

Comparing the evolution of the number of deaths from COVID-19 in Spain, Italy and the United States.

The US will overtake Spain in total number of deaths by April 7.
Spain will suffer more deaths than Italy by the end of the crisis.

Thursday, April 2, 2020

This letter shows a comparison of the COVID-19 epidemic evolution in a set of 9 of the most affected countries. These are Spain, Italy, USA, UK, France, Germany, China, Iran, and South Korea. In addition, a forecast for the future evolution of the number of deaths in Spain, Italy and USA is presented. Insights drawn from the comparison include the fact that Spain is the most intensely affected country by the virus in terms of deaths per capita, while when talking about total numbers, given the larger population size affected in the United States, it is highly likely that this country will suffer more deaths than both Spain and Italy by the end of the pandemic.

In order to properly compare the time evolution of COVID-19 epidemic's intensity in different countries, it is important to establish the outset time of the epidemic based on adequate criteria. Only by appropriately offsetting the time lag between countries, due to the different times in the first arrival of infected individuals causing local outbreaks, an accurate cross-country comparison of the pandemic's different development stages can be carried out.

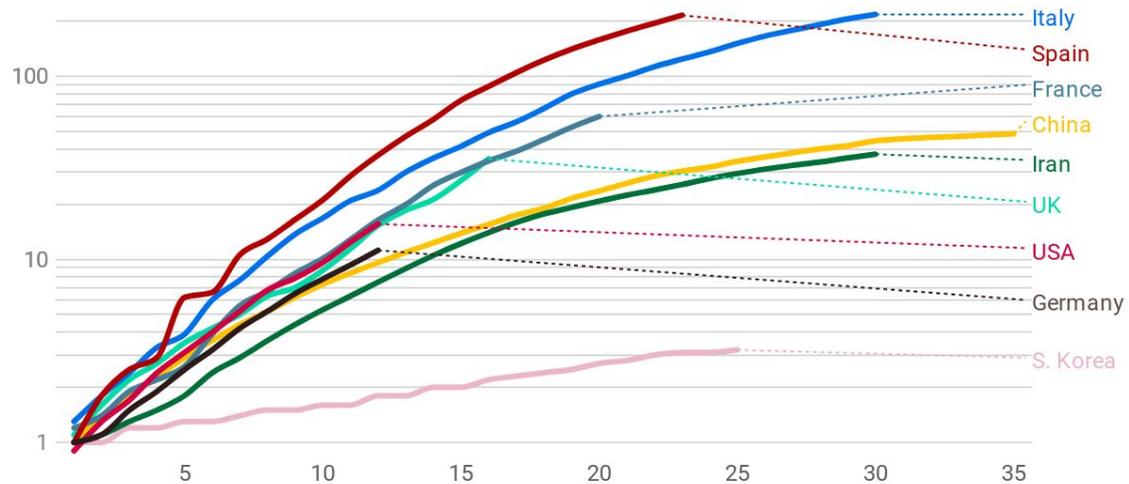
An interesting magnitude to observe is the number of deaths per capita, allowing for an undistorted comparison between countries with very different population sizes. For the purpose of this study, the epidemic's outset time is defined as the day the number of deaths reaches one death per million people.¹

A side-by-side comparison of the number of deaths per million people shows the pandemic's different spreading velocities in different countries (especially when using a logarithmic scale, Chart 1).

¹ For China only the population size of Hubei province has been considered, since no other province in that country has reached the outset condition (as defined here).

Chart 1: Deaths per million people

Cumulative number of deaths per million people from COVID-19 by number days since the outbreak's beginning (in logarithmic scale).



Outset time is defined as the day each country reaches one death per million people.

Chart: INVERENCE • Source: Spain's Ministry of Health & Worldometer • Created with Datawrapper

(Chart 1 link: [//datawrapper.dwcdn.net/5zHF8/1/](https://datawrapper.dwcdn.net/5zHF8/1/))

In particular, several distinct behaviors are shown. A clear outlier is South Korea, where the epidemic has been effectively contained from the outset, not attaining an exponential growth in the number of deaths at any stage. On the opposite extreme is Spain, where the epidemic acquired the fastest spreading speed seen so far around the world. Spain is clearly above Italy in terms of deaths per million people when both countries are compared in equivalent stages of the epidemic evolution (although the fact that Italy is currently at a later epidemic stage means its total number of deaths is at this time still larger than that of Spain). This shows that Spain suffering a considerably higher number of deaths per capita than Italy is a very likely outcome by the end of the epidemic crisis. The difference when looking at total numbers is not as wide, given Italy's larger population size, but unless a sharp change in trends happen, it is highly likely that **Spain will suffer a larger final death toll than Italy.**

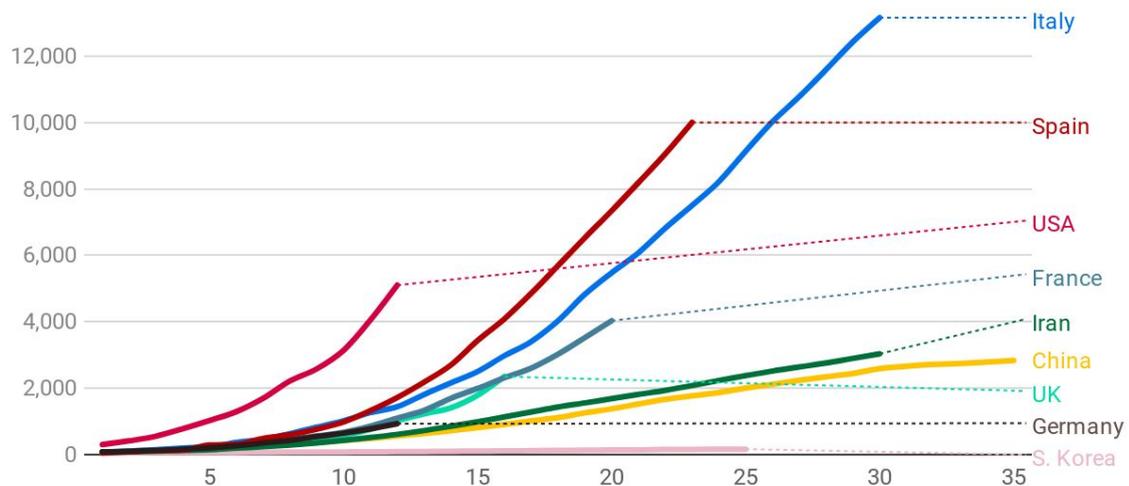
Below Italy there is a group of three countries with very similar behaviours, even though each of them is at a different stage in the spreading process. These are France, UK, and USA. The three countries follow overlapping trends in terms of deaths per million people, which, under equal conditions, would suggest similar outcomes. On the other hand, if different intensity confinement measures do have a relevant impact on the pandemic evolution, then the curves of France (with stricter confinement) on the one hand, and UK and USA (with looser measures) on the other, should depart in the mid term. Thus,

comparing these three curves during the next few weeks will shed light on the efficiency of confinement measures to slow down the pandemic.

There is a last group, formed by China and Iran (with similar long-term behaviours and both in late stages of the epidemic), joined by Germany, which though at a much earlier stage, appears to follow their same evolution path.

Chart 2: Total deaths by country

Daily evolution of the cumulative number of deaths from COVID-19, since the epidemic's outset in each country.



Outset time is defined as the day each country reaches one death per million people.

Chart: INVERENCE • Source: Spain's Ministry of Health & Worldometer • Created with Datawrapper

(Chart 2 link: [//datawrapper.dwcdn.net/qFilg/1/](https://datawrapper.dwcdn.net/qFilg/1/))

It is also interesting to look at the comparison in terms of total values (Chart 2), where the size of countries plays an important role. The United States is then seen clearly above all other countries, for the obvious reason that it is by far the country with the largest population considered (recalling that only Hubei province was considered for China). However, the question still remains of whether or not (and if so, when) the United States, despite its larger size, will go above Spain and Italy in the long term in total number of deaths. To answer this question, INVERENCE has developed Bayesian predictive models for those three countries, forecasting the future evolution of the total number of deaths. In the following Chart, those forecasts are shown. The conclusion is clear, and it shows that indeed, **the United States will most likely go above Spain** in terms of total deaths from COVID-19, and that it will have probably done so **by April 7**.

Chart 3: Forecast of cumulative death toll

Cumulative deaths from COVID-19 in Spain, Italy and the USA, including a 7-day forecast developed by INVERENCE

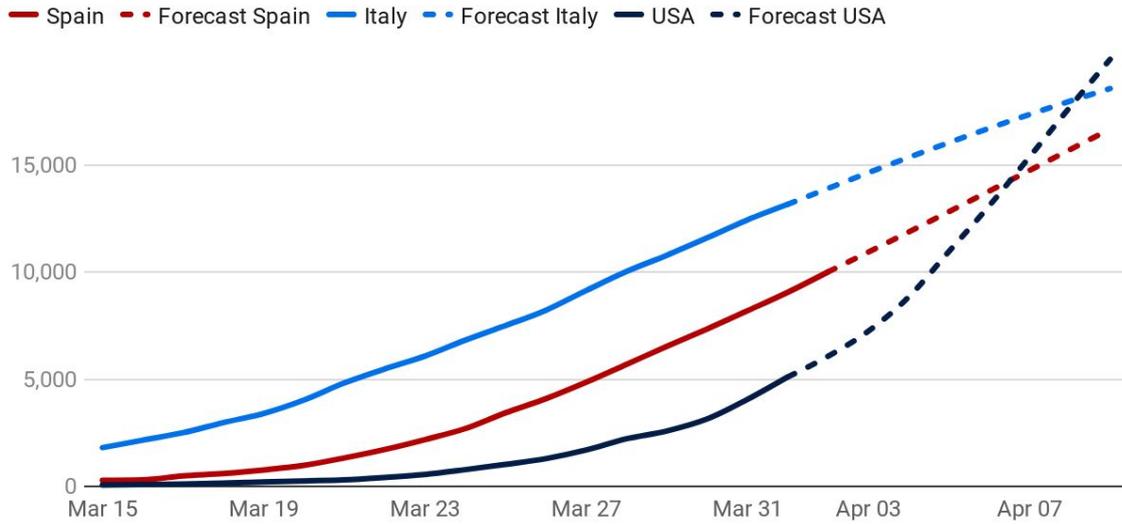


Chart: INVERENCE • Source: Spain's Ministry of Health & Worldometer • Created with Datawrapper

(Chart 3 link: [//datawrapper.dwcdn.net/lh4vr/2/](https://datawrapper.dwcdn.net/lh4vr/2/))