

PHE real time model - initial results

PHE Modelling Cell

March 2020

- This document summarises results from the application of the PHE real time model to confirmed cases data from the PHE's Epi Cell line-listing from 2nd March to 16th and all deaths occurring on or prior to March 15th.
- We use both national data and look at London and the rest of the UK to estimate the number of new infections and predict ICU admission over the next 8 weeks. The ability of deterministic epidemic models to forecast over such a long period are highly questionable, especially when so far before the peak in incidence.
- Typically we consider three scenarios for school closure. Based on an analysis of POLYMOD matrices we have a 'mid' level efficacy of a 48% reduction in overall contact rates. Based on an analysis of the BBC matrices we have a 'low' level of efficacy of a 24% reduction in overall contact rates. We also engineer a high efficacy scenario where there is a 64% reduction in overall contact rates.
- To derive predictions of ICU admissions from the reconstructed number of infections, we assume that 2.5% of all infections will lead to an ICU admission.
- We estimate a number of parameters:
 - Dispersion parameter of the negative binomial likelihood function, $\eta \sim \Gamma(1, 0.2)$.
 - Latency period = 4 days.
 - Infectious period, $d_I \sim 2 + \Gamma(1.43, 0.549)$ (mean 4.6 days).
 - Proportion of cases ascertained $p \sim \beta(0.199, 1.2)$ (mean 14.2%).
 - Exponential growth rate $\psi \sim \Gamma(31.36, 224)$.
 - Initial rate of ascertainment $\nu \sim N(-17.5, 1.25)$ (derived parameter, linked to the initial seeding of the model with infectives).
 - Incubation period mean is 4 days
 - Delay from symptom onset to death is assumed to have a mean 9.63 days
 - Infection fatality ratio $IFR \sim \Gamma(5.4, 767.5)$, with a mean of 0.7%

Results

Using deaths only

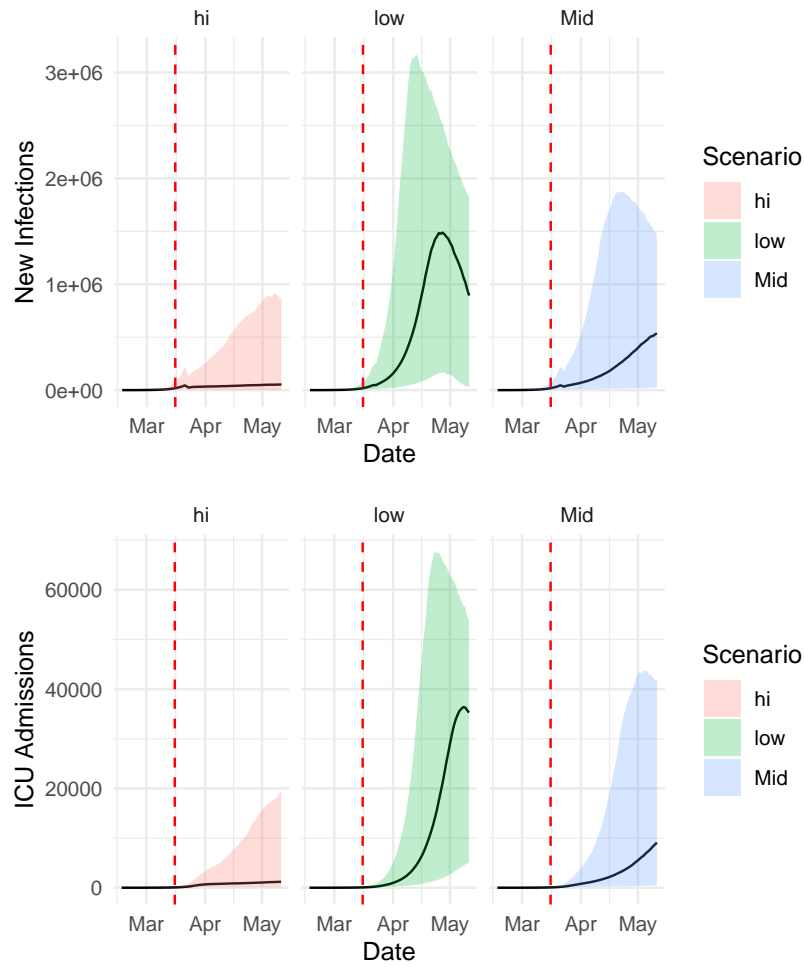


Figure 1: Estimated and forecast new infections (top) and ICU admissions for the United Kingdom

Is London ahead?

See Figure 2..

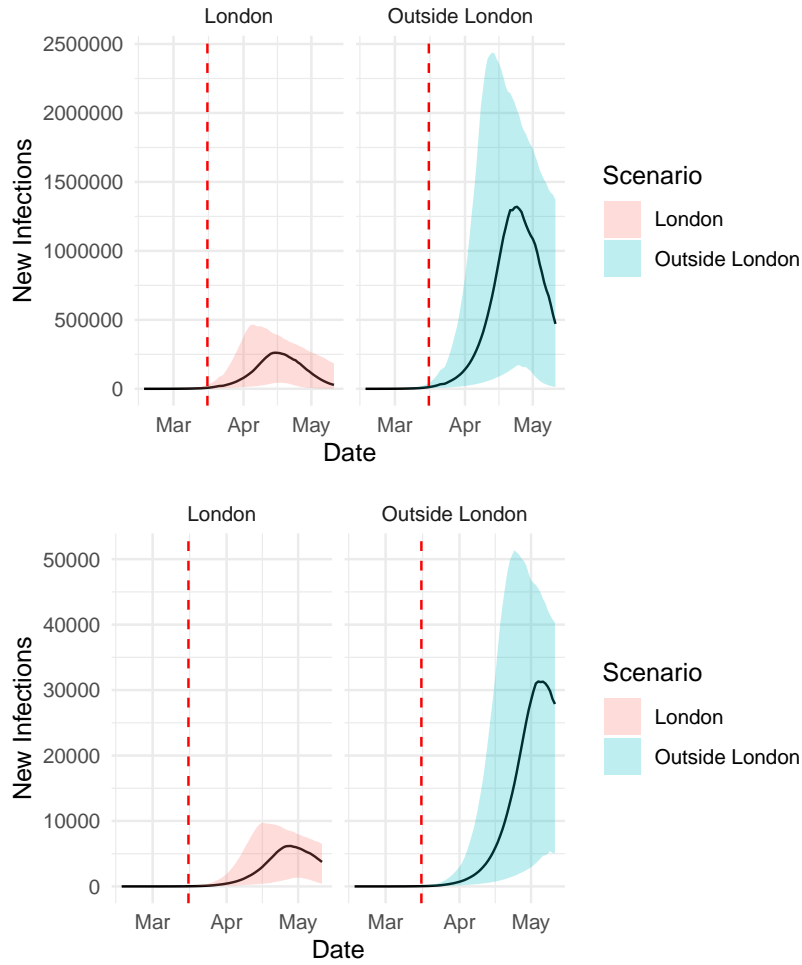


Figure 2: Estimated and forecast new infections (top) and ICU admissions for London and for England (outside of London)

Including the Linelisting

If we use all data from both the line-listing and the deaths, the estimated number of daily new infections are as in figure 3

Conclusions

Current data on confirmed cases and deaths indicate a possible peak in infections as early as mid April and a corresponding peak in ICU admissions well above current capacity.

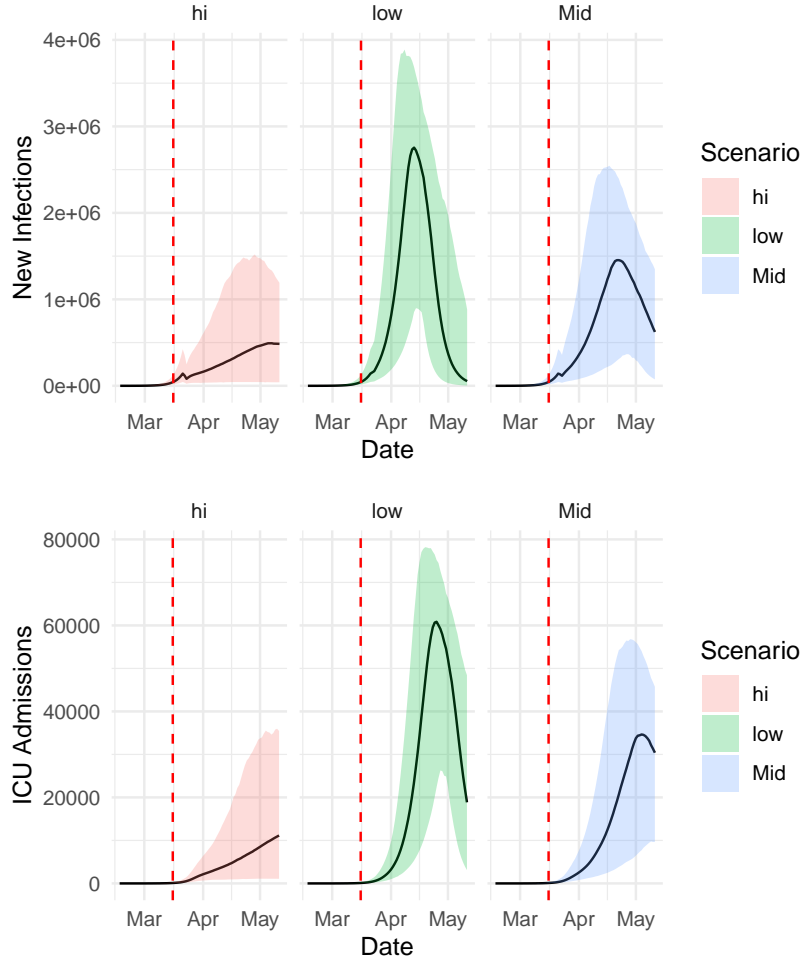


Figure 3: Estimated and forecast new infections (top) and ICU admissions for the United Kingdom using both sources of data

We have run a number of different combinations changing the data used, the mean time from onset to death, the priors we put on some parameters, but the results were quite consistently predicting a very high peak in infections and ICU admissions. Estimates and corresponding predictions remain, however, very uncertain.

The most important conclusion is that at the moment the available data are consistent with a different possible outcomes and only the addition of further data and, hopefully some serological information, will crucially reduce the current uncertainty.