Projection of early spread of COVID-19 in Africa as of 25 March 2020

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Summary

According to the WHO Situation reports (SITREPs) of 24 March 2020, 45 out of 56 African countries have reported at least one case of COVID-19 (World Health Organisation 2020). Here we estimate the timing for the first 1 000 (1K) and first 10 000 (10K) COVID-19 cases for those countries. Based on current trends, we find almost all African countries are likely to pass 1K reported cases by 1 May, and 10K within another few weeks (Figure and Table 1); alarmingly, these are largely synchronised continent-wide, and real burdens are certainly higher than reports. This calls for urgent action across Africa.

New containment measures, e.g. increased testing, contact tracing, isolation of cases, and quarantine of contacts are likely to slow, but not halt, real epidemic growth (Hellewell et al. 2020). Increased testing may accelerate the time to reporting these numbers, as improved ascertainment increases the identified fraction of real cases, but should ultimately reduce real overall burden.

These forecasts are only as accurate as the data available in the SITREPs and applicability of global experience to Africa. Lags and missingness in that data tend to delay onset of the 1K and 10K case dates, so the real timing is likely sooner than our estimates for many countries. Additionally, our model is inappropriate for long range forecasts, hence the restricted projections. However, we are currently reproducing the reporting in some countries with advanced epidemics, like South Africa, when assuming $R \approx 2$; for $R \approx 3$ (as suggested for other settings in some recent studies), we forecast all countries to likely have 10K cases by the end of April.

Methods

We estimate the cumulative reported cases using a branching process model to simulate the epidemic. We assume the epidemic is seeded by cases distributed in time proportionally to the earliest SITREP cases; transmission from those specific cases may have been contained, but we assume other undetected transmission chains persist and eventually lead to detected cases. We assume the epidemics proceed similarly to other regions in the world, and whatever rates of detection and other intervention measures affected the initially reported cases remain constant on a country-by-country basis.

The model is initialized assuming that the epidemic was seeded by the cases represented in the SITREPs. We used the first 25 (or fewer) cases as representative the timing of early seeding. For countries with fewer than 25 cases on 24 March, the projections are made from 25 March. For example, South Africa's last day with fewer than 25 cases is 13 March, so projections are made from 14 March.

Epidemic parameters:

- Each case produces an average of 2 additional cases (Abbott et al. 2020) (negative binomially distributed offspring distribution with mean 2 and dispersion parameter 0.58 (Bi et al. 2020)).
- The average time between the onset of a case and the onset of a subsequent case infected by that case (serial interval) is 4.7 days (log-normally distributed with mean 4.7 and standard deviation 2.9) (Nishiura, Linton, and Akhmetzhanov 2020).

The model was run 1000 times. The results are summarized using the middle 50% and 95% of the distribution for the time to reach the specified number of cases. The estimates specific to South Africa are based on a higher resolution forecast (10x samples) previously used for a national report.

The model was built using the `bpmodels` package in the R statistical programming language (Funk 2020), and using the `data2019nCoV` package for the SITREP data up to report 63 (Brown 2020). All analysis code is available from https://github.com/SACEMA/COVID10k.
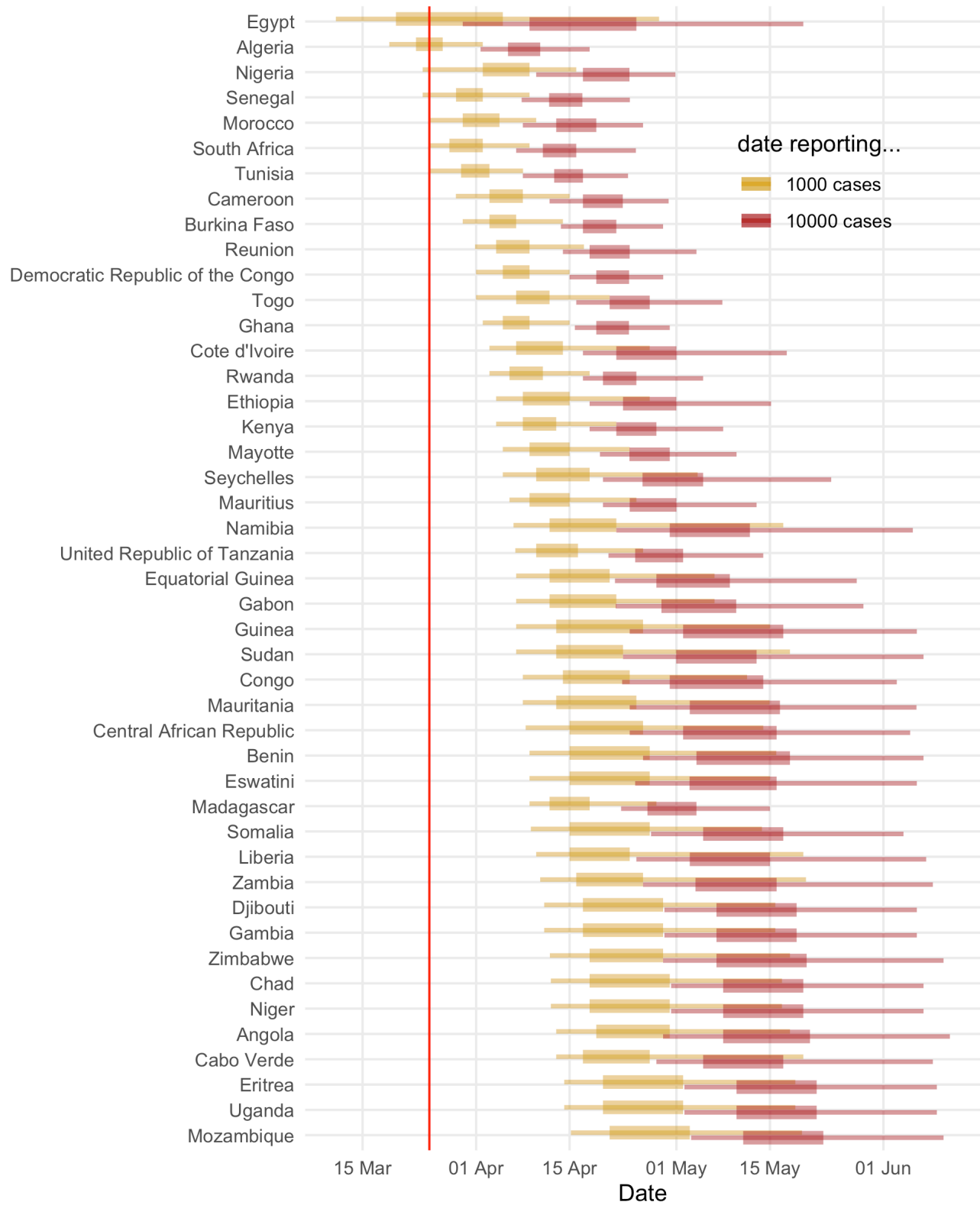
Figure 1: Distribution of times to 1K (yellow) and 10K (red) cases based on 1000 model runs, ordered by lower limit for estimate of reaching 1K cases. Wide boxes 50% interval, lines 95% interval. The red vertical line corresponds to 25 March 2020.

Table 1: Dates of timing to 1K and 10K cases, by Country (Alphabetical)

Country	Date of 1K Cases, 50% interval (95%)	…10K Cases
Algeria	Mar 23-Mar 27 (Mar 19-Apr 02)	Apr 05-Apr 10 (Apr 01-Apr 18)
Angola	Apr 19-Apr 30 (Apr 13-May 18)	May 08-May 21 (Apr 29-Jun 10)
Benin	Apr 15-Apr 27 (Apr 09-May 15)	May 04-May 18 (Apr 26-Jun 07)
Burkina Faso	Apr 03-Apr 07 (Mar 30-Apr 14)	Apr 17-Apr 22 (Apr 13-Apr 29)
Cabo Verde	Apr 17-Apr 27 (Apr 13-May 20)	May 05-May 17 (Apr 28-Jun 08)
Cameroon	Apr 03-Apr 08 (Mar 28-Apr 15)	Apr 17-Apr 22 (Apr 12-Apr 29)
Central African Republic	Apr 15-Apr 26 (Apr 08-May 14)	May 02-May 16 (Apr 24-Jun 05)
Chad	Apr 18-Apr 30 (Apr 12-May 16)	May 08-May 20 (Apr 30-Jun 07)
Congo	Apr 14-Apr 24 (Apr 08-May 11)	Apr 30-May 14 (Apr 22-Jun 03)
Cote d'Ivoire	Apr 07-Apr 14 (Apr 03-Apr 27)	Apr 22-May 01 (Apr 17-May 17)
Democratic Republic of the Congo	Apr 05-Apr 09 (Apr 01-Apr 15)	Apr 19-Apr 23 (Apr 15-Apr 29)
Djibouti	Apr 17-Apr 29 (Apr 11-May 15)	May 07-May 19 (Apr 29-Jun 06)
Egypt	Mar 20-Apr 05 (Mar 11-Apr 28)	Apr 09-Apr 25 (Mar 30-May 20)
Equatorial Guinea	Apr 12-Apr 21 (Apr 07-May 06)	Apr 28-May 09 (Apr 21-May 28)
Eritrea	Apr 20-May 02 (Apr 14-May 18)	May 10-May 22 (May 02-Jun 09)
Eswatini	Apr 15-Apr 27 (Apr 09-May 15)	May 02-May 16 (Apr 24-Jun 06)
Ethiopia	Apr 08-Apr 15 (Apr 04-Apr 27)	Apr 23-Apr 30 (Apr 18-May 15)
Gabon	Apr 12-Apr 22 (Apr 07-May 06)	Apr 28-May 09 (Apr 21-May 29)
Gambia	Apr 17-Apr 29 (Apr 11-May 15)	May 07-May 19 (Apr 29-Jun 06)
Ghana	Apr 05-Apr 09 (Apr 02-Apr 15)	Apr 19-Apr 23 (Apr 15-Apr 30)
Guinea	Apr 13-Apr 26 (Apr 07-May 15)	May 02-May 17 (Apr 24-Jun 06)
Kenya	Apr 08-Apr 13 (Apr 04-Apr 22)	Apr 22-Apr 28 (Apr 18-May 08)
Liberia	Apr 15-Apr 24 (Apr 10-May 20)	May 03-May 15 (Apr 25-Jun 07)
Madagascar	Apr 12-Apr 18 (Apr 09-Apr 28)	Apr 26-May 04 (Apr 22-May 15)
Mauritania	Apr 13-Apr 25 (Apr 08-May 14)	May 03-May 16 (Apr 24-Jun 05)
Mauritius	Apr 09-Apr 15 (Apr 06-Apr 25)	Apr 24-May 01 (Apr 20-May 13)
Mayotte	Apr 09-Apr 15 (Apr 05-Apr 24)	Apr 23-Apr 30 (Apr 19-May 10)
Morocco	Mar 30-Apr 04 (Mar 25-Apr 10)	Apr 13-Apr 19 (Apr 08-Apr 26)
Mozambique	Apr 21-May 03 (Apr 15-May 19)	May 11-May 23 (May 03-Jun 10)
Namibia	Apr 12-Apr 22 (Apr 06-May 17)	Apr 30-May 12 (Apr 22-Jun 05)
Niger	Apr 18-Apr 30 (Apr 12-May 16)	May 08-May 20 (Apr 30-Jun 07)
Nigeria	Apr 02-Apr 09 (Mar 24-Apr 16)	Apr 17-Apr 23 (Apr 10-Apr 30)
Reunion	Apr 04-Apr 09 (Mar 31-Apr 17)	Apr 18-Apr 24 (Apr 14-May 04)
Rwanda	Apr 06-Apr 11 (Apr 03-Apr 18)	Apr 20-Apr 25 (Apr 17-May 05)
Senegal	Mar 29-Apr 02 (Mar 24-Apr 09)	Apr 11-Apr 16 (Apr 07-Apr 24)
Seychelles	Apr 10-Apr 18 (Apr 05-May 04)	Apr 25-May 05 (Apr 20-May 24)
Somalia	Apr 15-Apr 27 (Apr 09-May 13)	May 05-May 17 (Apr 27-Jun 04)
South Africa	Mar 28-Apr 02 (Mar 25-Apr 09)	Apr 11-Apr 16 (Apr 07-Apr 24)
Sudan	Apr 13-Apr 23 (Apr 07-May 18)	Apr 30-May 13 (Apr 23-Jun 07)
Togo	Apr 07-Apr 12 (Apr 01-Apr 21)	Apr 21-Apr 27 (Apr 16-May 07)
Tunisia	Mar 29-Apr 03 (Mar 25-Apr 08)	Apr 12-Apr 17 (Apr 08-Apr 23)
Uganda	Apr 20-May 02 (Apr 14-May 18)	May 10-May 22 (May 02-Jun 09)
United Republic of Tanzania	Apr 10-Apr 16 (Apr 06-Apr 26)	Apr 24-May 02 (Apr 20-May 14)
Zambia	Apr 16-Apr 26 (Apr 10-May 20)	May 03-May 16 (Apr 26-Jun 08)
Zimbabwe	Apr 18-Apr 29 (Apr 12-May 18)	May 07-May 20 (Apr 29-Jun 10)

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