Projections of the Ebola epidemic in Guinea and Sierra Leone at the county level

Compiled up to 5 July 2015

http://cmmid.lshtm.ac.uk/research/ebola
Introduction

Projections

Methods

Acknowledgement

http://cmmid.lshtm.ac.uk/research/ebola
Introduction
We focus on the 6 counties in West-Africa with the most active transmission over the past 3 weeks:

- **Guinea**: Boke, Dubréka, Forécariah.
- **Sierra Leone**: Kambia, Port Loko, Western Area.

Our model averages the transmission dynamics over the last 3 weeks in order to project it over the next 4 weeks.

We report median estimates and interquartile range credible intervals.

Our approach assumes that the situation remains broadly unchanged and can not therefore anticipate large and sudden changes in transmission.

http://cmmid.lshtm.ac.uk/research/ebola
Projections
Recent variations in the number of cases might reflect rapid changes of the transmission dynamics. To visualize this variability, we now present two forecasts:

- The first one is based on the average reproduction number $R$ over the last three weeks. This is the forecast we used to present in our previous reports.
- In addition, we present a forecast based on the latest value of $R$.

When both forecasts are similar this means that the dynamics has not changed recently. However, where they are quite different, this indicates that substantial changes in $R$ happened recently and that there is more uncertainty for the number of expected cases over the next weeks, depending whether recent changes in $R$ persist or not.

http://cmmid.lshtm.ac.uk/research/ebola
Guinea

http://cmmid.lshtm.ac.uk/research/ebola
Sierra Leone

http://cmmid.lshtm.ac.uk/research/ebola
Methods
Data

- WHO provides weekly number of confirmed & probable cases at the subnational level for Guinea and Sierra Leone.
- WHO data comes from the linelist, which is the most reliable data source because it is continuously cleaned. In particular, it takes into account reclassification and thus avoid double counting of cases.
- However, the linelist is updated with substantial delay so that the number of cases is well underestimated on the most recent weeks.
- By contrast, the daily SitReps are published with a delay of a few days only.
- We compared both data sources and then used a reliable combination of both to perform our fitting and forecast.

http://cmmid.lshtm.ac.uk/research/ebola
Transmission model

- We set a stochastic transmission model including susceptible, exposed, infectious and removed individuals (SEIR).
- The model was parametrized using country-specific empirical estimates (1) for the incubation (around 9 days) and infectious periods (around 11 days).
- Changes in the reproduction number ($R_t$) over time was modelled using a time-varying contact-rate parameter ($\beta_t$) (2).

$\beta_t \frac{SI}{N}$

Incubation period

Infectious period

http://cmmid.lshtm.ac.uk/research/ebola
The model was fitted to the time-series of weekly cases (probable and suspected) using a Bayesian approach (3).

We assumed that only 60% of the cases were reported in the data.

We used country-specific empirical estimates (1) for the delay between onset of symptoms and notification/hospitalization of reported cases (around 5 days).

We accounted for potential over-dispersion in the data.
The fitted model was used to simulate 3000 stochastic trajectories from 05 July (last fitted data point) until 02 August.

Each simulation started with a different value of $R_t$ sampled from the posterior distribution averaged over the last three data points in order to smooth over recent changes.
Limitations

- Our model uses a time-varying $R_t$ to capture the overall change of the reproduction number.
- Such changes are due to community behaviour, burial practice and control interventions.
- However, our model doesn’t explicitly account for the mechanistic effect of these different source of change. Rather it is a phenomenological description of their overall effect.
- Our forecast assumes that no intervention is implemented to reduce the reproduction number below what is inferred from the last three data-point (i.e. the situation remains broadly unchanged).

http://cmmid.lshtm.ac.uk/research/ebola
Acknowledgement
Contribution

- Anton Camacho (Research Fellow at LSHTM) & Sebastian Funk (Lecturer at LSHTM) performed data cleaning, extraction and analysis.
- Beth Smout, Rebecca Glover, Tim Pollington (Research Assistents at LSHTM), Lisa Knight (Medical Student at King’s College) and Julia Carney (MSc Student at LSHTM) performed data cleaning and extraction.
- We are grateful to Prof. Bernard Cazelles (UPMC) for access to the computational ressource and to Joseph Dureau (Snips) for useful advices on the use of the SSM library.
- We are also grateful to Etienne Gignoux (Epidemiologist at Epicentre), Dr Boubacar Diallo (WHO Guinea) and Prof. René Migliani (Conseiller du coordinateur national de la lutte contre Ebola en Guinée) for providing the Liberian and Guinean SitReps.

http://cmmid.lshtm.ac.uk/research/ebola
Funding

- This project (#13165) is funded by the Research for Health in Humanitarian Crises (R2HC) Programme, managed by Research for Humanitarian Assistance (ELRHA).
- The R2HC programme aims to improve health outcomes by strengthening the evidence base for public health interventions in humanitarian crises. Visit www.elrha.org/work/r2hc for more information.
- The £8 million R2HC programme is funded equally by the Wellcome Trust and DFID, with Enhancing Learning and ELRHA overseeing the programme’s execution and management.

http://cmmid.lshtm.ac.uk/research/ebola
References


http://cmmid.lshtm.ac.uk/research/ebola