Technical insights from estimating excess mortality in South Africa during COVID-19

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History and background

- Vital registration of births, deaths, and marriages in South Africa began before the start of the 20th century, and was codified by legislation in 1923 (although voluntary for African South Africans in rural areas)
  - Extended to all population groups in 1963
- South Africa instituted a National Population Register (NPR) in 1950, which was seeded largely by the data from the 1951 Census, and thence updated through registered births and deaths
  - Originally, due to apartheid policies, African South Africans were excluded from the NPR. African South Africans were included in the NPR after 1986
- Both systems are overseen by the Department of Home Affairs. The national statistics office (Statistics SA) is mandated to produce official vital statistics from the CRVS, including analysis of cause of death data

Death notification process

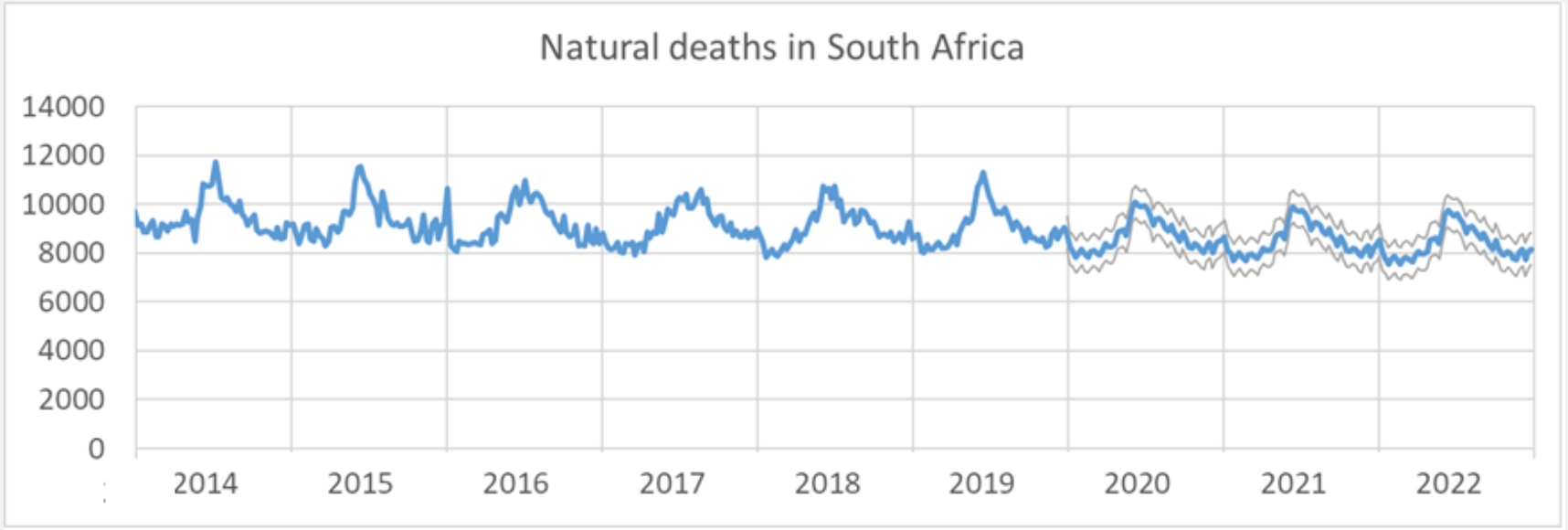
- On death, a 3-page death notification form (DNF) should be completed
  - Part A (1 page) contains basic information on the decedent
  - Part B (2 pages) contains a confidential medical certification of causes leading to death
    - Part B is sealed by the certifying medical officer, and not opened until processed by Statistics SA
- The DNF is then taken to the Department of Home Affairs, who capture some of the information from Part A in real-time, and issue a short-form death certificate (no causes other than natural/unnatural), and a permit for burial/cremation
- If the decedent is on the NPR, the Register is updated in real-time. If the decedent is NOT on the NPR, the DNF is held over for processing by Statistics SA
- **There are thus TWO distinct lacunae in the NPR data**
  - 1. Not ALL deaths are notified (at all) to DHA – “incompleteness”
  - 2. Deaths of those without South African ID numbers are not on the NPR

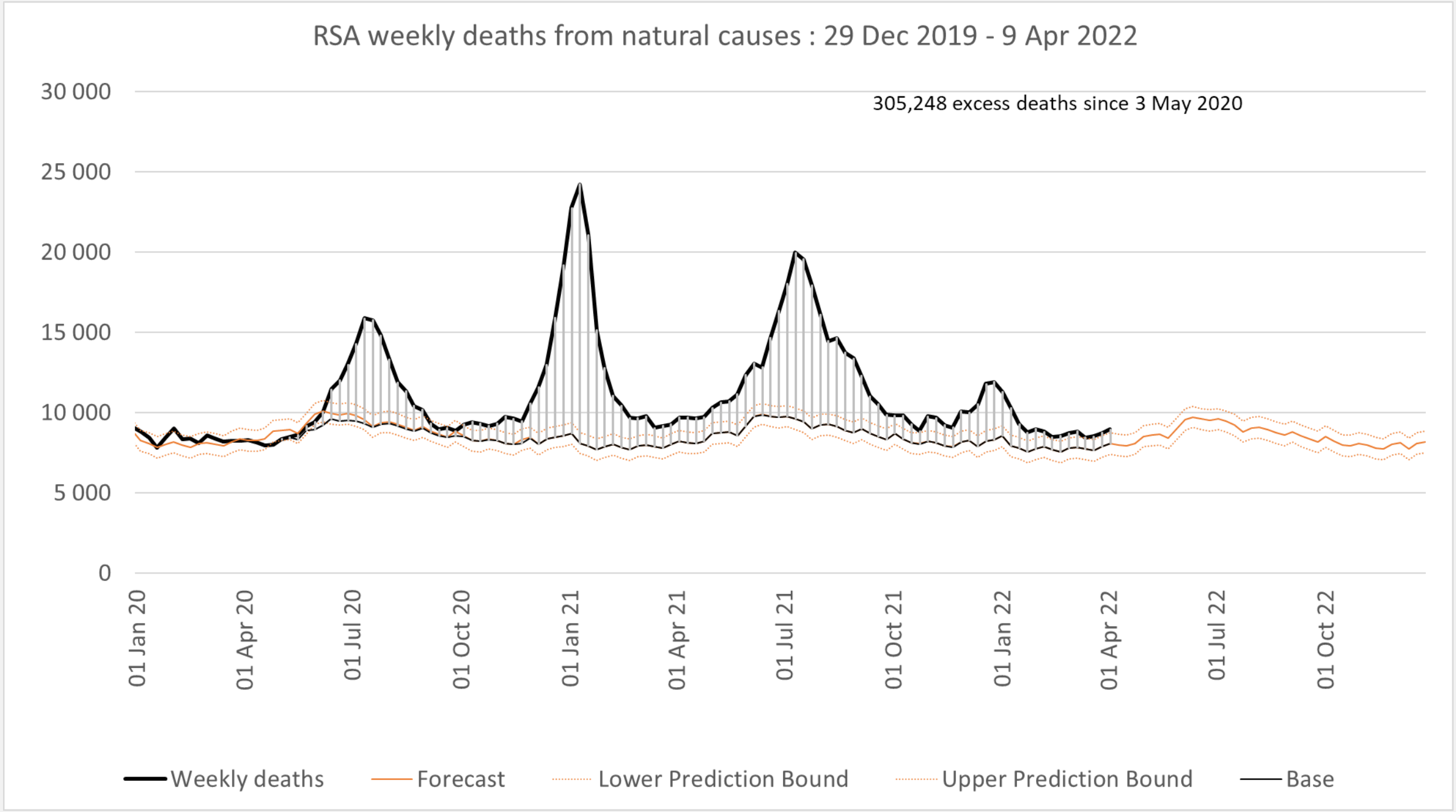
Monitoring excess mortality in South Africa in near-real time

- Through a data-sharing agreement, the SA Medical Research Council receives each Tuesday a file of the incremental deletions from the NPR in respect of deaths notified to DHA in the immediately preceding epi-week (Sunday to Saturday)
- Information received: ID number, dates of birth and death, sex, office where notification was given, and whether death was from natural or unnatural causes
- The data are then adjusted for …
  - Incurred-but-not-(yet)-reported deaths in the immediately preceding week (including allowance for delayed registration owing to public holidays in that week)
  - Deaths notified to DHA but not on the NPR (built from retrospective analysis of these deaths as reported on by Statistics SA – but these are released 2-3 years after)
  - Incompleteness of death reporting by age (from analysis of official CRVS and census data)
- … to provide an estimate of the 'true' number of deaths in the week
  - Adjustments result in an overall inflation of the NPR deaths by c 10-15% (in reality, more finely grained than that)

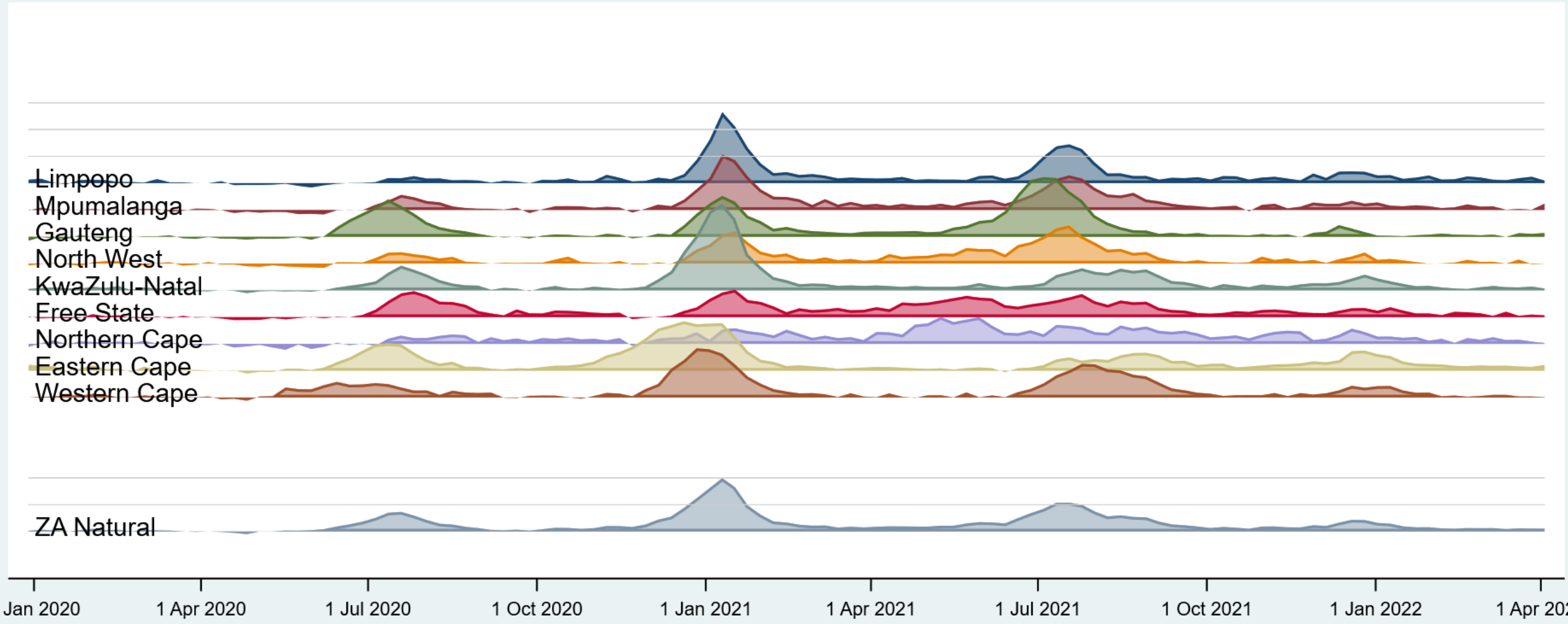
Monitoring excess mortality in South Africa in near-real time

- A counterfactual of the weekly number of expected deaths (by age, sex, province, and the major metropolitan areas) is derived from a negative binomial statistical model fitted to the death data from 2014-2019, including a time-trend parameter (allowing for the opposing effects of population growth and declining mortality)
  - Predicted weekly deaths (and prediction bounds) for 2020-2022 obtained by extrapolation




RSA weekly deaths from natural causes : 29 Dec 2019 - 9 Apr 2022
305,248 excess deaths since 3 May 2020
30 000
25 000
20 000
15 000
10 000
5 000
0
01 Jan 20
01 Apr 20
01 Jul 20
01 Oct 20
01 Jan 21
01 Apr 21
01 Jul 21
01 Oct 21
01 Jan 22
01 Apr 22
01 Jul 22
01 Oct 22
Weekly deaths
Forecast
Lower Prediction Bound
Upper Prediction Bound
Base

p-scores by week and province, South Africa

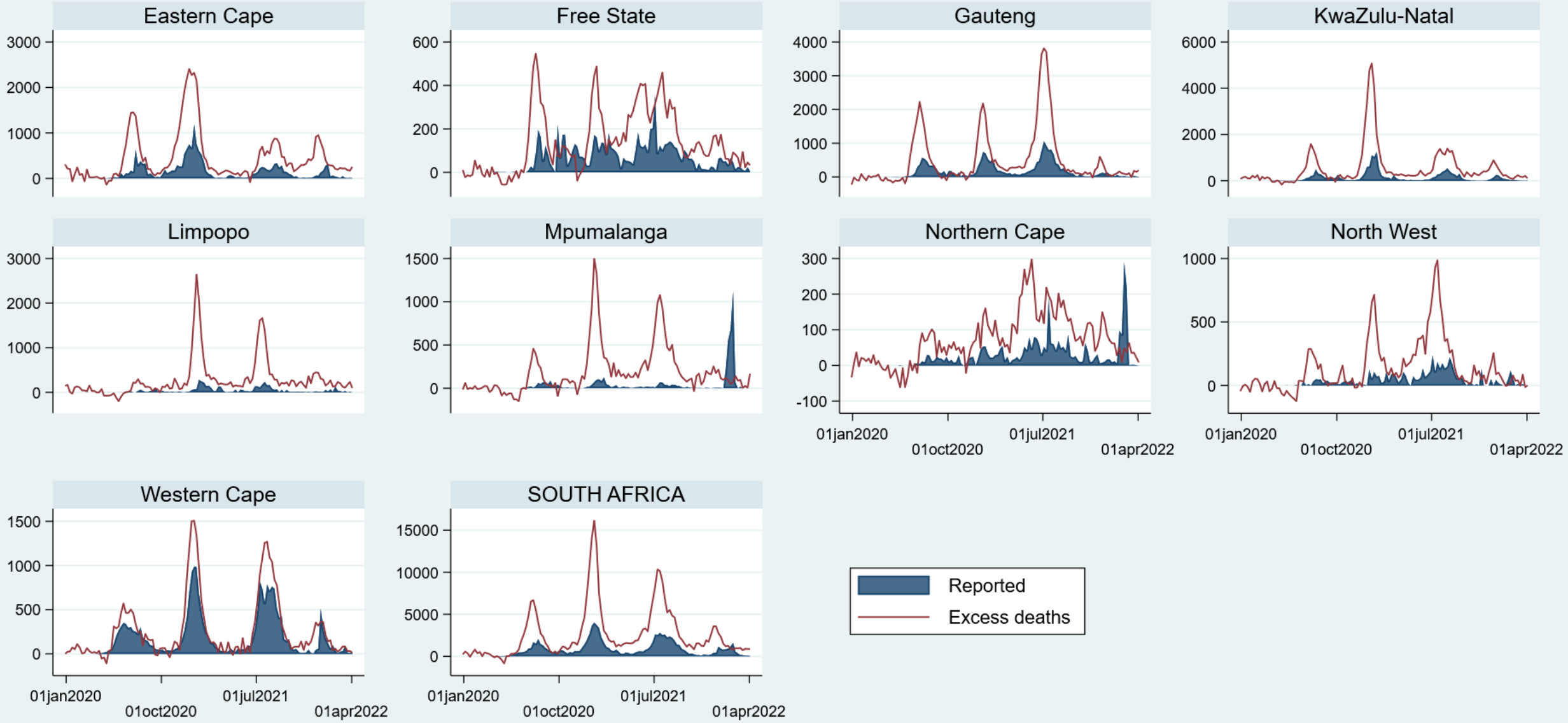


Final week runs from 3/04/2022 to 9/04/2022

Each vertical increment represents 100% extra mortality above the series' baseline

A p-score is a measure of excess mortality, and is expressed as the percentage by which observed deaths exceed expected deaths

Reported Covid-19 deaths and excess deaths by province and week



Data through to 09Apr22

Ingredients for a successful near-real time mortality monitoring system

- Essential: a real-time death notification system
  - Either, a national population register (coupled with a national identity system); or
  - A mostly-complete vital registration system
- Necessary:
  - detailed understanding of limitations, incompleteness and deficiencies of those systems
  - ability to provide at least basic information in real-time, governed by a data-sharing protocol
- Desirable:
  - Political will and high-level support for the effort

- In South Africa, we have been able to utilise the timeliness of the NPR in conjunction with a deep historical understanding of completeness (from the CRVS) to build a hybrid system
  - Yet, the ability to provide near-real time estimates of excess mortality in the country has been achieved despite the barriers placed in our path: obstruction, obfuscation, indifference, delay