



COVID-19 – interpreting the deaths data

By Matt Fletcher and Dan Ryan for

COVID-19 Actuaries Response Group – Learn. Share. Educate. Influence.

Summary

Details of COVID-19 deaths in the UK are published by various bodies, including the ONS, the Department of Health and Social Care, and the NHS. These datasets are not all the same, representing different populations and different ways of recording the deaths data.

Many people are trying to interpret these figures and project them – however, given the pace at which the outbreak has moved and the pressure that those reporting are under, it is difficult to determine even how many deaths have occurred by a given day.

At this stage, when modelling the outbreak we would recommend using the NHS England figures as a starting point, although we would caution that this figure relates only to people who died in hospital and tested positive for COVID-19, so the final figures will be significantly higher.

Hospital deaths – Department of Health and Social Care and NHS England

Data for the total number of positive tests for and deaths with COVID-19 in the UK (that is, individuals hospitalised in the UK who tested positive for COVID-19) are published daily at around 2pm, by the Department of Health and Social Care (DHSC).

Taking the difference between the number of deaths reported by DHSC on a given day and the previous day gives an indication of the number of people that died of COVID-19 on that day. Until recently, these were the numbers that were typically reported in the press and used in analysis. However, the focus now seems to have turned to other sources.

On 1 April, [NHS England](#) published a list of deaths in England, which allocated hospital deaths reported up to and including 31 March 2020 to the date they actually occurred. They have since published equivalent figures daily [here](#).

The number of deaths allocated to a given day in each data source is very different. This is because the DHSC figures represent the numbers of deaths **reported** by a given point, so the difference between the figures represents the number of deaths **reported** on a given day – some of these will have been deaths that **occurred** on that day, but many will have occurred **before** that day.

On a given day, both of these data sources give a lower figure than the actual number of deaths that have occurred by that day. This is because there is a lag between deaths occurring and being reported; only a relatively small proportion of the deaths that occur on a given day are actually reported on that day, typically they are reported a few days afterwards. This point was noted in a number of articles – this was one of the first: <https://amp.theguardian.com/world/2020/apr/04/why-what-we-think-we-know-about-the-uks-coronavirus-death-toll-is-wrong>

This “incurred but not reported” (IBNR) feature should not typically cause forecasting problems in and of itself, provided it is relatively consistent over time.

When forecasting numbers of deaths into the future, we would suggest using the NHS dataset (adjusted for IBNR) rather than the DHSC one – we consider a simplistic way of doing this below. It is important to note that this doesn't mean that we think the DHSC figures are wrong, rather that they necessarily reflect when deaths were **reported** rather than when they actually **occurred**, where typically we are more likely to be interested in projecting occurrences.

We believe that projecting the reported death figures for the UK was one of the reasons why the figures published on 7 April by the Institute for Health Metrics and Evaluation (IHME) were so high. Their calculations resulted in a projection of over 66,000 deaths, significantly higher than any other European country. These projections were widely shared on social and other media, although there was some criticism, including by Neil Ferguson (see for example <https://www.theguardian.com/world/2020/apr/07/uk-will-be-europes-worst-hit-by-coronavirus-study-predicts>). It is worth noting that after a few more days' data, IHME reduced their projection on 10 April to around 37,500 deaths in the UK, and then again on 13 April to around 24,000.

Deaths outside hospital – ONS and international indicators

A further challenge is that neither of the data sources discussed gives a full picture of the numbers of deaths with or due to COVID-19 in England or the UK, as both are based only on deaths in hospital, of those with positive tests. The Office for National Statistics publish weekly deaths for England & Wales, roughly two weeks after the deaths were registered. They have started to report COVID-19 deaths, which is any death where COVID-19 is reported on the death certificate (including suspected cases) – so this is a broader definition than the DHSC and NHS England figures in at least two respects.

The difficulty of identifying deaths outside hospitals is not just an issue for the UK. [Comparative reports](#) from around the world have highlighted the increasing number of deaths in nursing homes, with studies in France, Italy and the USA estimating that nursing home deaths may account for between 25% and 50% of all deaths that should be associated with COVID.

These figures have been backed up in an initial analysis from other countries, which shows that around half of deaths from COVID-19 have been in care homes <https://itccovid.org/2020/04/12/mortality-associated-with-covid-19-outbreaks-in-care-homes-early-international-evidence/>

ICU constraints

Whilst the NHS is increasing ICU capacity (e.g. with the NHS Nightingale hospitals in London and elsewhere, and use of private hospitals), variation in demand may mean that locally accessible capacity may become strained. ICNARC (the Intensive Care National Audit and Research Centre) released a [report](#) on 10 April that summarised the experience of all patients (3,883) who had been admitted to intensive care up to 9 April. This report highlighted that 229 of 284 ICU units in the UK had one or more patients with COVID then.

Occupancy rates of ICU units have been [published monthly](#) until the outbreak of COVID-19, and are typically high at around 90%. More recent reporting has indicated that some ICU units are now full and are unable to accept further patients, having to make use of High Dependency Units (HDUs) and other capacity.

As well as those in nursing homes, individuals with severe symptoms who are self-isolating and who would benefit from ICU care may face restrictions on who can be admitted. Such restrictions are likely to be on the basis of age and pre-existing medical conditions. This would lead to an increasing number of deaths both in nursing homes or at home that will eventually show up in the ONS weekly reports but would be missed by the data from the NHS and DHSC.

ONS reported on 14 April that there had been a total of 3,475 deaths in England & Wales in 2020 involving COVID-19 and reported in the week to 3 April, an increase from 539 in the previous week. As expected, the ONS figure for COVID-19 deaths in England is higher (by 15%) than the corresponding NHS England number.

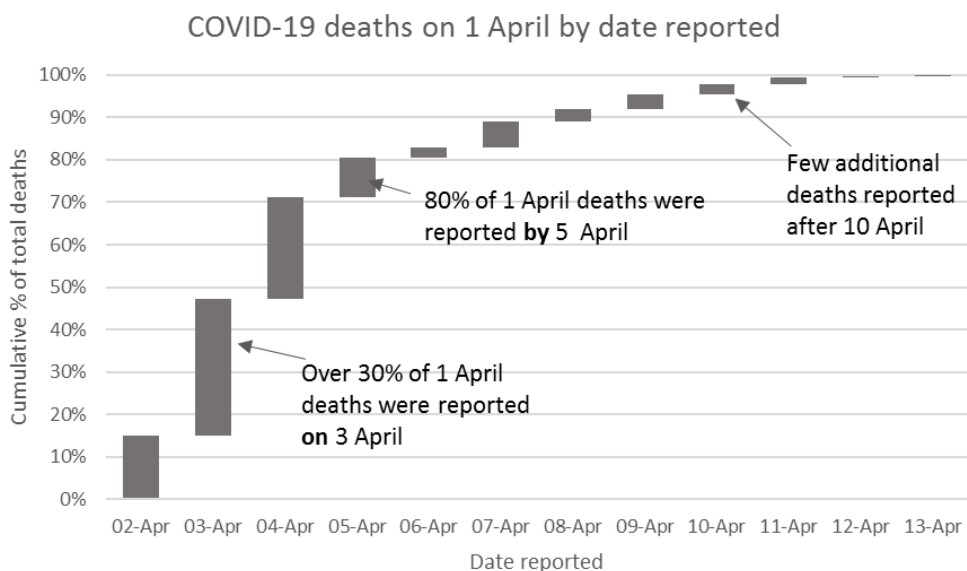
The ONS publications will also give an indication of **total** deaths in England & Wales, and whether this is overall higher or lower than previous years. For example, they note that the 16,387 deaths registered for the latest week was the highest weekly total since at least 2005, and around 6,000 higher than the five-year average. The Continuous Mortality Investigation have recently published their [quarterly report](#) based on ONS data, and will update this on a weekly basis through the outbreak – the weekly updates will be found here ([Link](#)), with the first here ([Link](#)).

Estimating the total number of hospital deaths

There are many ways in which the number of hospital deaths can be estimated from the daily death occurrence figures; we set out below a simplistic method and note how different the figure is from those reported on the same day. Please note that we do **not** recommend using this approach without adjustment for forecasting, it is provided simply to illustrate the concept. The approach could be improved by, for example, allowing for the ‘weekend effect’ seen in the reported figures.

It is worth noting that the death occurrence figures themselves are not immune from data error – it is hard to see the fact that there were only 308 deaths occurring on 31 March, but over 550 on both 30 March and 1 April as anything other than a quirk in reporting.

In total, 557 deaths are recorded as having occurred on 1 April 2020. It appears that this figure represents the vast majority of the deaths that occurred on that date (of the deaths figures reported on 13 April, only 2 occurred on 1 April). Of those 557 deaths, 448 (80%) were reported by 5 April.



Further analysis suggests that subsequent days’ figures (where the total number of deaths can be assumed to be reasonably complete) follow similar pattern; we can use these patterns to estimate the number of deaths that might eventually have occurred on a given day, based on the number of deaths reported for that day so far. The most uncertainty is in the most recent day’s figure where based on the figures seen to date the figure reported by NHS England could be between 5 and 10 times smaller than the total deaths.

On average, to reach a realistic figure for the total number of deaths that have occurred up to a given date, we would recommend uplifting previous days' figures – a worked example is given below, for the figures published on 13 April 2020, estimating the number of deaths that had occurred by the end of 12 April 2020:

Day	Deaths occurred (NHS England data)	Multiplier	Estimated total deaths	Additional deaths not yet reported
Latest available (12 April)	118	7x	826	708
-1 day (11 April)	443	2x	886	443
-2 days (10 April)	516	1.4x	722	206
-3 days (9 April)	611	1.22x	745	134
-4 days (8 April)	737	1.12x	825	88
-5 days (7 April)	673	1.07x	720	47
-6 days (6 April)	625	1.04x	650	25
Earlier (up to 5 April)	6,537	1x	6,537	0
Total	10,261		11,912	1,651

So, based on this simplistic calculation, we can estimate that there had been a total of around 12,000 hospital deaths in England up to the end of 12 April, compared to 10,261 deaths reported by 5pm on 12 April. If we ratio up for the UK, we estimate around 13,250 hospital deaths up to the same date, compared to 11,329 reported. This could be an understatement as it's not clear what impact the Easter weekend is likely to have had on the reporting of deaths.

It is important to note that the fact that there may be over 2,000 COVID-19 deaths in the UK that have occurred but not yet been reported does not mean that we think the numbers of deaths have been deliberately understated: the simple fact is that it takes time (for various good reasons) to report and register a death, so it is not possible for all deaths to be reported on the day they occur.

Based on the published data, we believe that it is as yet too early to say whether the number of daily deaths in the UK has peaked or even stabilised.

Finally, as noted above, the total number of COVID-19 deaths to date will be significantly higher than this, because the figure does not include deaths outside a hospital setting, or where COVID-19 is suspected but not confirmed.

14 April 2020