

# Briefing for C19AG: Comparison of doubling times

## NOT FOR DISTRIBUTION

COVID-19 Epidemic Response Unit, University of Edinburgh

09/04/2020

### Key points summary

We compare the size and rate of increase of the COVID-19 epidemic for Scotland, London and the rest of the UK except for London (rUKxL).

**The epidemic in Scotland is ~8-12 days behind London and is now growing at a faster rate but is slowing down.**

#### Based on deaths:

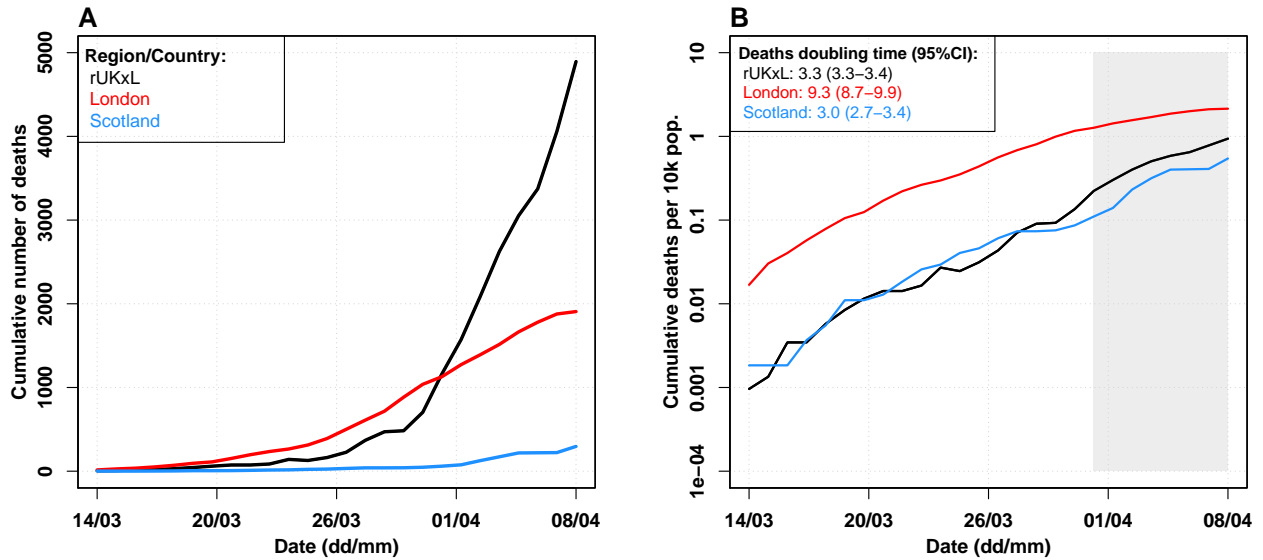
- The epidemic in Scotland is 12.1 days behind London and 3.5 days behind rUKxL (Figure 1).
- The current 7-day doubling time for deaths in Scotland is 3.0 days (95% confidence interval (CI): 2.7 - 3.4 days) (Figure 1).
- This is significantly shorter than the doubling time for deaths for the previous 7 days (4.8 days; 95%CI: 3.7 - 6.5 days).
- This is significantly shorter than the deaths doubling time for London (9.3 days; 95%CI: 8.7 – 9.9 days) and not significantly different from the deaths doubling time for rUKxL (3.3 days; 95%CI: 3.3 – 3.4 days).

#### Based on case counts per 10,000 population available as of 08/04/2020:

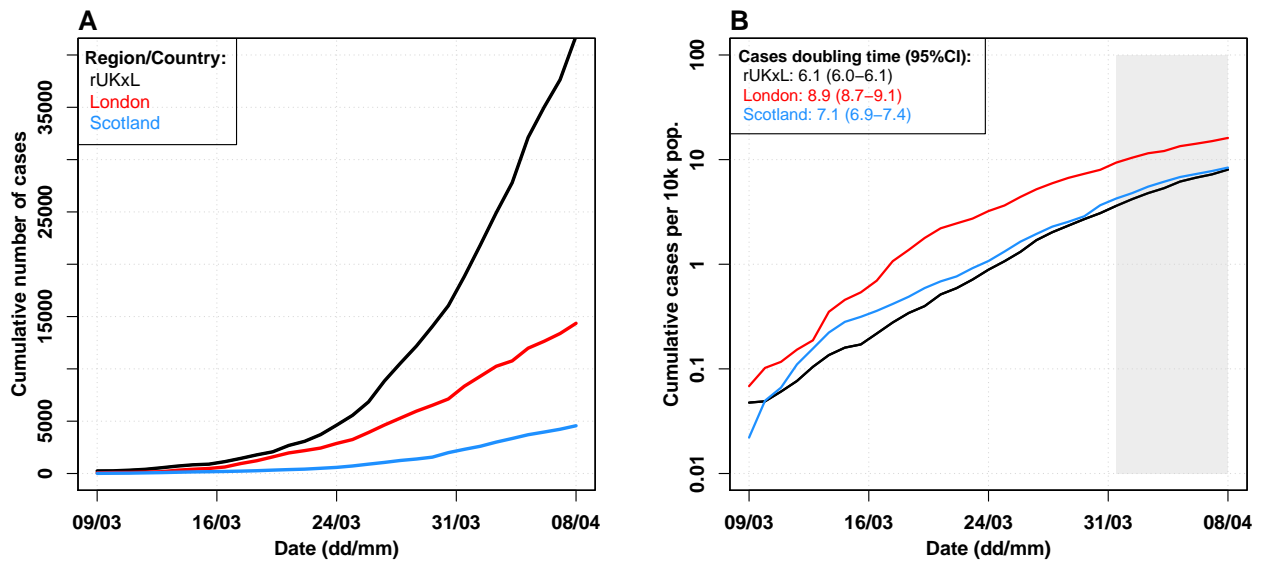
- The epidemic in Scotland is 7.7 days behind London and 0.6 days ahead of rUKxL (Figure 2, Figure 3).
- The current 7-day doubling time in Scotland is 7.1 days (95%CI: 6.9 - 7.4 days).
- This is significantly longer than the doubling time for the previous 7 days (4.2 days; 95%CI: 4.0 - 4.3 days).
- The current doubling time in Scotland is significantly shorter than London (8.9 days, 95%CI: 8.7 - 9.1 days) and is significantly longer than rUKxL (6.1 days, 95%CI: 6.0 - 6.1 days) over the same time period (Figure 2).

- Across Health Boards in Scotland there is variation in cumulative case incidence (3.6 to 14.1 per 10,000 population, Figures 4, 5) and doubling time (10.8 to 8.2 days, Table 1 and 2).

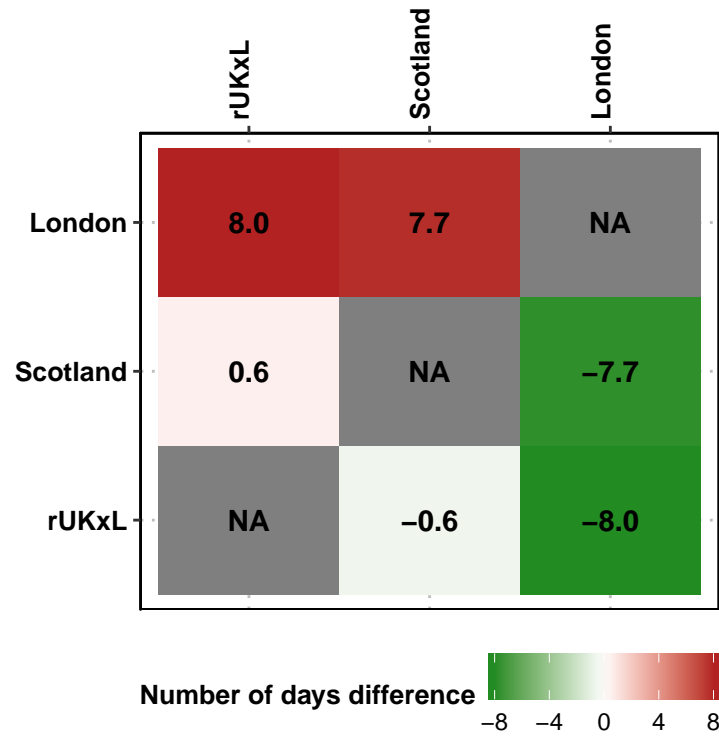
## Results



**Figure 1.** Comparison of epidemic curves for Scotland, London and rUKxL based on deaths over time up to 08/04/2020. **A)** Cumulative reported deaths **B)** Cumulative deaths per 10,000 population on a log<sub>10</sub> scale. Inset shows corresponding doubling times (in days) over the past 7 days (with 95% CIs).



**Figure 2.** Comparison of epidemic curves for Scotland, London and rUKxL based on cases up to 08/04/2020. **A)** Cumulative reported cases. **B)** Cumulative cases per 10,000 population on a log<sub>10</sub> scale. Inset shows corresponding doubling times (in days) over the past 7 days (with 95% CIs).



**Figure 3. Pairwise epidemic progression comparison based on cases.** The reported numbers are the numbers of days ahead (positive numbers, red) or behind (negative numbers, green) the regions in horizontal entries are relative to the regions in vertical entries. Horizontal entries are arranged from most ahead to least ahead.

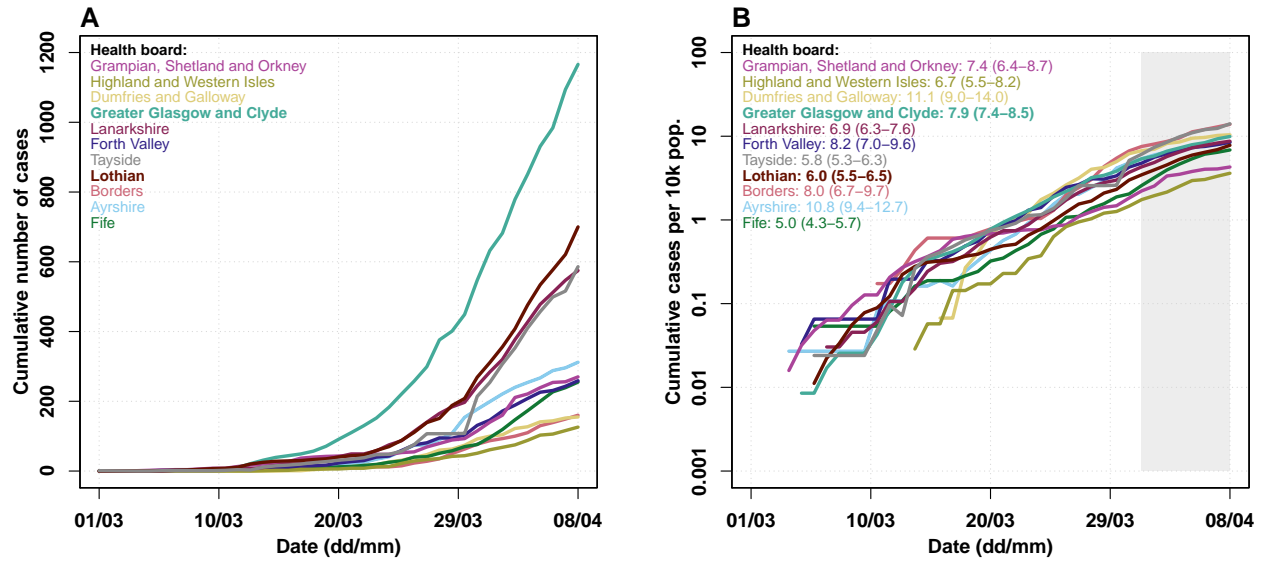


Figure 4. Comparison of epidemic curves for all Scottish Health Boards, based on cases up to 08/04/2020. A) Cumulative reported cases. B) Cumulative cases per 10,000 population on log10 scale. Inset shows corresponding doubling times (in days) estimated over the past 7 days with 95% CIs.

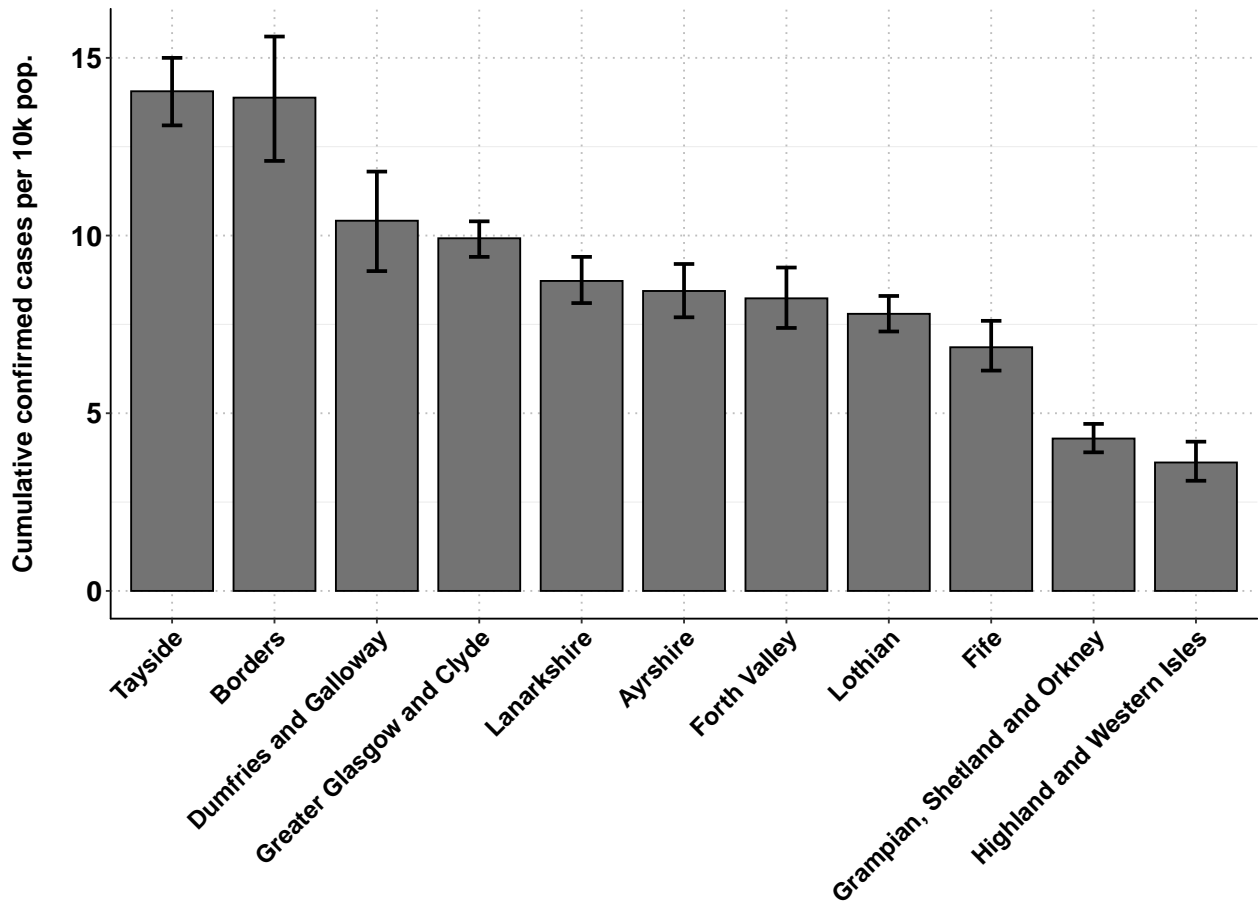
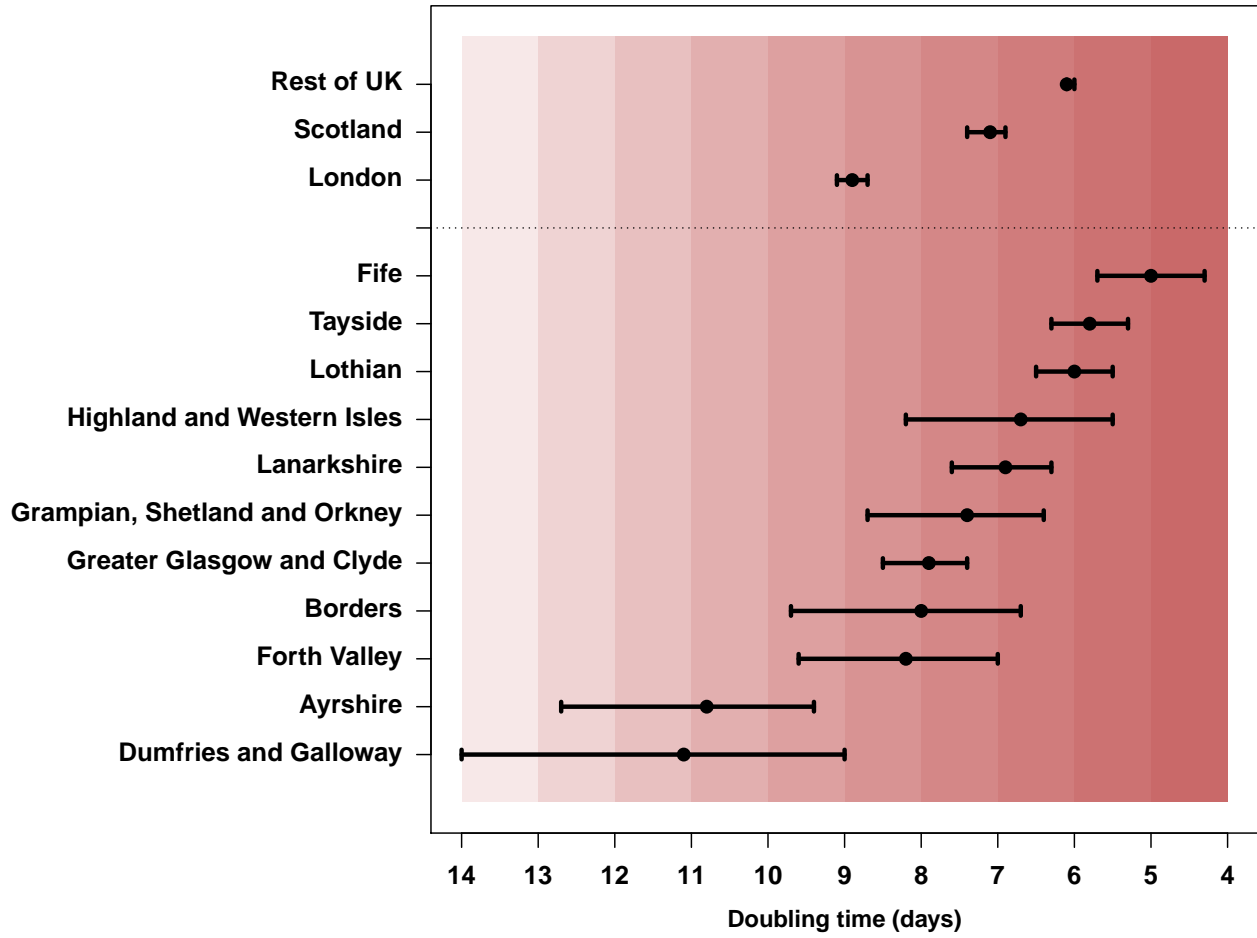


Figure 5. Cumulative incidence for all Scottish Health Boards up to 08/04/2020. The error bars show the 95%CI of the cumulative incidence per 10,000 population reached at last time point over the bootstrapped simulated datasets with Poisson error structure.



**Figure 6. Doubling time of cases.** Doubling times are calculated over a 7 day period up to 08/04/2020. Error bars indicate 95% CIs.

UK region	Measure	Doubling time (days)	95%CI lower	95%CI upper
London	deaths	9.3	8.7	9.9
Scotland	deaths	3.0	2.7	3.4
Rest of UK	deaths	3.3	3.3	3.4

**Table 1. Summary of all deaths doubling times and their 95% CIs reported in the above figures.**

UK region/Health board	Measure	Doubling time (days)	95%CI lower	95%CI upper
London	cases	8.9	8.7	9.1
Scotland	cases	7.1	6.9	7.4
Rest of UK	cases	6.1	6.0	6.1
Ayrshire	cases	10.8	9.4	12.7
Fife	cases	5.0	4.3	5.7
Forth Valley	cases	8.2	7.0	9.6
Grampian Shetland and Orkney	cases	7.4	6.4	8.7
Greater Glasgow and Clyde	cases	7.9	7.4	8.5
Lanarkshire	cases	6.9	6.3	7.6
Lothian	cases	6.0	5.5	6.5
Tayside	cases	5.8	5.3	6.3
Borders	cases	8.0	6.7	9.7
Highland and Western Isles	cases	6.7	5.5	8.2
Dumfries and Galloway	cases	11.1	9.0	14.0

**Table 2. Summary of all cases doubling times and their 95% CIs reported in the above figures.**

## Data

- Case counts for Scotland and for Scottish HBs from <https://www.gov.scot/coronavirus-covid-19/> (accessed 1400 08/04/2020).
- Case counts for London and rUKxL from <https://www.arcgis.com/apps/opsdashboard/index.html#/f94c3c90da5b4e9f9a0b19484dd4bb14> (accessed 2000 08/04/2020).
- Death count for London from <https://www.england.nhs.uk/statistics/statistical-work-areas/covid-19-daily-deaths/> (accessed 1000 09/04/2020).
- Death count for UK from <https://www.arcgis.com/apps/opsdashboard/index.html#/f94c3c90da5b4e9f9a0b19484dd4bb14> (accessed 1000 09/04/2020).
- Death count for Scotland from <https://www.gov.scot/coronavirus-covid-19/> (accessed 1400 08/04/2020).
- Population counts from the Office of National Statistics (mid-year 2018).
  - UK: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland>, Mid-2018, spreadsheet ‘MYE2-all’ (accessed 1140 26/03/20)
  - Scotland Health Board Areas: <https://statistics.gov.scot/atlas/resource?uri=http://statistics.gov.scot/id/statistical-geography/S92000003> (accessed 1200 11/03/20).

## Doubling time calculations:

Calculated over prior 7 days using method described by *E. Vynnycky & R. White (2010) An Introduction to Infectious Disease Modelling*, page 74.

Confidence intervals calculated using bootstrapping of a simulated dataset with Poisson error structure, using method published here: <https://doi.org/10.1101/2020.02.05.20020750>.

## Caveats

- Case count data are affected by any changes in testing strategy or testing effort over time and/or any variation in testing strategy or testing effort between regions.
- Case count data are likely a substantial under-representation of the true number of COVID-19 infections.
- Death data are considered more reliable but may lag behind case data by as much as 3 weeks.
- However, death data for London and rUKxL cannot be disaggregated. Nor can death data for Scottish Health Boards. Therefore more detailed analyses using death data are not currently possible.