Graphs showing the day-to-day development of the Covid-19 pandemic

These graphs have been created in order to give insight into the way the Covid-19 pandemic is developing in different countries. Many indicators are updated daily on the site https://ourworldindata.org/coronavirus, but the site doesn't show us how the growth ratio (the ratio of today's totals to yesterday's) changes over time. This statistic can tell us how close an outbreak is to reaching zero growth, i.e. 'peaking' – something many of us would like to know at the moment.
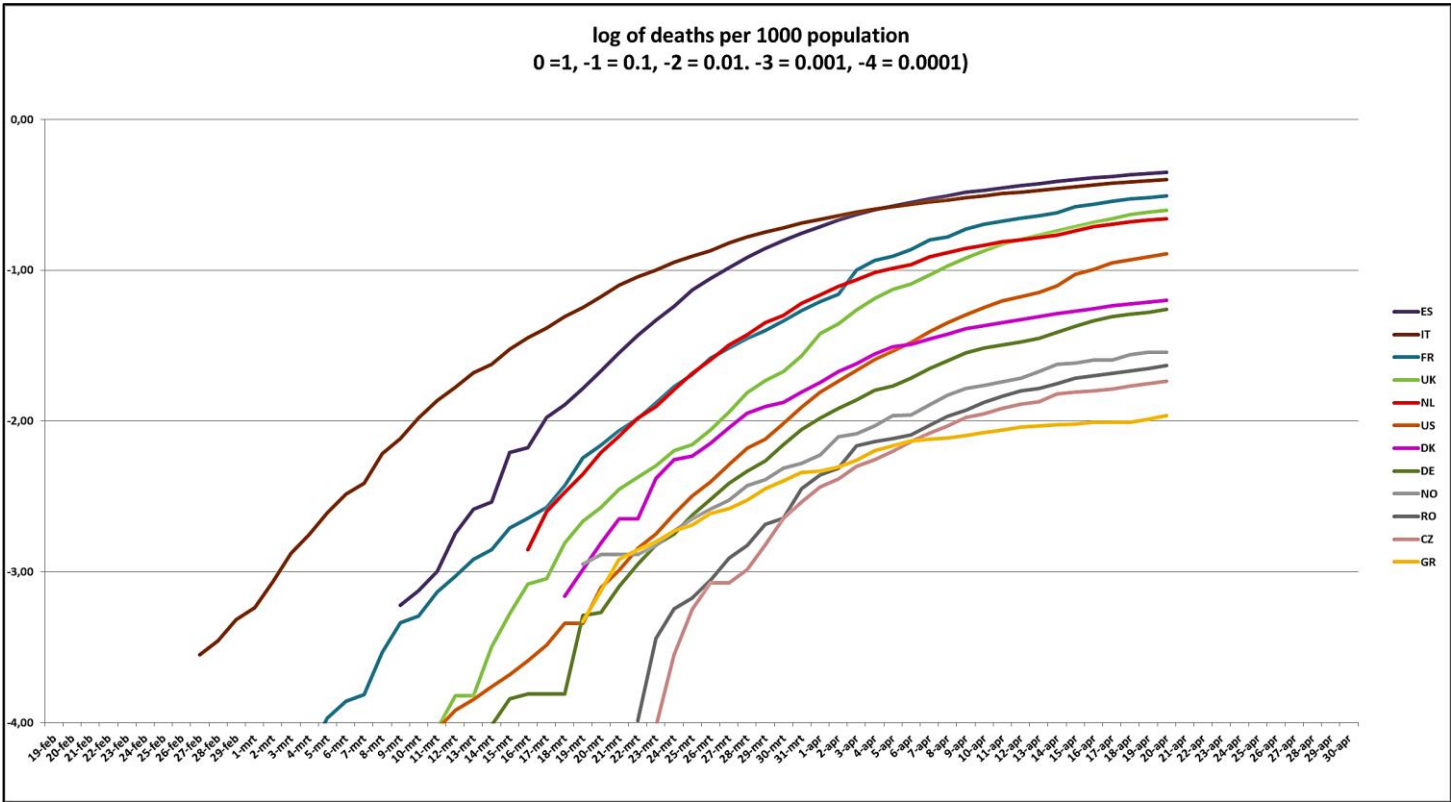
The graphs cover two groups of countries, in different regions of Europe as well as the USA:
   (A) Czech Republic, France, Italy, Spain, United Kingdom, United States;
   (B) Denmark, Germany, Greece, Netherlands, Norway and Romania.
More countries can be covered if there is interest: you can also use the Excel file yourself to insert new countries (instructions below).

The indicator used is the total number of confirmed Covid-19 deaths, downloaded from the above site (which takes its data from ECDC). These figures refer to the previous day, so that is the date used here. The first graph plots the logarithm of the cumulative total, the second shows the slope of this line, i.e. the growth ratio, also as a logarithm. The trend of the slopes is downwards, indicating countries' success in "bending the curve". Deaths are studied because this indicator is more valid than cases, due to the differences in testing policy between countries and over time. (The number of patients admitted to hospital would also be a good indicator, but is not as easy to get hold of.)
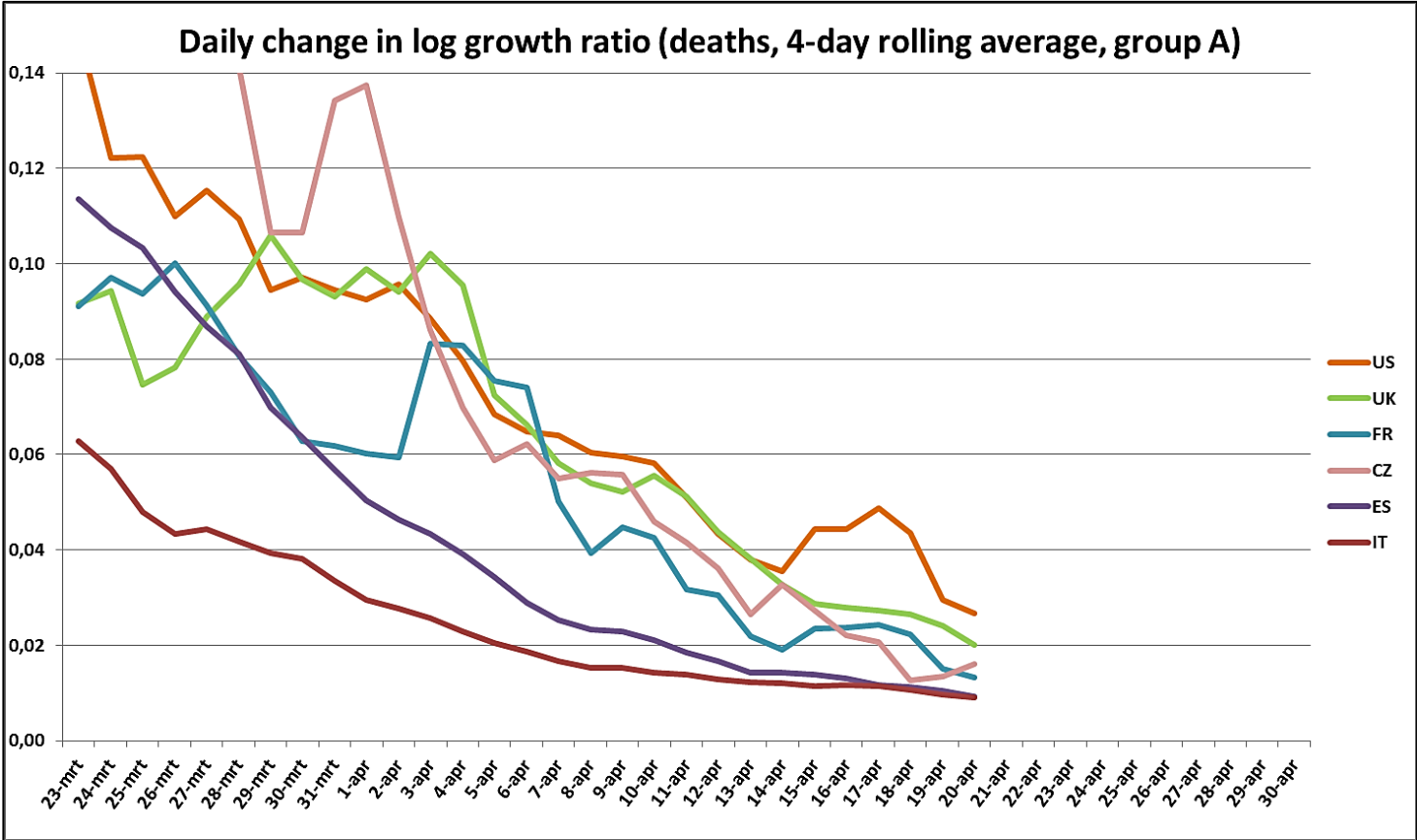
Here is the first graph showing all twelve countries together: it can be examined more closely in the Excel file.

Italy (brown line) was the first of these countries in which the pandemic took off. Initially the line was more or less straight, showing that growth was not being slowed, but it has been bent increasingly and has now become virtually flat. This is more clearly visible in the graph below.

The most recent outbreaks shown here took place in Romania and the Czech Republic. (There is no precise definition of when an outbreak begins; in the beginning, deaths were mainly of patients who had arrived from other countries.) Spain's outbreak started later than that of Italy, but overtook it numerically in early April. Together with France, the UK and the Netherlands, these countries have the unenviable distinction of having the highest number of deaths per thousand in Europe (currently 0.40 for Italy, 0.45 for Spain and 0.13 for the US). We can also see that Greece and the Czech Republic had early success with measures to contain the outbreak. However, these countries had several weeks in which they could observe the horrific effects of not doing so.

Concerning the validity of reported deaths as an indicator, the quality of medical care a country is able to give will obviously affect it, as well as the prevalence of infections and the percentage of older people. However, more research will be needed to discover how important these factors are. The major obstacle is that it's not yet possible to even guess at the true number of people who have been infected, as opposed to the number who tested positive. Another factor affecting total deaths is the extent to which those occuring outside hospital (e.g. at home or in care institutions) are being reported. ECDC only recognises cases that have tested positive for the virus, but outside hospitals little testing may take place. Public concern has led to countries adding these deaths to their totals. France announced this would be done from April 1st: below we can see clearly that its blue line jumps to a higher level from April 2nd, when 2,000 deaths were added to the existing total of 4,500 instead of the usual 500 or so at that time. (This suggest that perhaps a quarter of all deaths were taking place outside hospital.) Unfortunately we don't know whether other countries have also started to include such deaths in the totals they report to ECDC. This might lead us to think that the outbreak is worsening, when only the reporting policy has changed. Here is the second graph showing how slopes have changed over time:
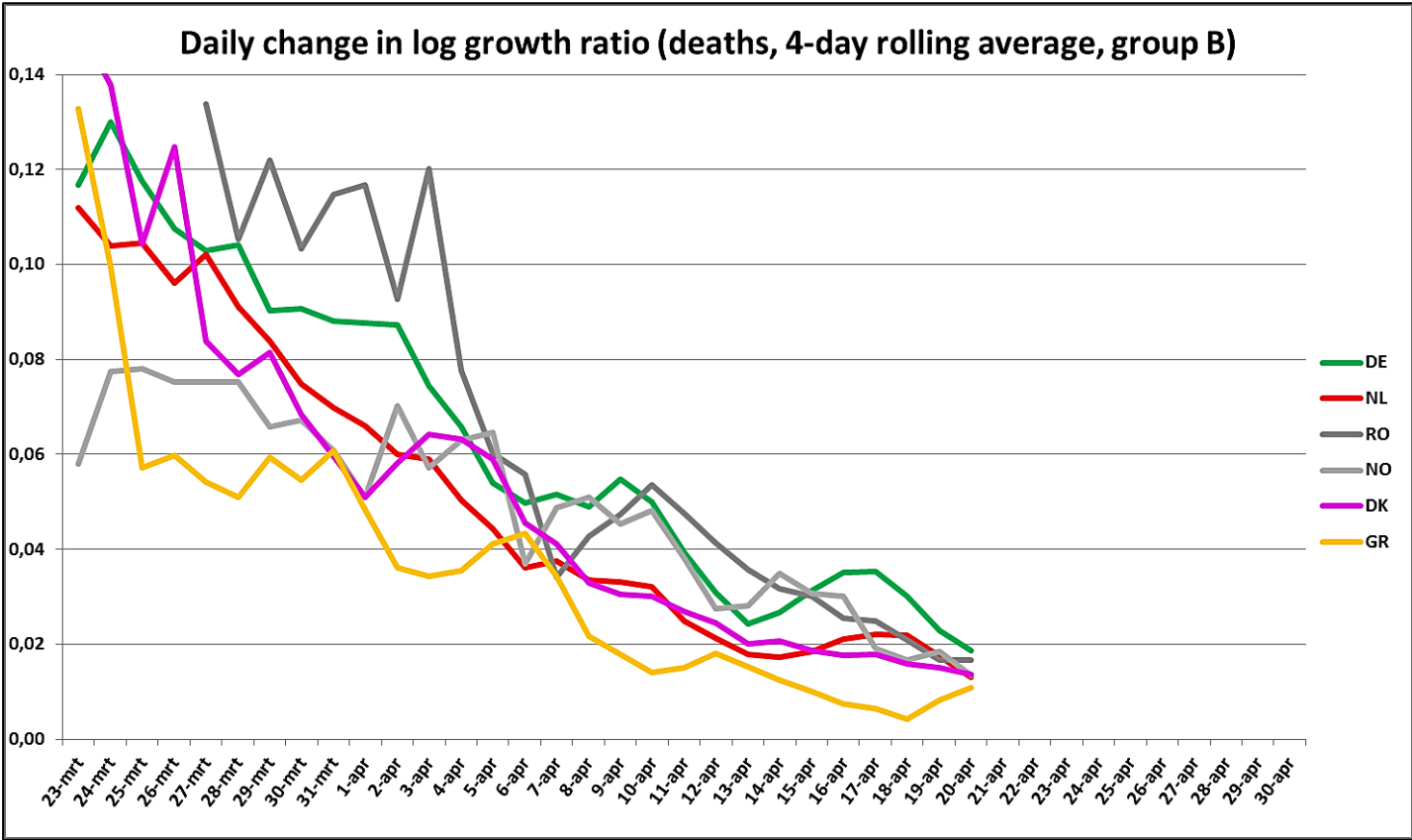
The upper four lines show large variations, despite the fact that this is a 'rolling average' taking the mean of figures from the previous four days. (This introduces a time lag: strictly speaking, the date axis should refer to two days earlier.) At the beginning of an outbreak, extreme variations are found: with small numbers, ratios can change greatly. In many countries, regular peaks and troughs also occur at intervals of about a week. These variations probably result from reporting procedures, which vary greatly. It's important to make allowance for such rhythms when trying to assess how the slope of a line is changing.

The sustained measures taken in Italy and Spain are clearly visible in the above graph. Both countries have reached a point at which daily new deaths are less than 2% of the cumulative total. However, further decline in the growth ratio is taking place only slowly. This effect is seen in several countries: as the growth ratio approaches 1, its decline slows down. Frustratingly, as the peak comes into view it appears to recede. One likely explanation for this is that every country contains a collection of different outbreaks: the largest and oldest ones will peak first, but others will take longer to do so. These graph lines therefore represent only a central tendency, with a wide margin of error.

What has to be avoided now is relaxing restrictions in such a way that the more recent outbreaks in a country are allowed to grow into major ones. To monitor this risk, it would be important to study outbreaks in different regions separately; it's not clear how many countries are doing this, or where the results can be found. On the face of it, however, a curve that is almost flat and close to 2% is very good news. It means the virus is currently unable to maintain its own population and has become – literally – an endangered species. The next phase is taking us into uncharted territory, in which thorough data-gathering backed up with testing will be vital.

Here is the second graph for the countries in group B. On the lowest line (Greece) some peaks that are probably due to reporting procedures can be seen.

Daily change in log growth ratio (deaths, 4-day rolling average, group B)

It is useful to relate these data to the national policies that are being monitored by the WHO/EC *Health System Response Monitor* (HSRM) at https://www.covid19healthsystem.org/mainpage.aspx. This should become a major resource for researchers and policymakers. There is a great need for rapid, coordinated research efforts to obtain as many insights as possible from the data being collected.

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Instructions for adding countries to the Excel file

1. Download the full data for all countries from https://ourworldindata.org/coronavirus, using the tab DATA under the graph. (You may have to change the extension from .csv to .txt to load the file correctly into Excel.)
2. Copy and paste the data from your chosen country into the first box (CUMULATIVE TOTAL OF DEATHS) in the Covid Tracker file. Remember to subtract one day from the dates in the downloaded data.
3. Insert the country's population size in the formulae in the next box, following the method used for existing countries. Trim the data in the following boxes to avoid wild changes at the beginning of the outbreak.
4. Correct the label for the new country on the existing graphs.
5. When updating the file with new data, make sure all the boxes are updated by dragging down the previous line if necessary.

Please write to me if anything is unclear!