Weekly_SA_Provincial_COVID_19_Report

July 8, 2020

1 SARAO South Africa Provincial Epidemiological Model for COVID-19

This report summarises the results of an epidemiological model to estimate the upper and lower bounds for total demand for hospitalization per province in South Africa due to COVID-19, to aid with production planning for the National Ventilator Project executed by SARAO.

2 Provincial Ensembles
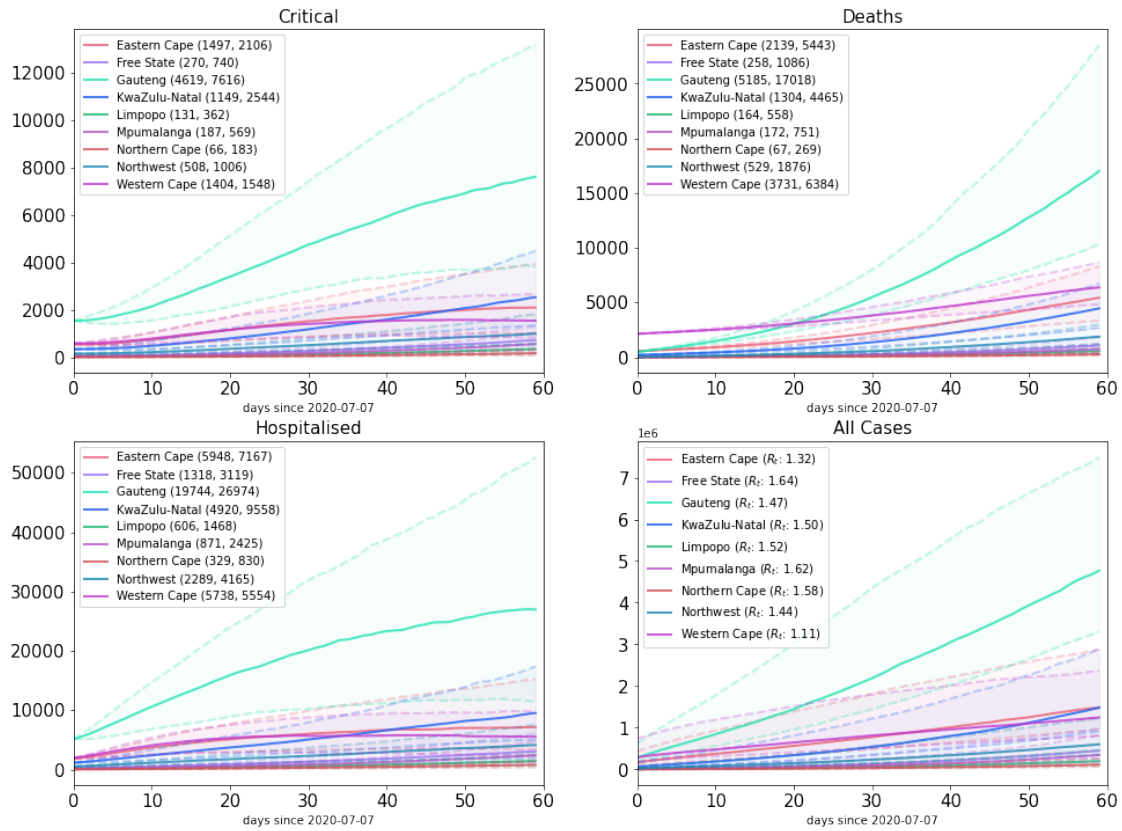
SARAO SEIR-HCD Provincial model from 2020-07-07

Figure 1: *An ensemble of 500 epidemic scenarios on a provincial level, run starting from this report's date. For each, an exponential function is fit to the previous two week's recorded cases. In the figures, the y-axis indicates the number of people in each epidemiological state (Top-left: ICU, Top-right: deaths, Bottom-Left: hospitalisations, Bottom-Right: Total Cases). Solid lines indicate the median value of all the simulations, and 1-sigma confidence intervals are shown shaded between dashed lines. Total cases includes all cases, not just those testing positive; i.e. it includes asymptomatic, symptomatic, tested and untested cases, as well as recovered and deceased.*

Predicted numbers at 30 and 60 days respectively are shown in parentheses following the province name in the legend, except for the bottom-left panel, which lists the R_t value derived from recorded cases over the last two weeks.

2.1 SEIR-HCD Model

An individual SEIR-HCD model is instantiated per province, and run for 60 days from this report's date. No inter-provincial mixing is taken into account. For details and an extended explanation of the model, please see our National Model Report

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Province	population	R_t (cases)	Hosp. (ICU) at day 30	Hosp. (ICU) at day 60
Eastern Cape	6712276	1.32	6989 (1557)	8782 (2378)
Free State	2887465	1.64	1327 (291)	3326 (809)
Gauteng	15176115	1.47	20857 (4752)	28934 (7714)
KwaZulu-Natal	11289086	1.50	5584 (1264)	10925 (2772)
Limpopo	5982584	1.52	634 (132)	1558 (353)
Mpumalanga	4592187	1.62	908 (197)	2557 (604)
Northern Cape	1263875	1.58	343 (70)	841 (192)
Northwest	4027160	1.44	2459 (538)	4322 (1066)
Western Cape	6844272	1.11	5663 (1506)	5541 (1677)

Table 1: *Key Provincial predictions. The current value of R_t per province is calculated from recorded cases over the previous 14 days using an exponential fit. This value is allowed to vary with a standard deviation of 0.15 for the first 30 days and 0.25 thereafter for 1000 ensemble runs. Median predictions for hospitalisation (critical) compartment numbers are tabled for 30 and 60 days*

2.2 Recorded Deaths

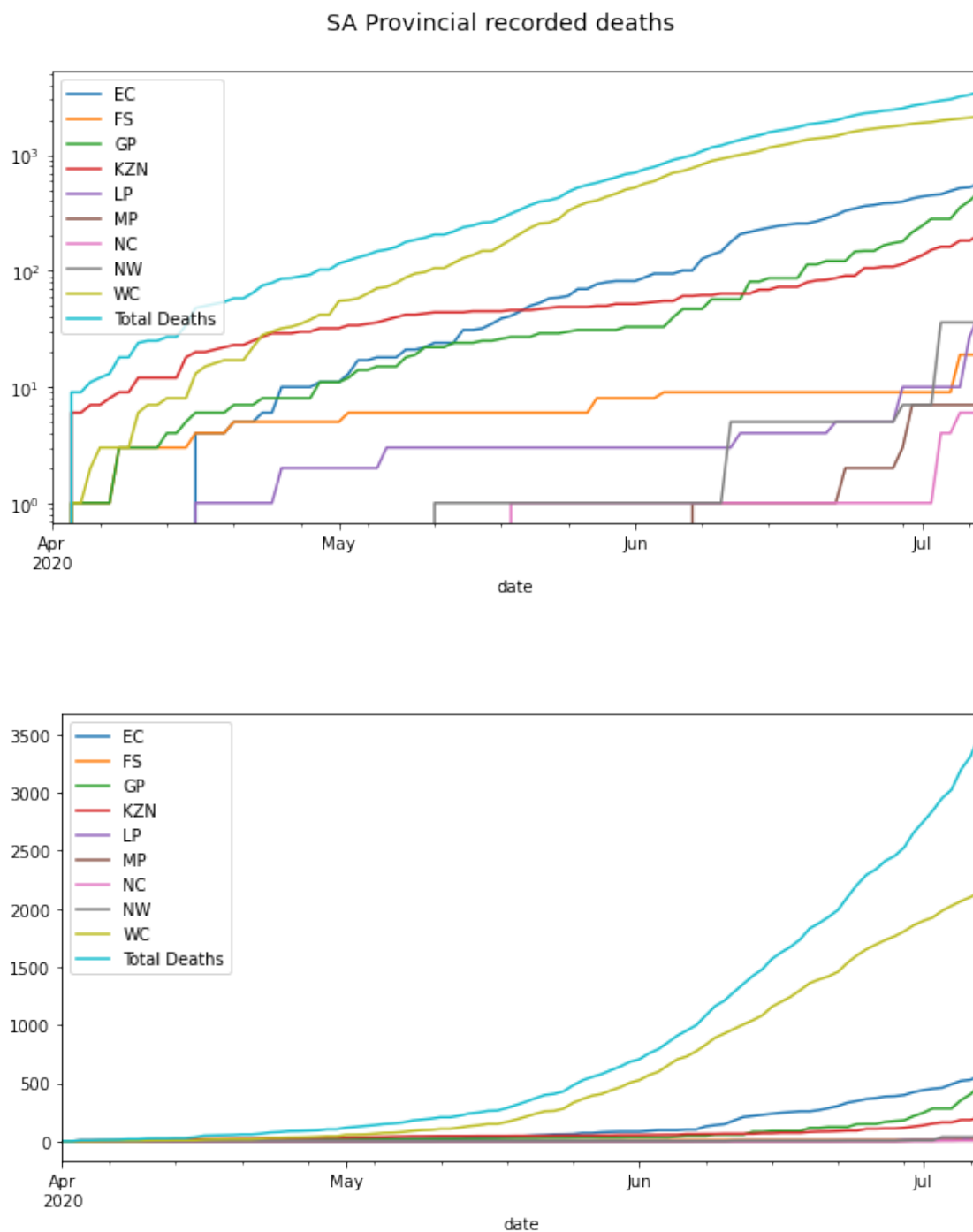The following two figures show the recorded deaths in each province on a logarithmic and a linear scale respectively since 1 April 2020 (from https://github.com/dsfsi/covid19za).

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Figure 2: *Deaths recorded per province on an (a) logarithmic, and (b) linear scale since 1 April 2020 (from* https://github.com/dsfsi/covid19za)

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             EC     FS     GP    KZN   …    NC    NW      WC  Total Deaths
date                                   …
2020-07-01  439.0    9.0  244.0  136.0  …   1.0    7.0  1896.0         2749.0
2020-07-02  451.0    9.0  282.0  152.0  …   1.0    7.0  1925.0         2844.0
2020-07-03  459.0    9.0  282.0  162.0  …   4.0   36.0  1983.0         2952.0
2020-07-04  490.0    9.0  282.0  162.0  …   4.0   36.0  2026.0         3026.0
2020-07-05  519.0   19.0  353.0  183.0  …   6.0   36.0  2066.0         3199.0
2020-07-06  528.0   19.0  403.0  183.0  …   6.0   36.0  2101.0         3310.0
2020-07-07  564.0   19.0  478.0  205.0  …   6.0   36.0  2145.0         3502.0

[7 rows x 10 columns]
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Table 2: *Confirmed COVID-19 cases per province for the last 7 days (from* https://github.com/ dsfsi/covid19za*)*
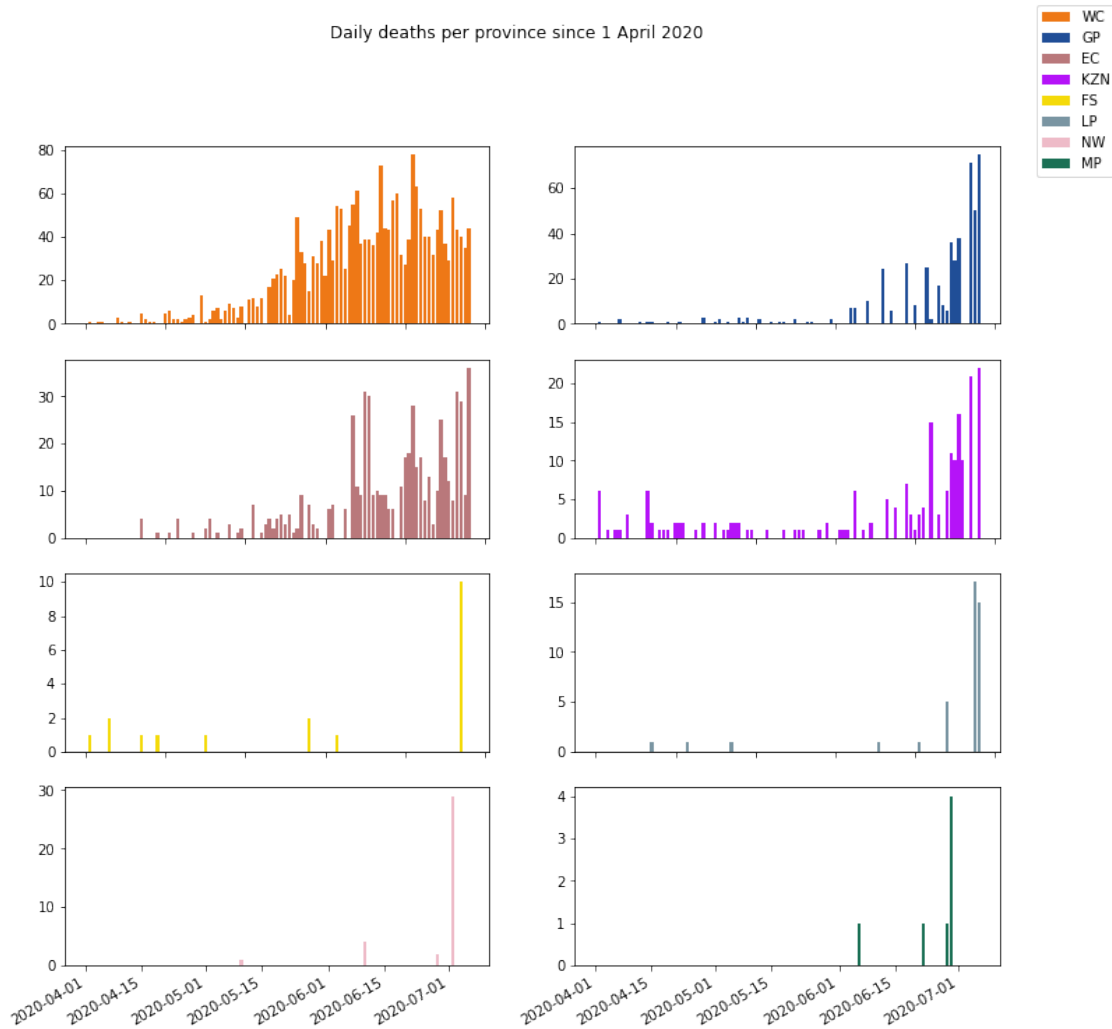

Figure 3: *Daily recorded deaths per province since 1 April 2020.*

3 National Model

Shown below for reference are the predictions of the SARAO NVP National Model ensembles.

The figure below shows a full ensemble of 2000 epidemic runs starting on 1 April 2020 (Day 0). On the y-axis we plot the number of people in each state (Top-left: ICU, Top-right: deaths, Bottom-Left: hospitalisations, Bottom-Right:Total Cases).

Our models have peaks that vary by up to about 100 days. White lines indicate the median value of all the simulations. Models with average Rt > 2 imply more than 80% of the population get infected. The black line on the fatalities curve shows actual South African deaths to 5 June 2020. Note that most of our models struggle to match observed deaths to the current time, suggesting that we may be underestimating the fatality rate.
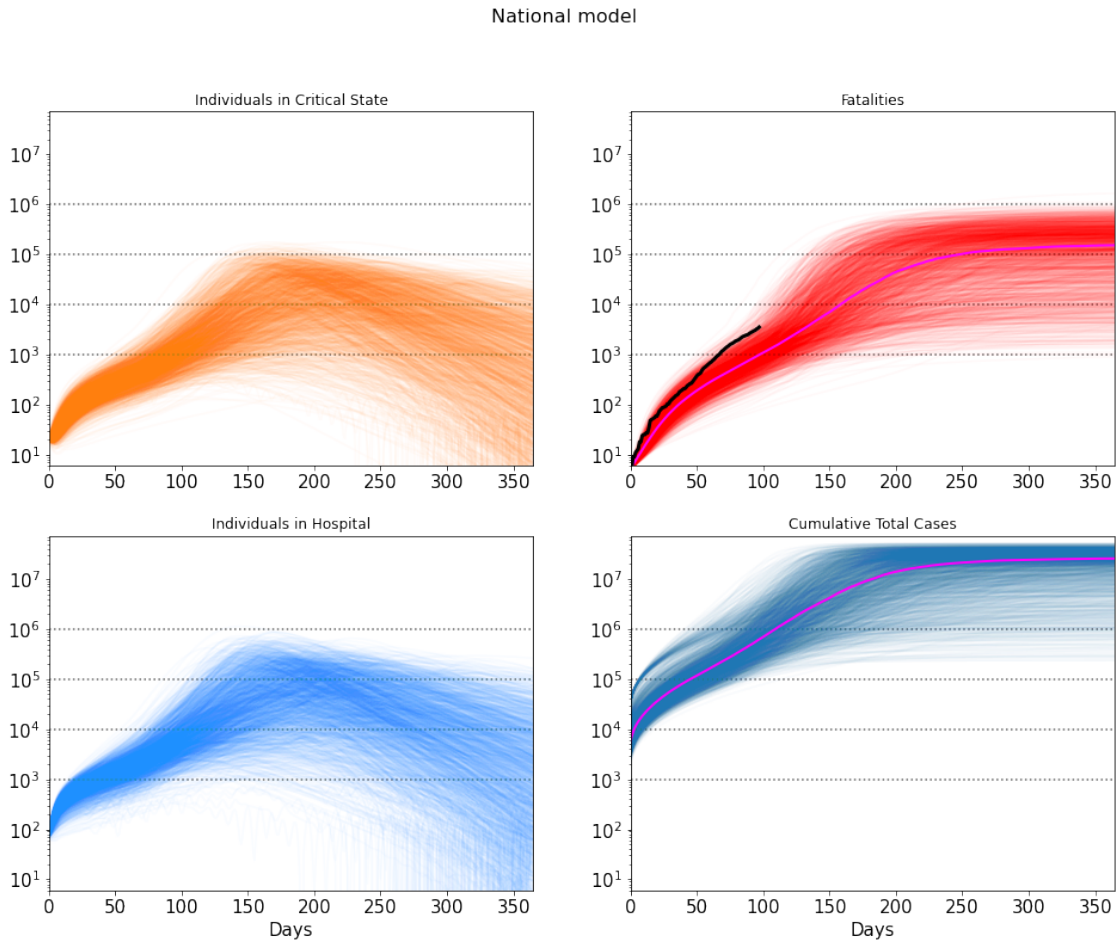
National model

Figure 4: *The full ensemble of 2000 epidemic runs starting on 1 April 2020 (Day 0). On the y-axis we plot the number of people in each state (Top-left: ICU, Top-right: deaths, Bottom-Left: hospitalisations, Bottom-Right:Total Cases). Note how the models have peaks that vary by up to about 100 days. White lines indicate the median value of all the simulations. Note that models with average Rt > 2 typically imply more than 80% of the population get infected. The black line*

on the fatalities curve shows actual South African deaths. Note that most of our models struggle to match observed deaths suggesting that we may be underestimating the fatality rate. Total cases includes all cases, not just those testing positive; i.e. it includes asymptomatic, symptomatic, tested and untested cases, as well as recovered and deceased.