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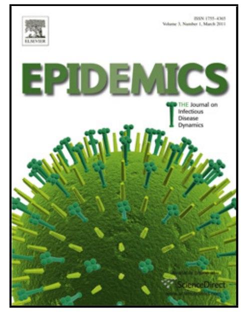

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Two approaches to forecast Ebola synthetic epidemics

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Abstract

We use two modelling approaches to forecast synthetic Ebola epidemics in the context of the RAPIDD Ebola Forecasting Challenge. The first approach is a standard stochastic compartmental model that aims to forecast incidence, hospitalization and deaths among both the general population and health care workers. The second is a model based on the renewal equation with latent variables that forecasts incidence in the whole population only. We describe fitting and forecasting procedures for each model and discuss their advantages and drawbacks. We did not find that one model was consistently better in forecasting than the other.

1 Introduction

The scale of 2014 West African Ebola epidemic took the world by surprise. Although several Ebola outbreaks erupted in Africa over the past 40 years, none reached more than several hundred cases, far from the estimated 28,000 cases and 11,000 deaths observed during this last epidemic. As national and international health organizations rushed to control an unprecedented epidemic, the need to forecast case incidence mounted daily in order to support difficult decisions about limited resource allocation. Mathematical and statistical tools developed over the last two decades have improved epidemic forecasting [1–3]. Yet it is still notoriously difficult to accurately predict an epidemic trajectory, because key features of the epidemic may be poorly known (e.g. pathogen natural history, routes of transmission, observation errors, etc.). Indeed, the 2014 West African Ebola epidemic was challenging to forecast because i) it was the first time an Ebola epidemic hit an African urban centre, ii) the natural history of the pathogen was poorly known and iii) the quality of epidemiological data reported was poor.

Forecasting incidence with a mathematical model involves two steps. First, the model parameters are fitted to observed data, then incidence is simulated forward using the inferred values for these parameters, while propagating uncertainty. The difficulty of each step depends on the modelling framework chosen. Here, we explore two different modelling approaches in the context of the Ebola Challenge, a forecasting exercise on synthetic Ebola epidemics ((cite overarching paper describing the Ebola challenge)).