

COVID-19 Actuarial Modelling of the Pandemic

Prepared by NMG Consulting

► Insight Report



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1. Multi-state actuarial model

NMG has built a multi-state actuarial model to forecast COVID-19 cases in a population and applied this model to the South African and other populations. The model can be calibrated to the latest reported South Africa experience to better understand how changes in the reported experience might impact on the longer-term outlook for the pandemic.

1.1 Workings of the model

The model assumes that the virus will move through a population where all individuals are initially equally susceptible to infection. In terms of the model, some individuals will come into contact with individuals infected with the virus and themselves become infected. Certain of these infected individuals will be hospitalised and some will die.

The model simulates how the virus moves through the South African population using parameters derived from international studies and local experience. The model is fit using the COVID-19 deaths reported for each of the nine provinces by using seed values for the starting infected population in each province as at 22 March 2020 and by adjusting the parameter that informs the speed of viral propagation in the population. The reported COVID-19 deaths are adjusted for underreporting using the Medical Research Council (MRC) data on all cause natural deaths as a guide.

A second fit has been added to the model using COVID-19 hospital admissions reported to the National Institute for Communicable Diseases. The reporting on COVID-19 hospital admissions has

become much more stable over the last month and currently covers 99% of public and 100% of private hospital admissions.

1.2 Reported data

The reported COVID-19 deaths and hospital admissions used to fit the NMG model are graphed together in Figure 1.

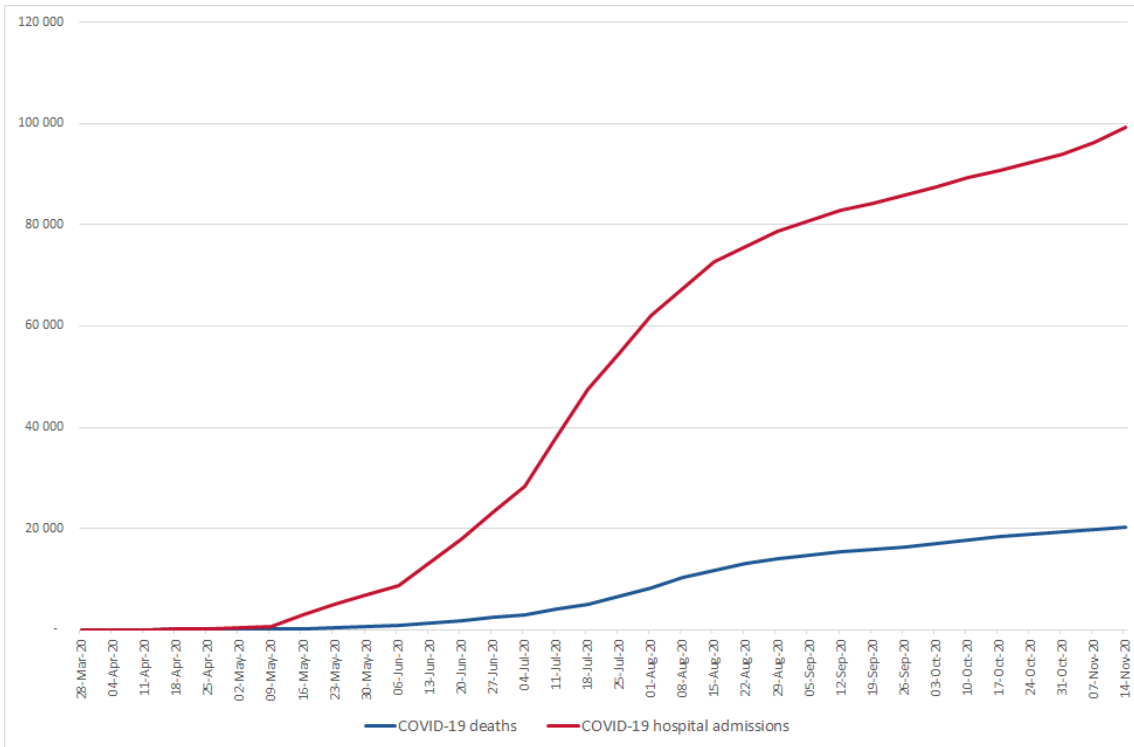


Figure 1 Cumulative reported COVID-19 and hospital admissions – South Africa

The reported COVID-19 hospital admissions provide a useful indicator for identifying a second wave of COVID-19 infections, especially for those provinces where the reporting COVID-19 deaths may be unreliable.

2. Forecast results

NMG has released a web-based version of the multi-state actuarial model that will allow interested parties to generate different COVID-19 forecast scenarios for South Africa. The model can be accessed at <https://nmg-covid-19.sctechnology.co.za/>

2.1 Results for South Africa

The reported and unreported COVID-19 deaths are compared against three forecast scenarios in the graph below. The forecasts scenarios are fitted for the first wave of COVID-19 infections and then projected for an anticipated second wave. Currently, only the Eastern Cape shows clear evidence of a second wave. For the other provinces, COVID-19 infections are assumed to continue after the first wave has passed but not at a level that results in a second wave.

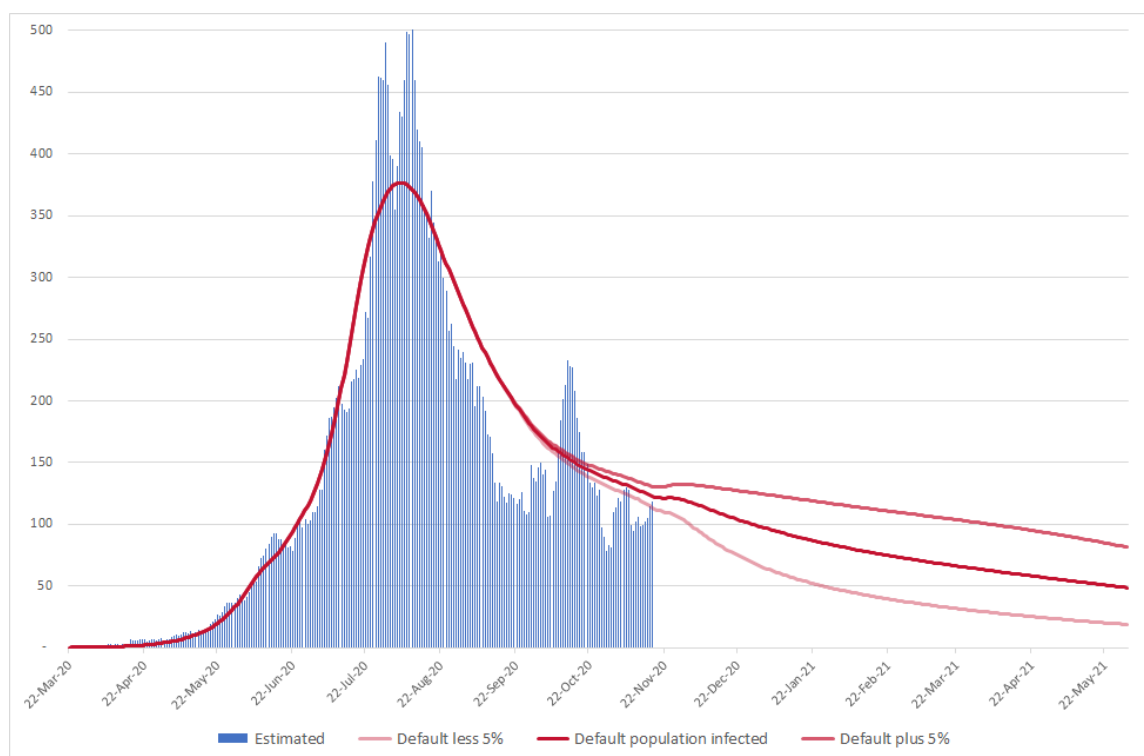


Figure 2 Forecast daily COVID-19 deaths (7-day moving average) – South Africa

The projections extend to 31 May 2021 and forecast a range of viral infection levels across the nine provinces. The Free State is forecast to have the highest infection levels with 50% of the population infected by 31 May 2021. Eastern Cape is also forecast to have high infection levels with 45% of the population infected. Gauteng, KwaZulu Natal and the Western Cape are next at 35% of the population infected. The rest of the provinces have between 20% and 25% of their respective populations infected.

The reported COVID-19 hospital admissions are compared against the same three forecast scenarios in the graph below.

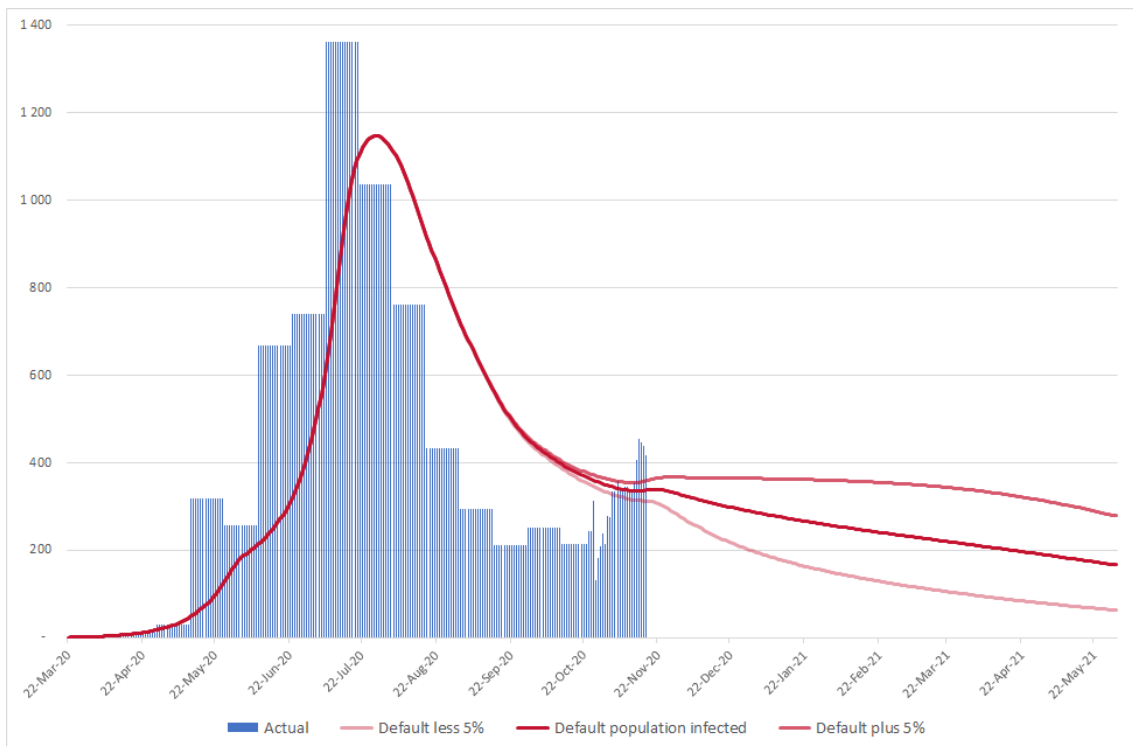


Figure 2 Forecast daily COVID-19 hospital admissions (7-day moving average) – South Africa

The historical fit of the model with reported COVID-19 hospital admissions is not as accurate as that for the reported COVID-19 deaths given that the primary data point used to calibrate the model was reported deaths. Going forward, the model will be calibrated using the reported COVID-19 hospital admissions as these are expected to be a more reliable indicator of a second wave of infections.

2.2 Results for the Western Cape

The reported and unreported COVID-19 deaths in the Western Cape are compared against three scenarios in the graph below.

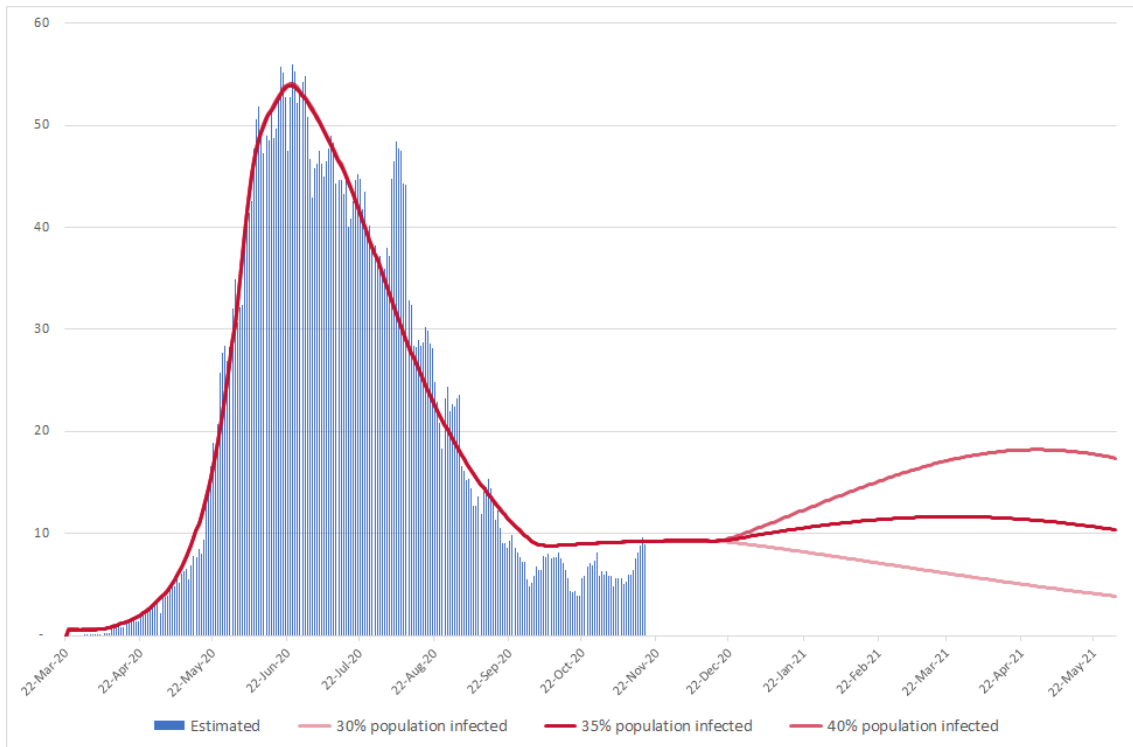


Figure 3 Forecast daily COVID-19 deaths (7-day moving average) – Western Cape

The reported COVID-19 hospital admissions in the Western Cape are compared against the same three scenarios in the graph below.

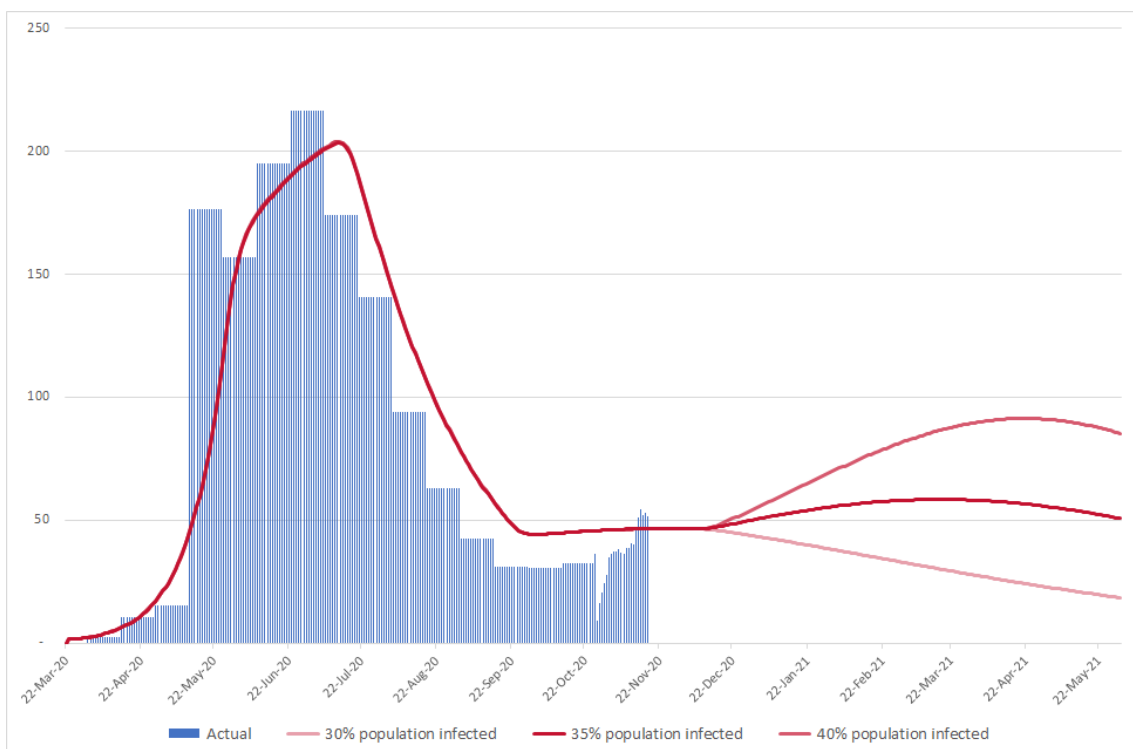


Figure 4 Forecast daily COVID-19 hospital admissions (7-day moving average) – Western Cape

2.3 Results for Gauteng

The reported and unreported COVID-19 deaths in Gauteng are compared against three scenarios in the graph below.

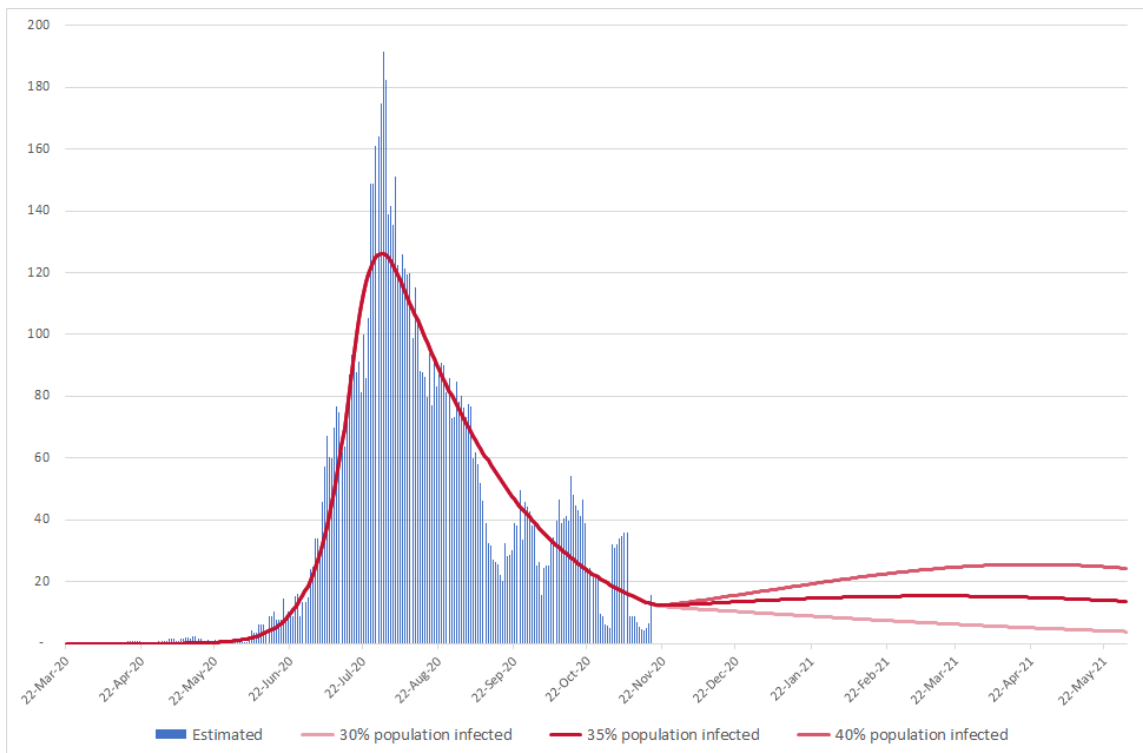


Figure 5 Forecast daily COVID-19 deaths (7-day moving average) – Gauteng

The reported COVID-19 hospital admissions in Gauteng are compared against the same three scenarios in the graph below.

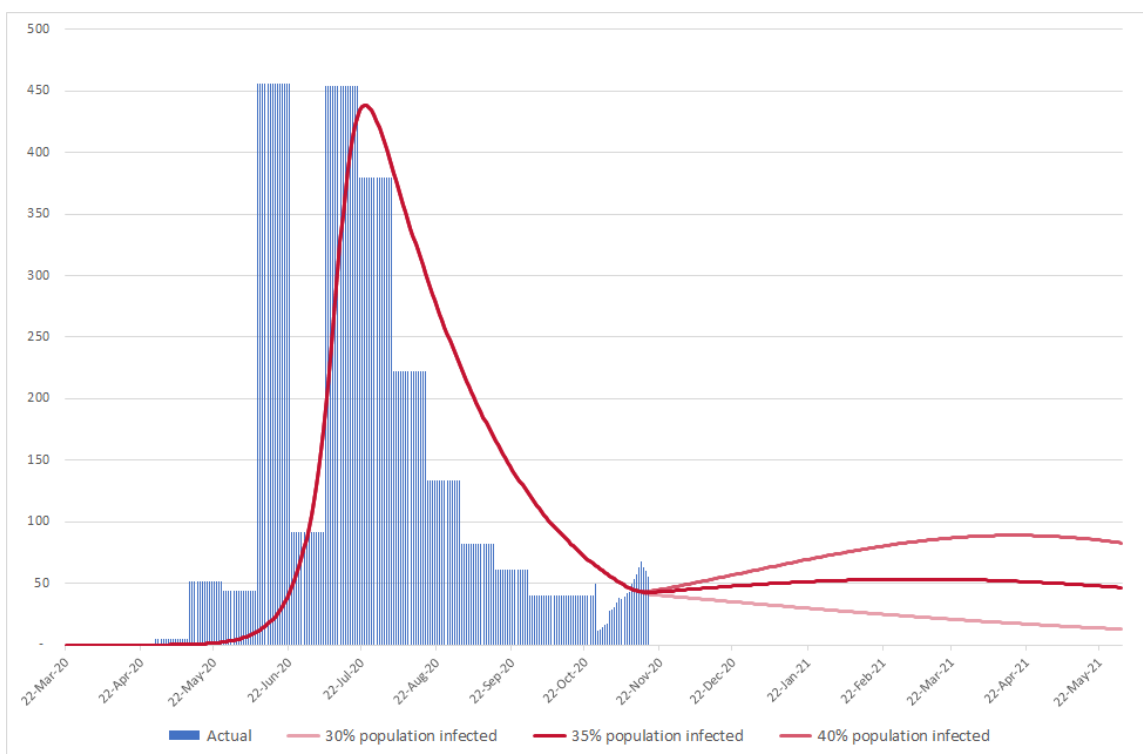


Figure 6 Forecast daily COVID-19 hospital admissions (7-day moving average) – Gauteng

2.4 Results for KwaZulu Natal

The reported and unreported COVID-19 deaths in KwaZulu Natal are compared against three scenarios in the graph below.

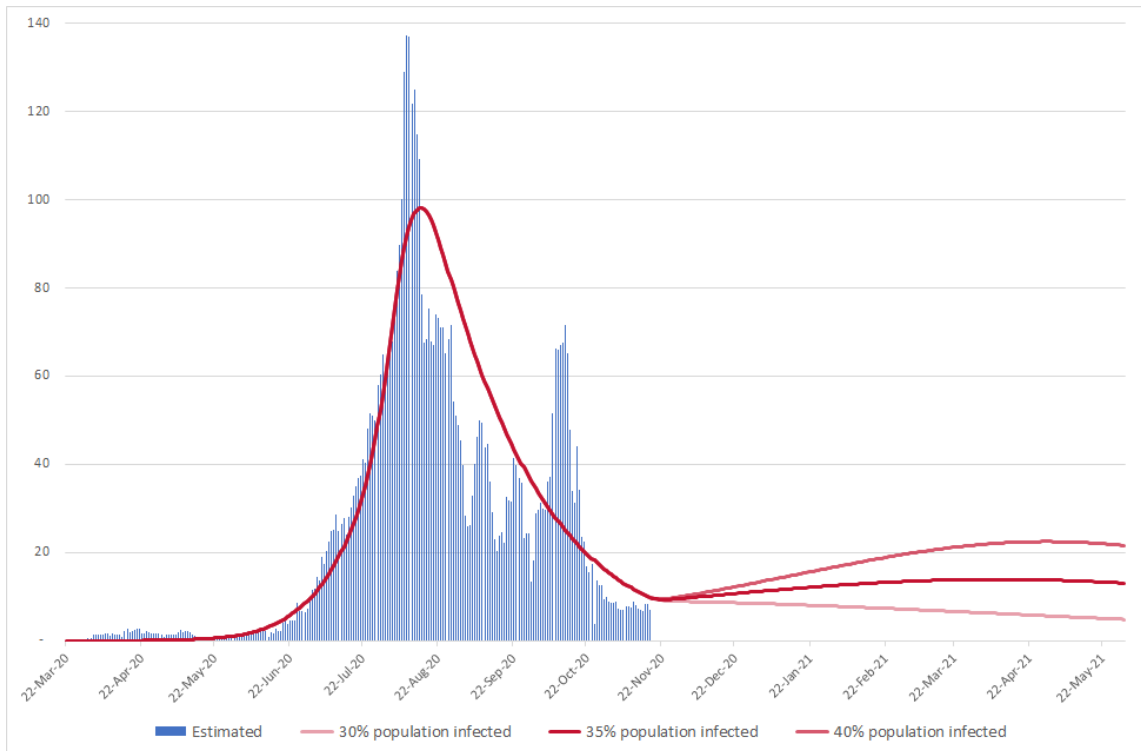


Figure 7 Forecast daily COVID-19 deaths (7-day moving average) – KwaZulu Natal

The reported COVID-19 hospital admissions in KwaZulu Natal are compared against the same three scenarios in the graph below.

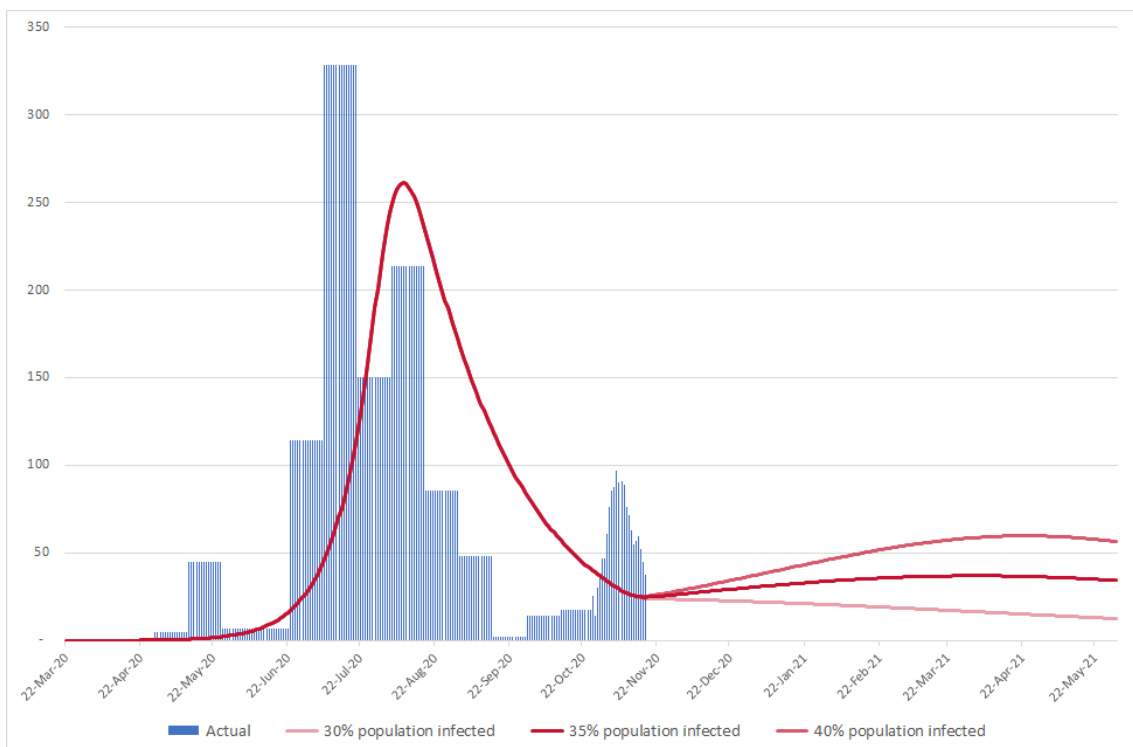


Figure 8 Forecast daily COVID-19 hospital admissions (7-day moving average) – KwaZulu Natal

2.5 Results for the Eastern Cape

The reported and unreported COVID-19 deaths in the Eastern Cape are compared against three scenarios in the graph below.

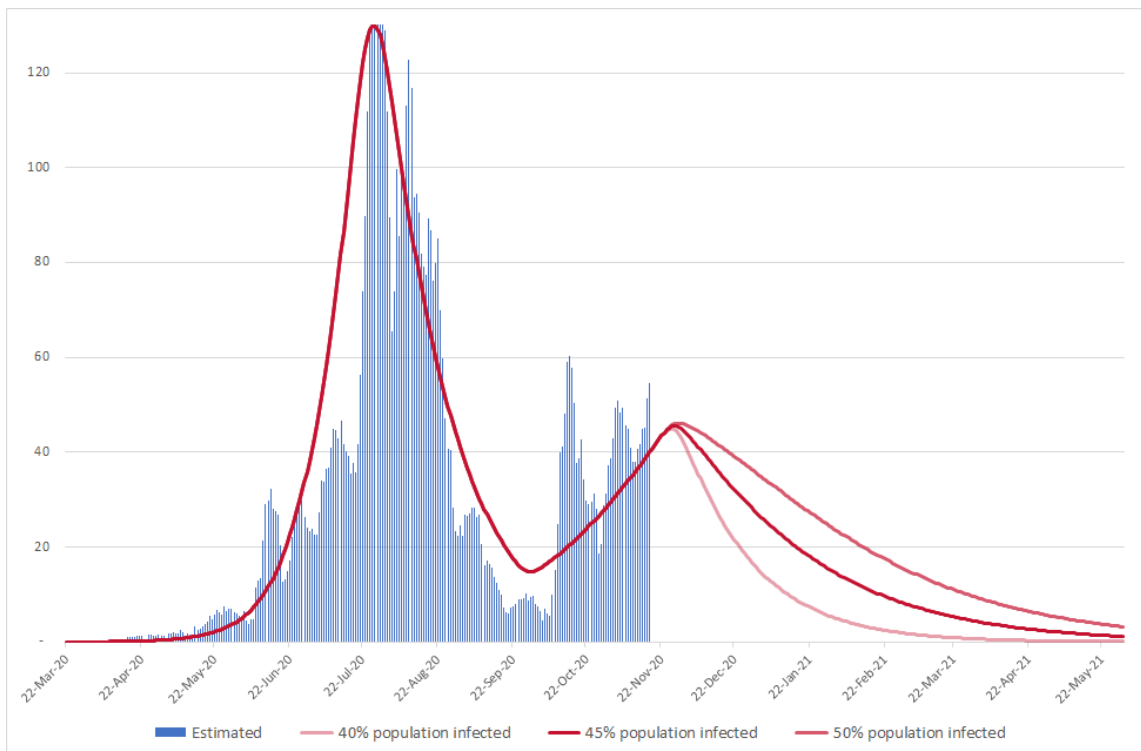


Figure 9 Forecast daily COVID-19 deaths (7-day moving average) – Eastern Cape

The reported COVID-19 hospital admissions in the Eastern Cape are compared against the same three scenarios in the graph below.

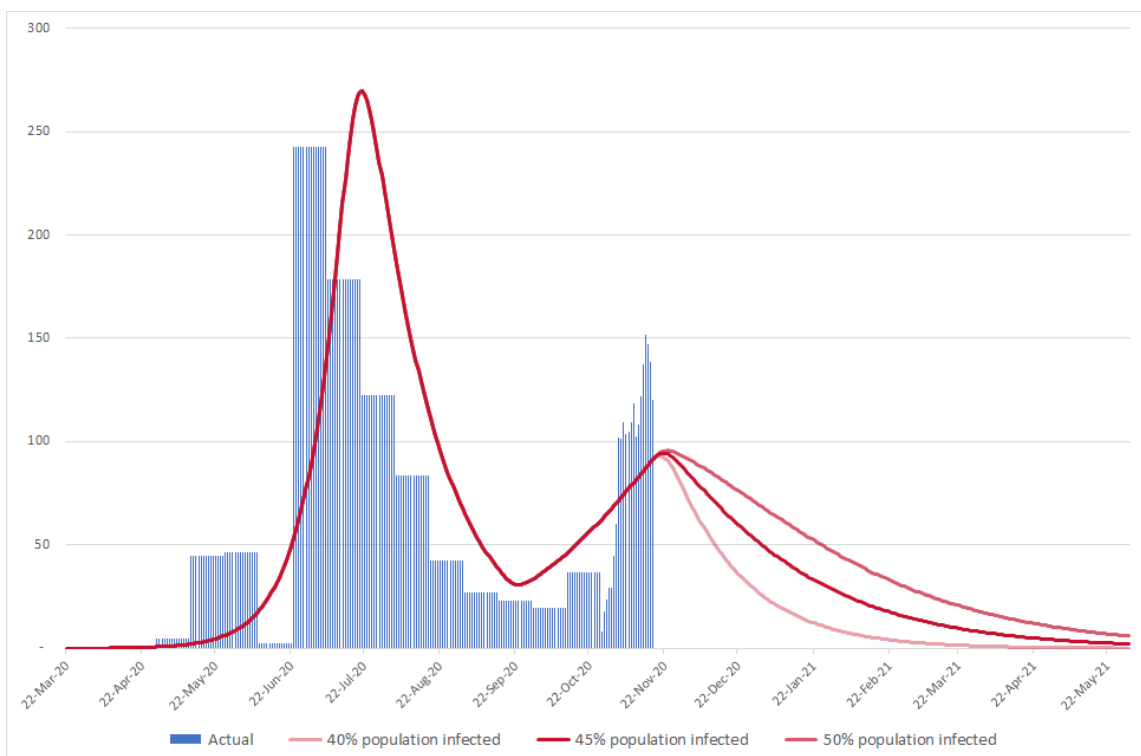


Figure 10 Forecast daily COVID-19 hospital admissions (7-day moving average) – Eastern Cape

2.6 Results for the Free State

The reported and unreported COVID-19 deaths in the Free State are compared against three scenarios in the graph below.

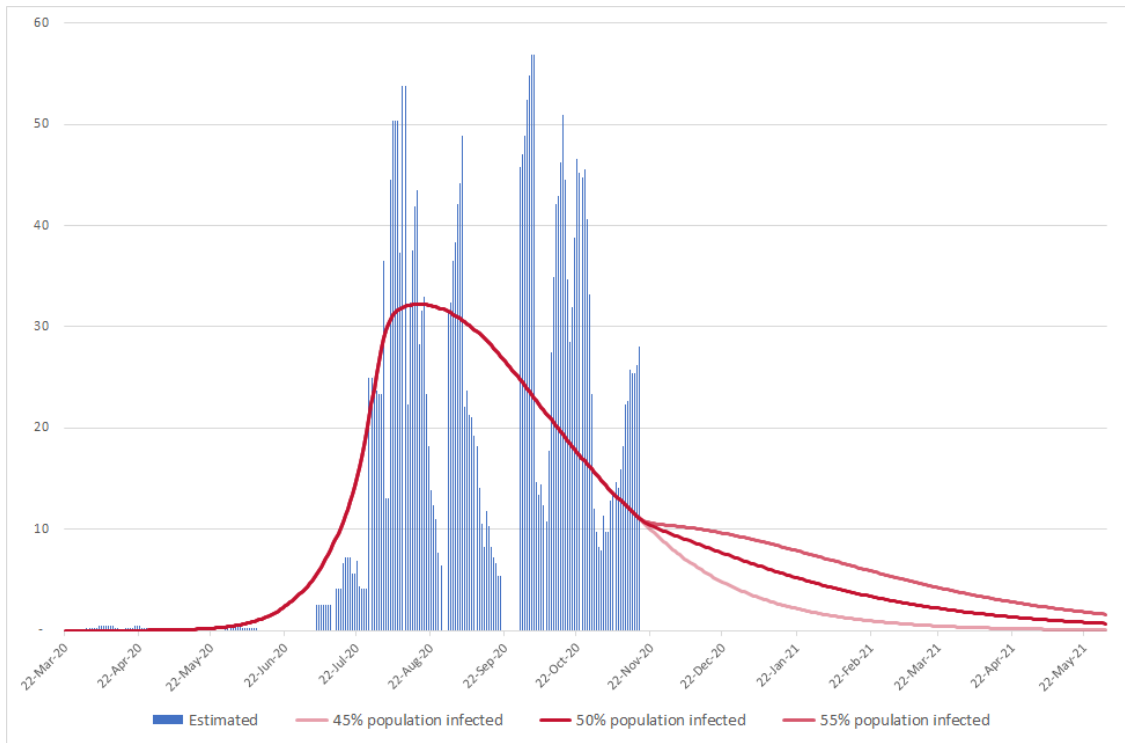


Figure 11 Forecast daily COVID-19 deaths (7-day moving average) – Free State

The reported COVID-19 hospital admissions in the Free State are compared against the same three scenarios in the graph below.

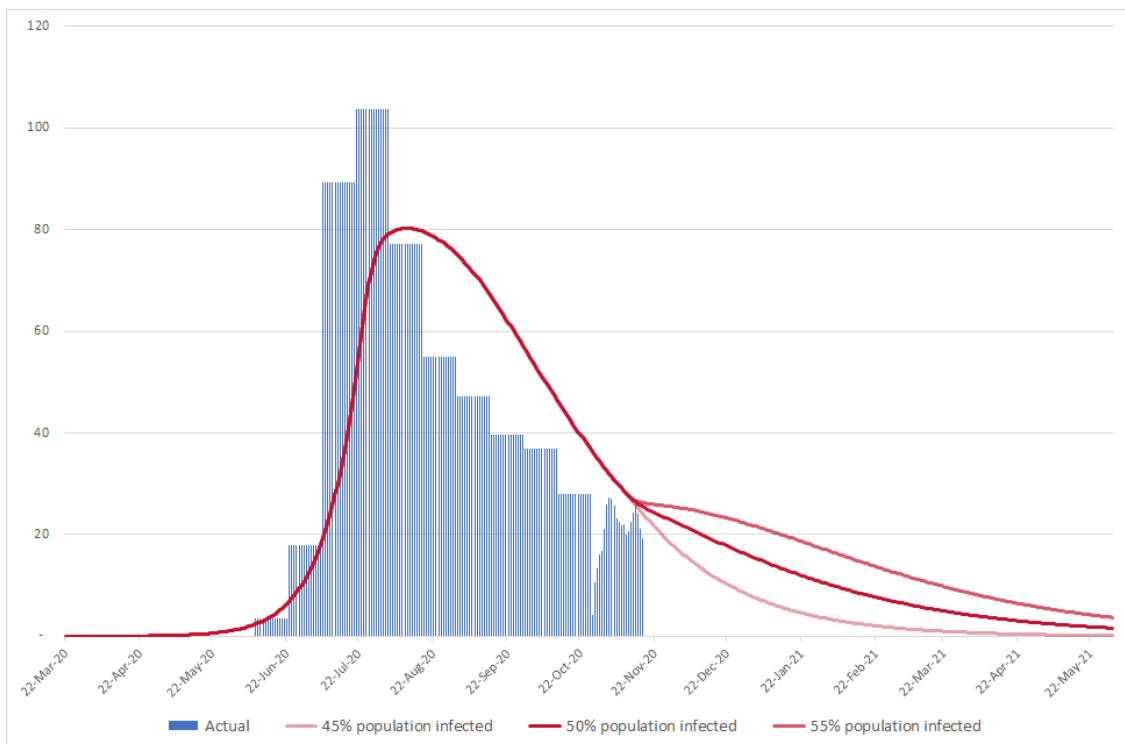


Figure 12 Forecast daily COVID-19 hospital admissions (7-day moving average) – Free State

2.7 Results for the other provinces

The reported and unreported COVID-19 deaths in Limpopo, Mpumalanga, the Northern Cape and the North West Province are compared against three scenarios in the graph below.

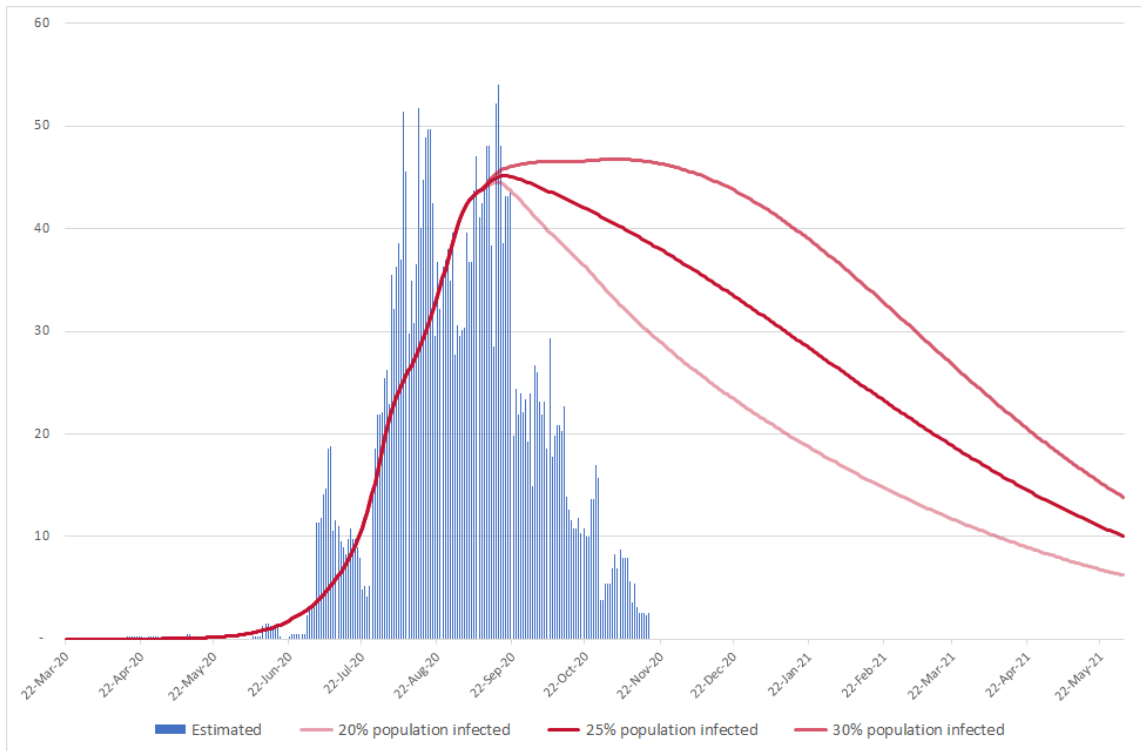


Figure 13 Forecast daily COVID-19 deaths (7-day moving average) – Other Provinces

The reported COVID-19 hospital admissions in the other provinces are compared against the same three scenarios in the graph below.

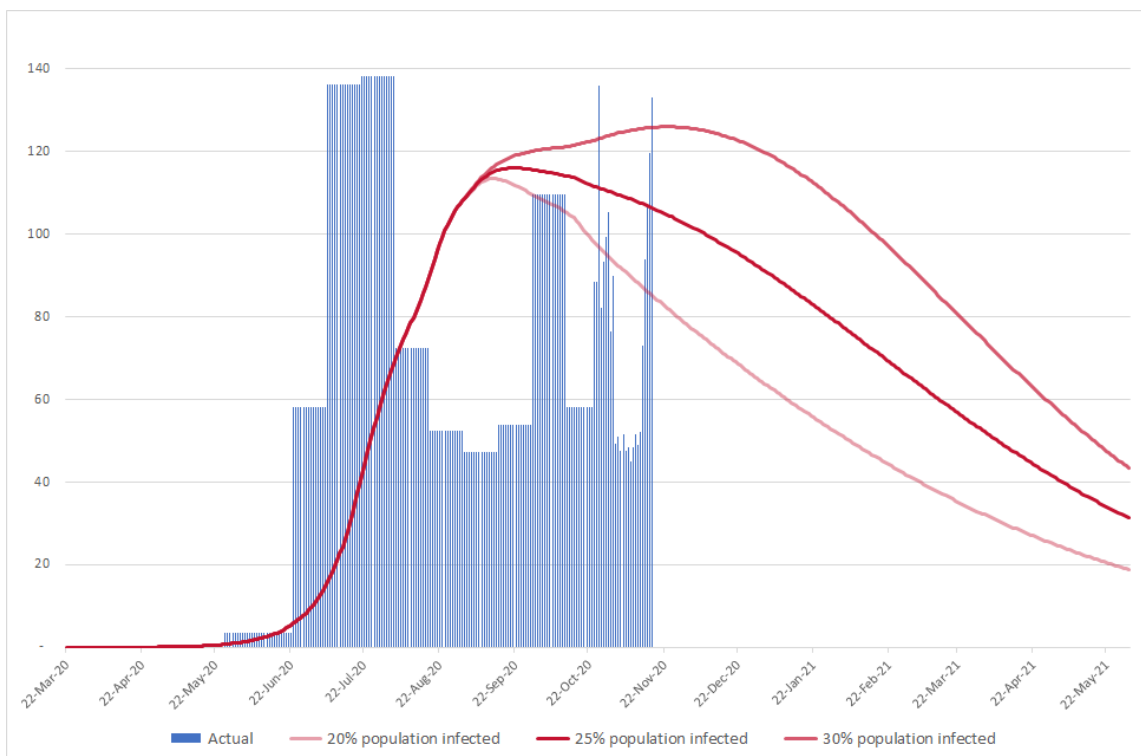


Figure 14 Forecast daily COVID-19 hospital admissions (7-day moving average) – Other Provinces

Thank you

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