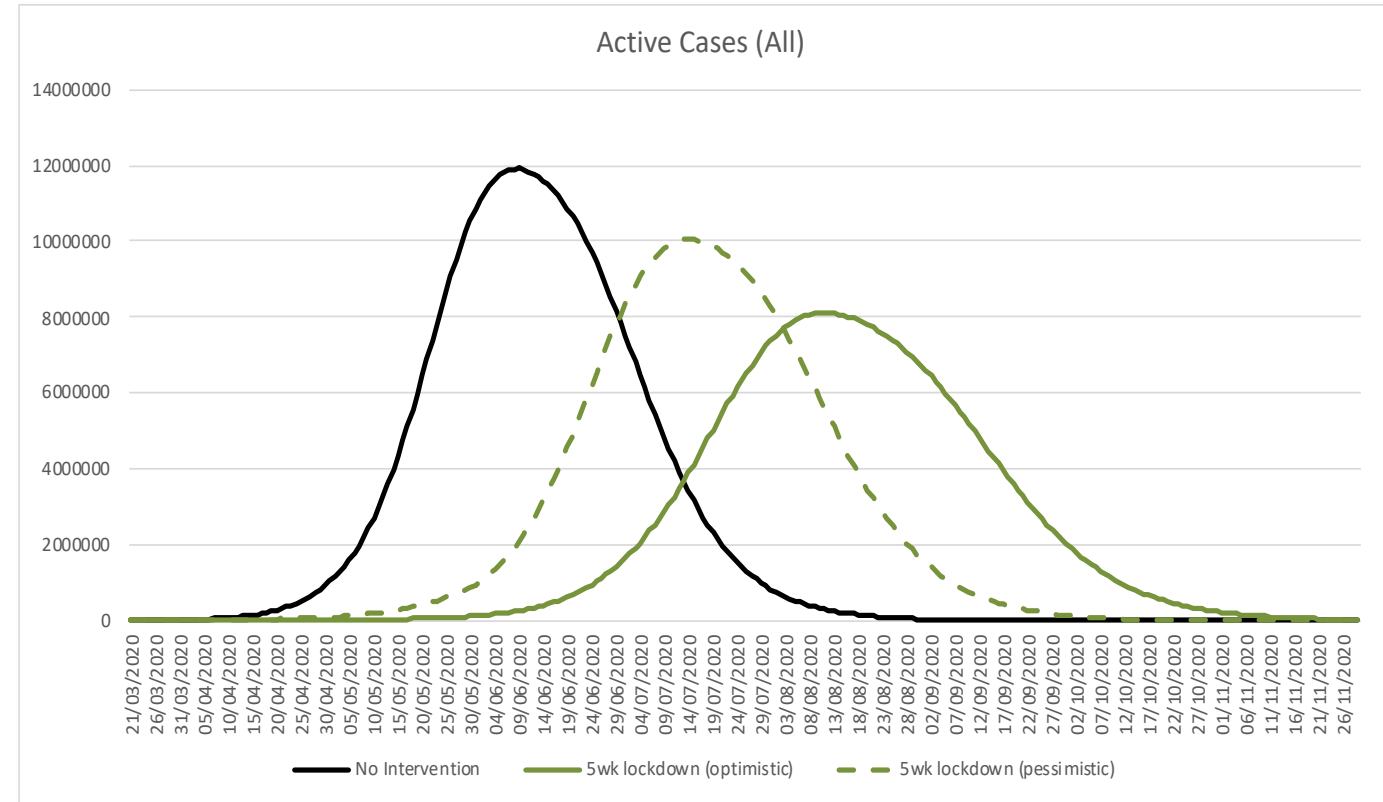
ICU bed threshold (~3,300 beds)

Long-term projections

NATIONAL

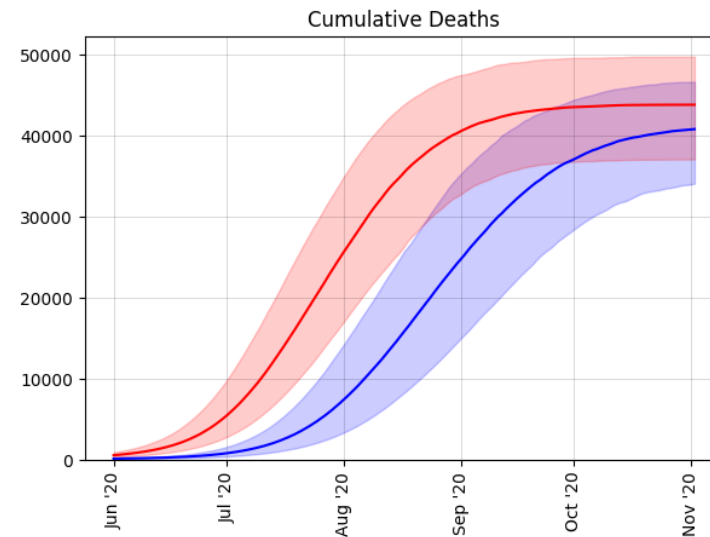
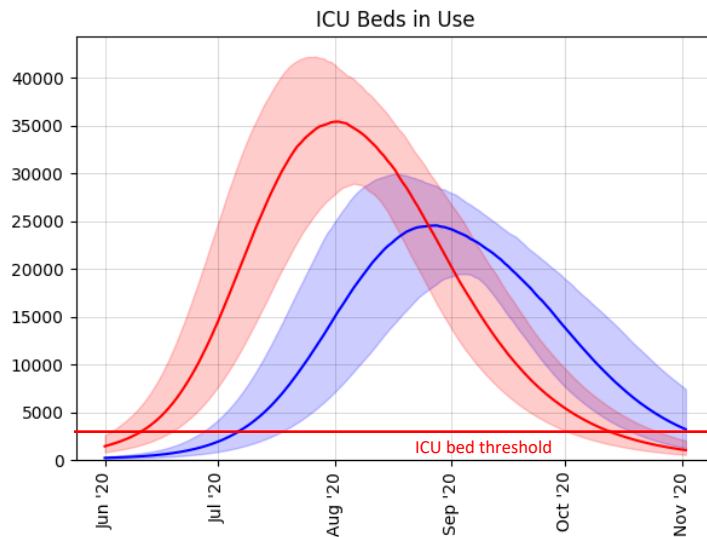
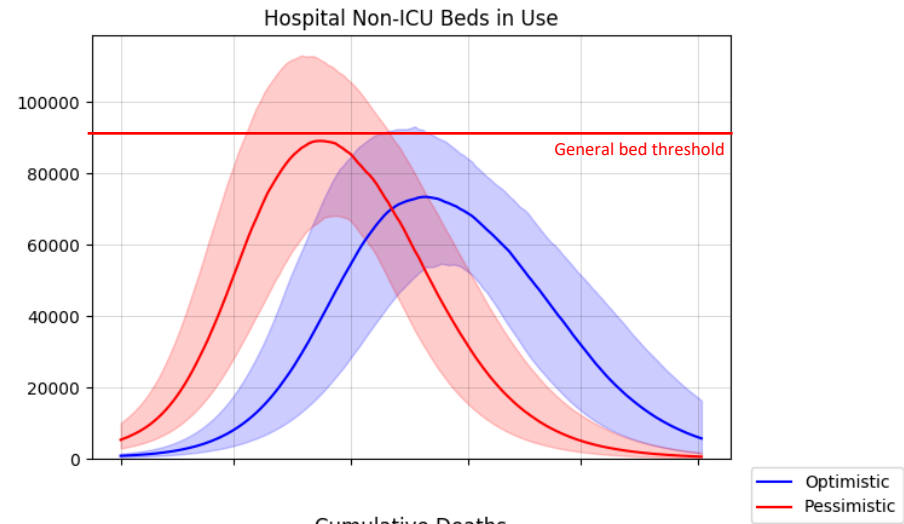
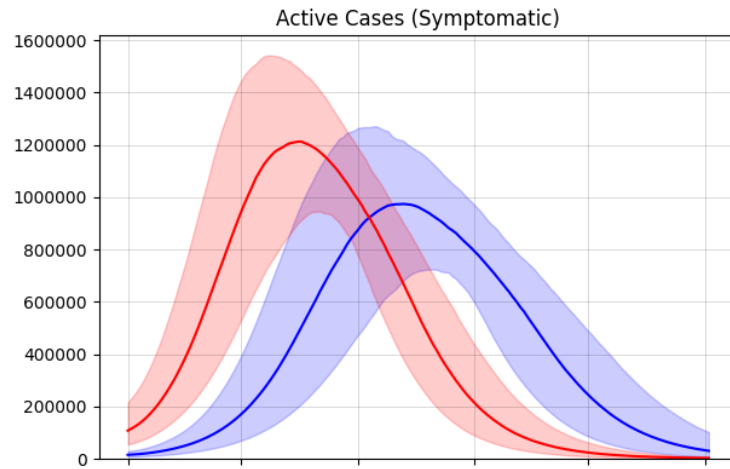
Long-term projections: Impact of lock-down

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



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

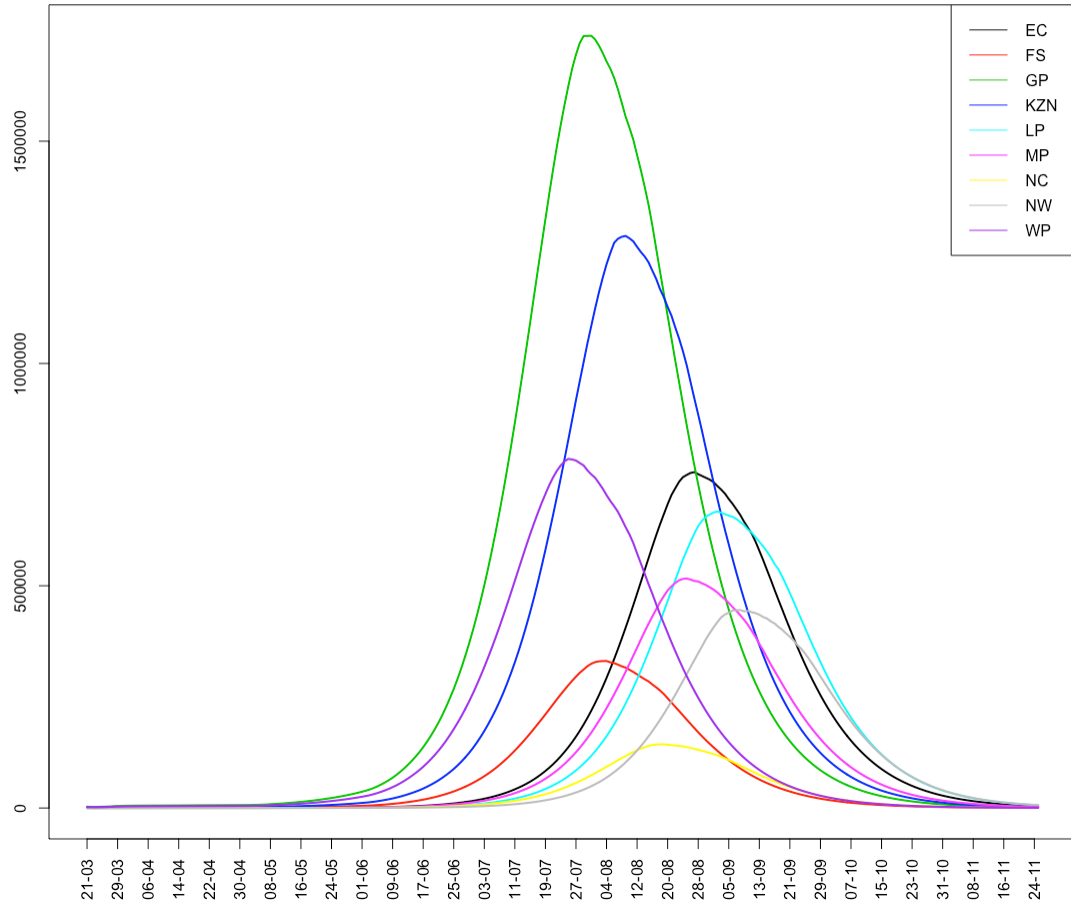
Long term projections: National



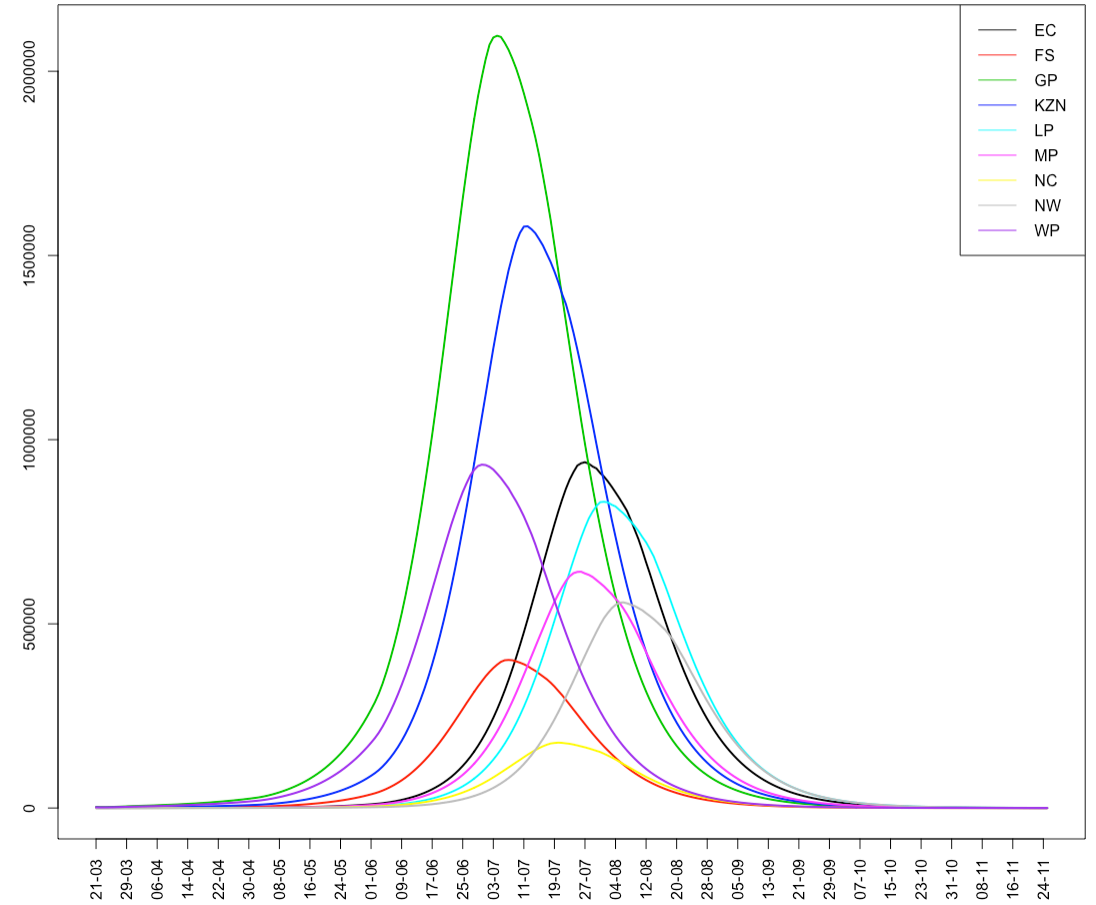
Current trajectory of **detected** cases: Optimistic

Provincial Projections

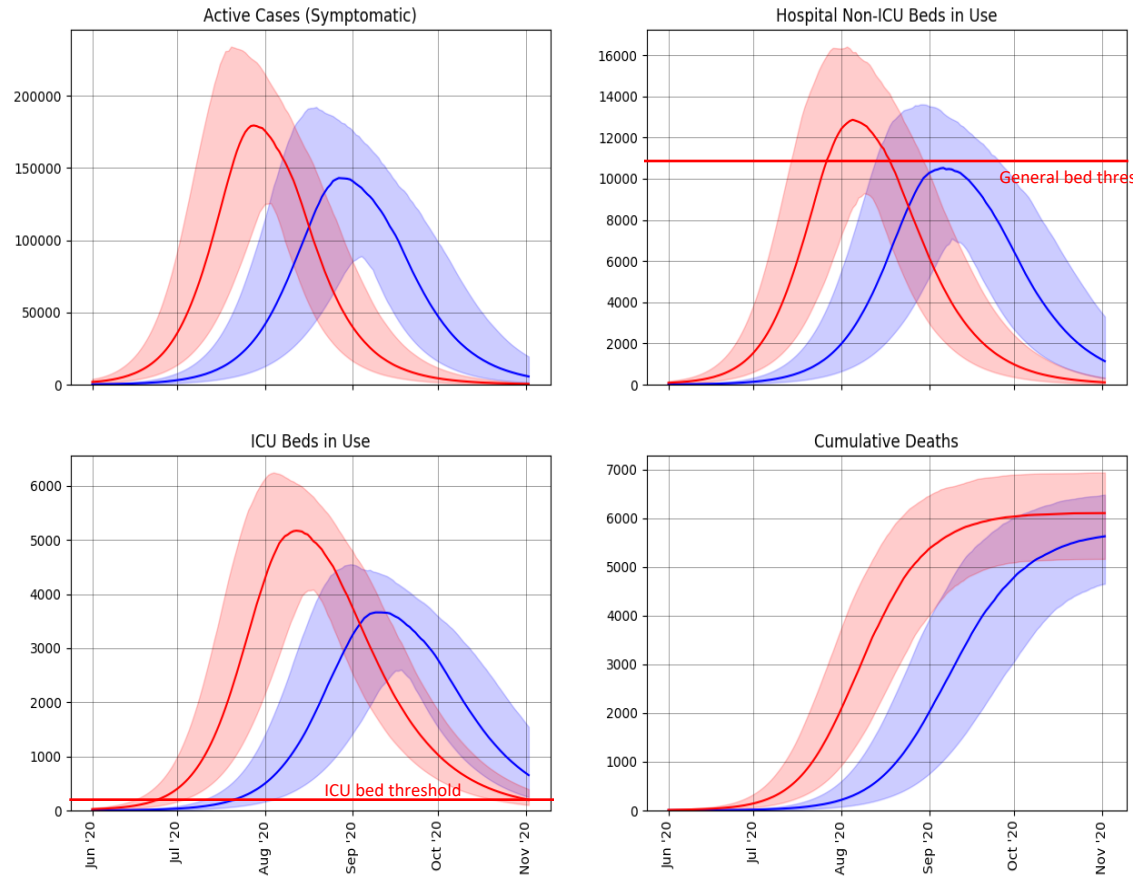
Optimistic Scenario: Active Cases (All)



Pessimistic Scenario: Active Cases (All)

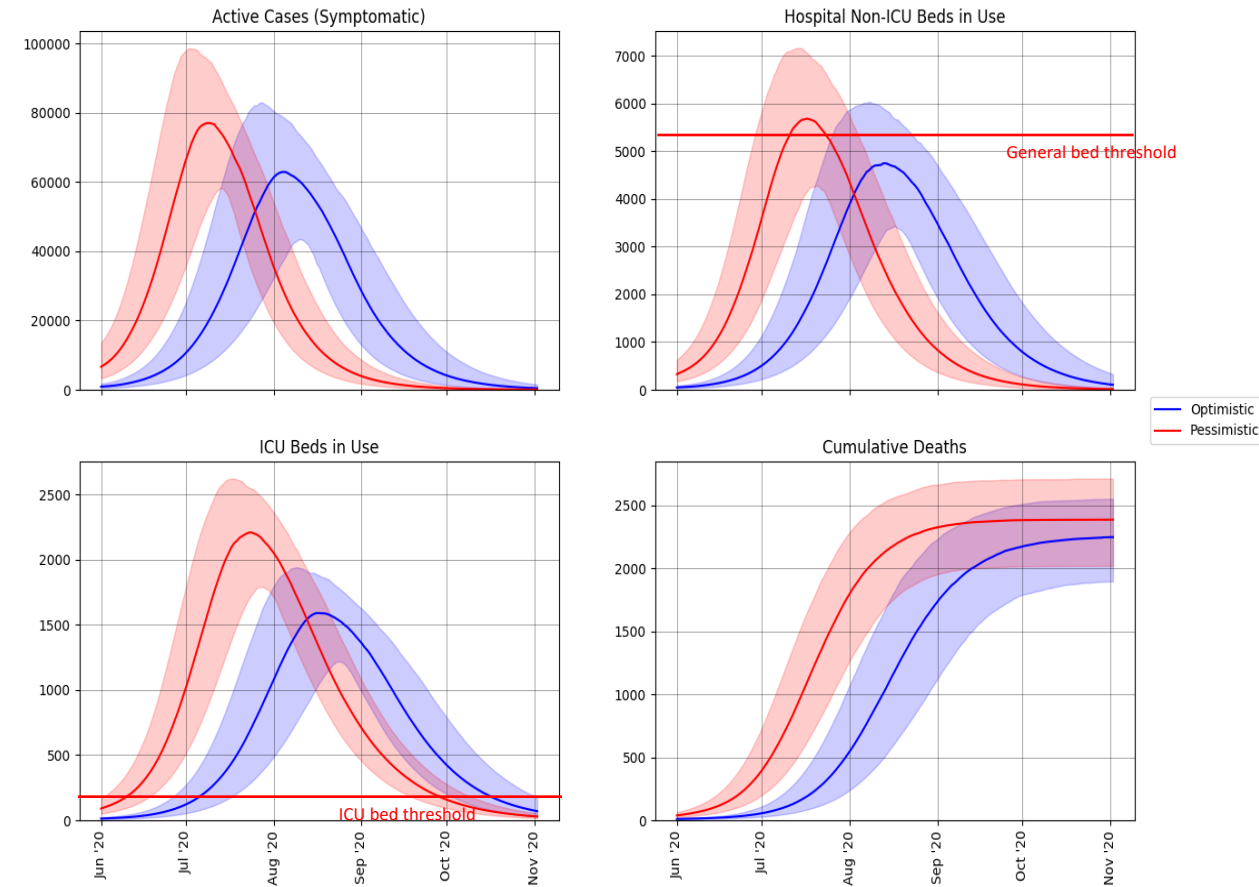


Eastern Cape



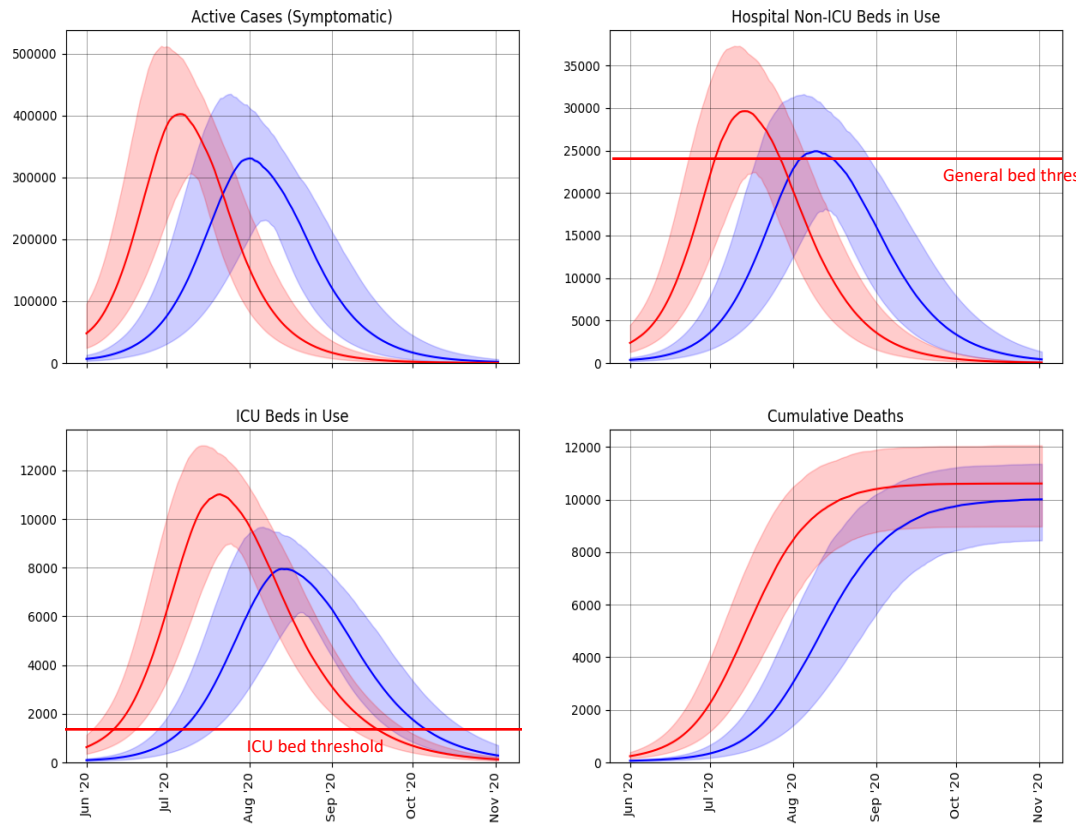
Current trajectory of **detected** cases: Pessimistic

Free State



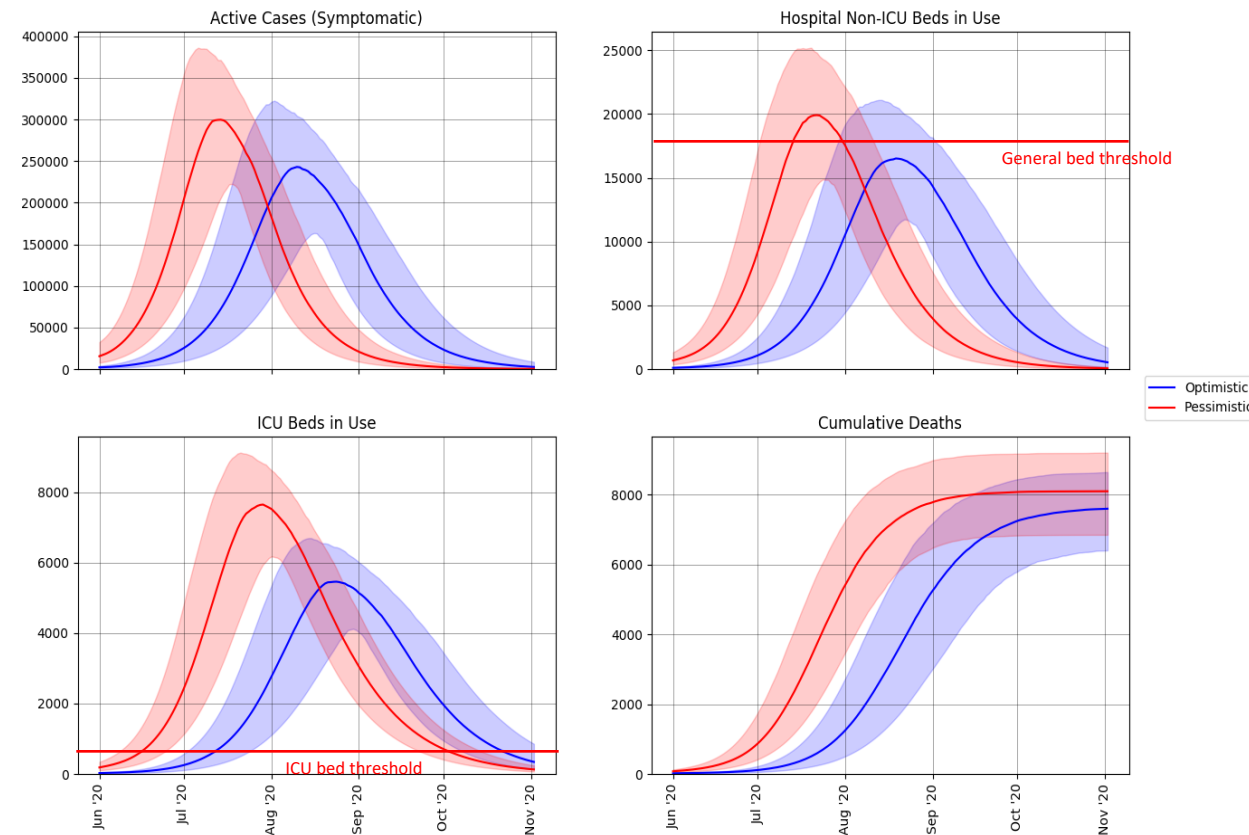
Current trajectory of **detected** cases: Better than optimistic

Gauteng



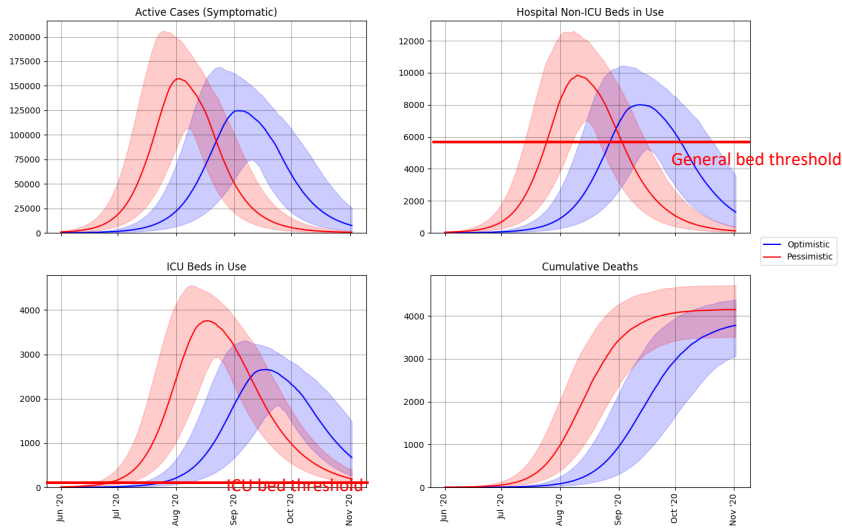
Current trajectory of **detected** cases: Optimistic

Kwa-Zulu Natal

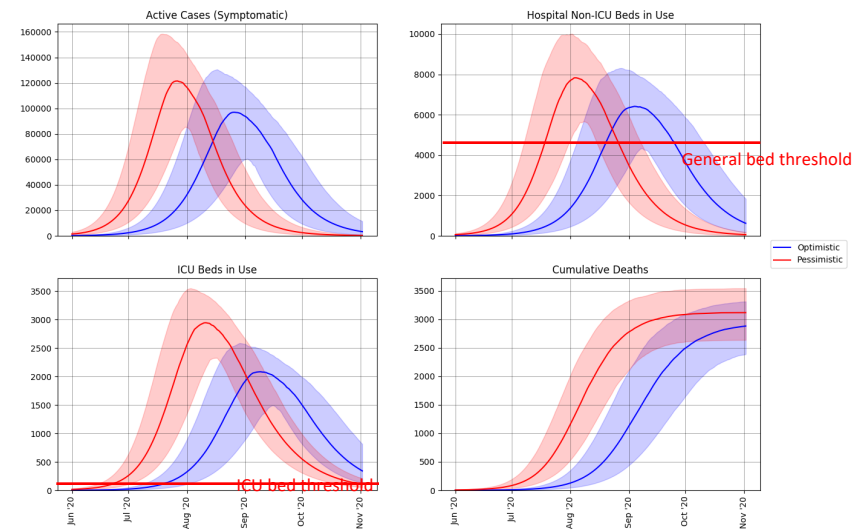


Current trajectory of **detected** cases: Optimistic

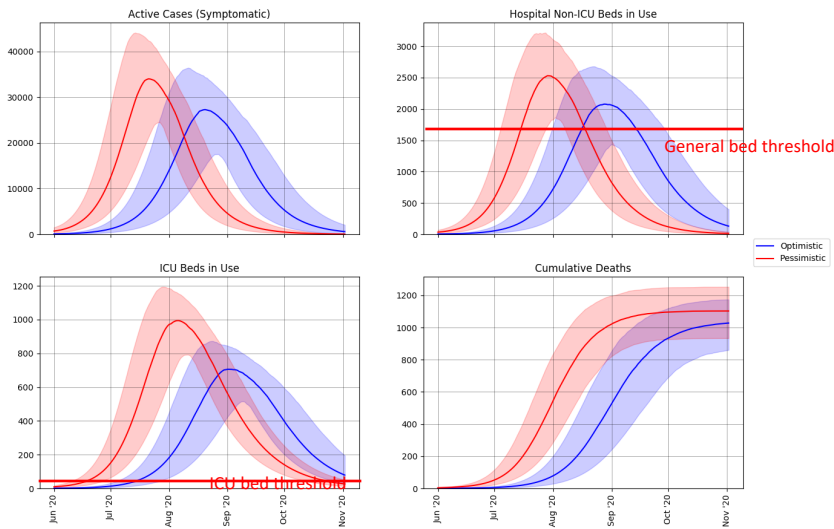
Limpopo



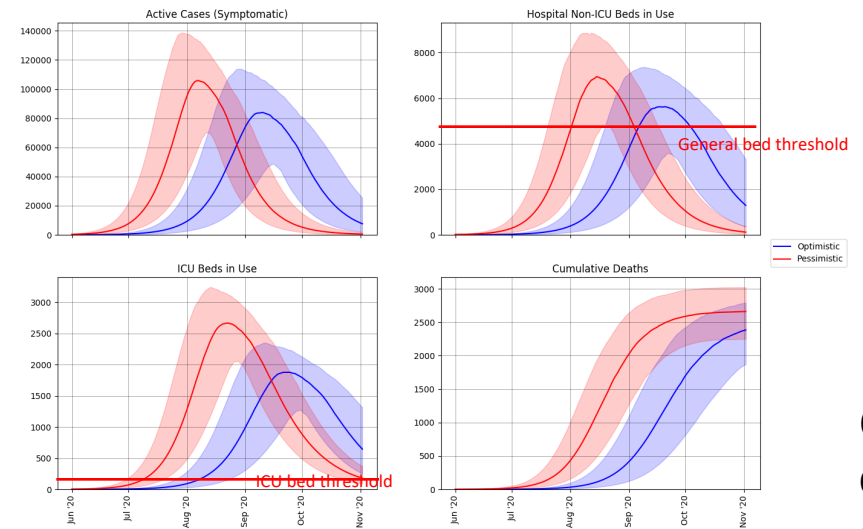
Mpumalanga



Northern Cape

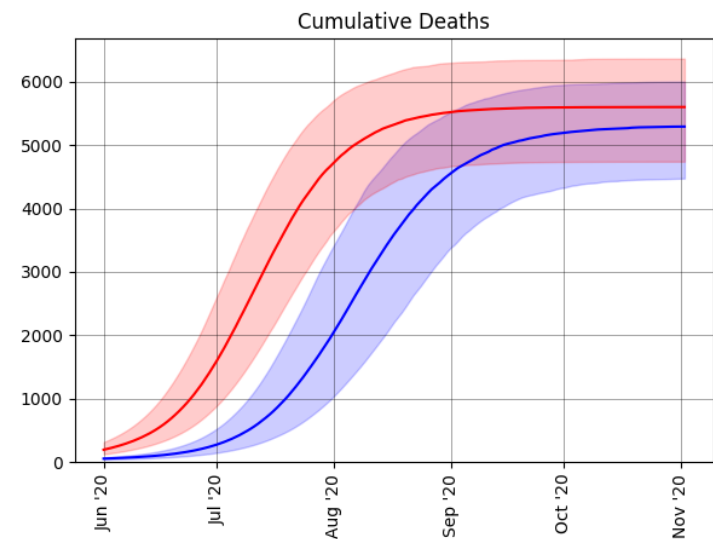
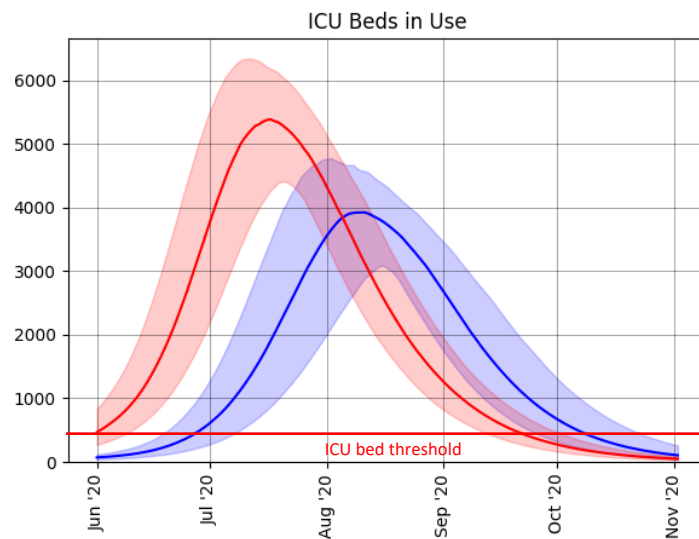
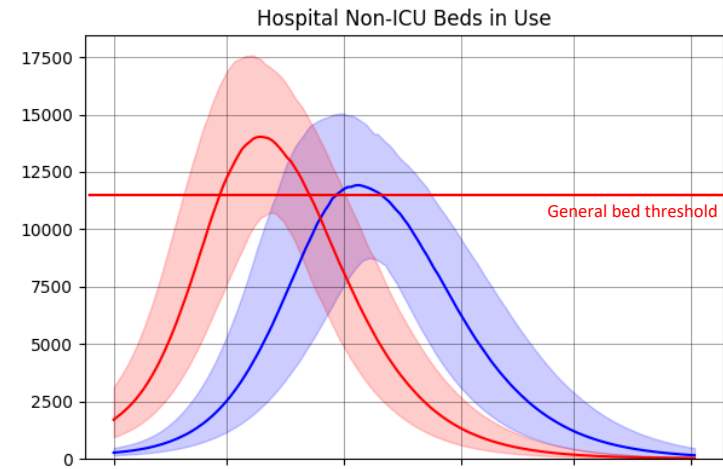
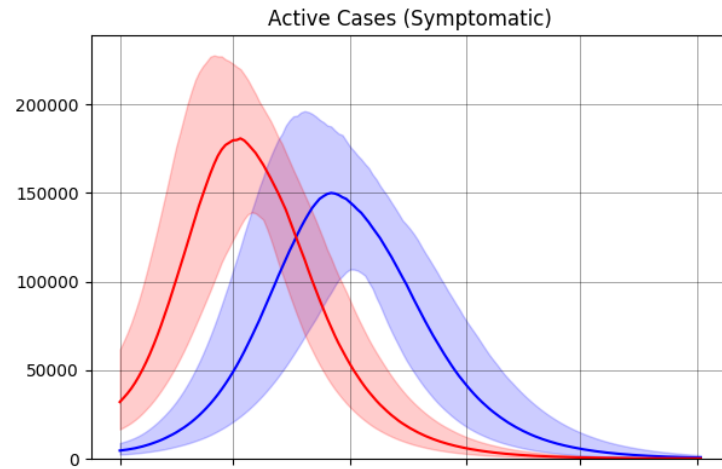


North West



Current trajectory of
detected cases:
Optimistic

Western Cape



— Optimistic
— Pessimistic

Current trajectory of **detected** cases: Pessimistic

Provincial budgets (Optimistic scenario) [mil 2019/20 R]

	PPE	ICU beds and staff	Ventilators	Testing	O2	Hospital beds	Drugs	PHC staff	TOTAL
EC	700	759	316	167	212	-	325	716	3,196
FS	227	334	88	126	110	-	163	320	1,368
GP	983	1,526	295	454	566	1	839	1,686	6,350
KZN	1,105	1,207	217	396	371	-	571	1,254	5,123
LP	582	529	-	120	141	61	235	625	2,293
MP	318	453	-	125	126	31	201	495	1,750
NW	303	157	3	59	45	4	67	138	776
NC	114	300	-	16	89	23	148	404	1,094
WC	496	844	196	162	280	2	407	758	3,146
TOTAL	4,828	6,110	1,115	1,626	1,940	123	2,955	6,396	25,095

Provincial budgets (Pessimistic scenario) [mil 2019/20 R]

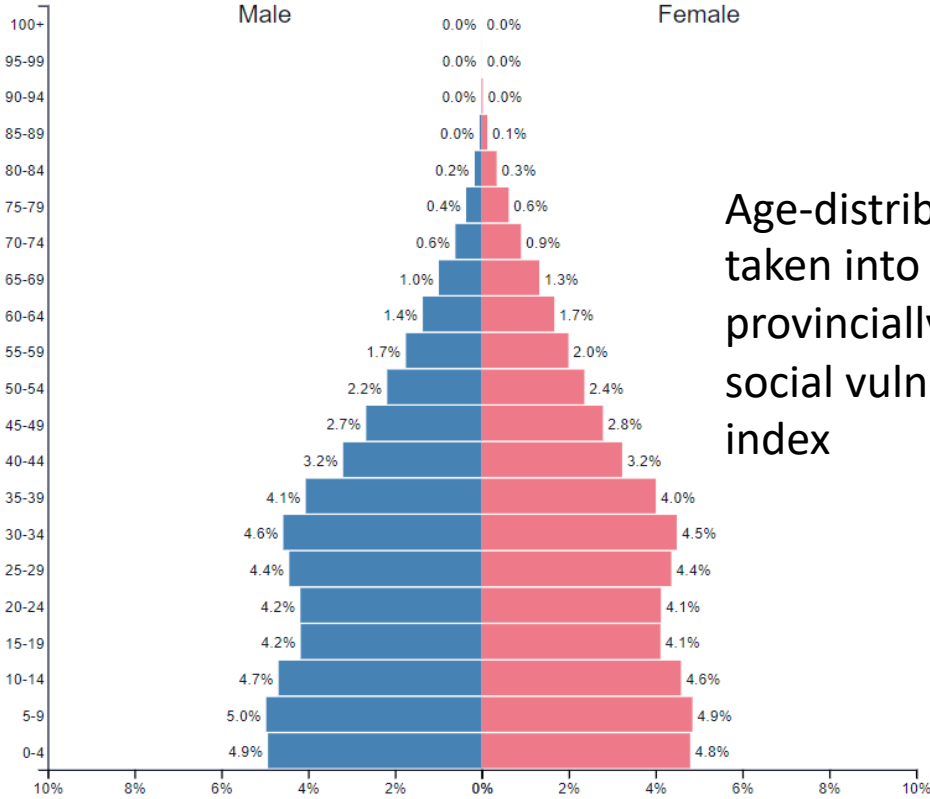
	PPE	ICU beds and staff	Ventilators	Testing	O2	Hospital beds	Drugs	PHC staff	TOTAL
EC	700	1,266	431	167	318	27	463	797	4,169
FS	227	480	120	126	143	5	206	341	1,648
GP	983	2,205	212	454	728	126	1,053	1,791	7,552
KZN	1,105	1,759	338	396	492	15	730	1,346	6,180
LP	582	943	-	120	230	131	351	714	3,071
MP	318	734	-	125	185	87	279	549	2,278
NW	303	241	-	59	63	11	90	150	917
NC	114	611	-	16	159	71	241	479	1,690
WC	496	1,204	205	162	357	53	508	801	3,786
TOTAL	4,828	9,443	1,306	1,626	2,674	524	3,921	6,968	31,291

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%



Of those with symptomatic infection

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

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

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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