HOW COMPARABLE IS COVID-19 MORTALITY ACROSS COUNTRIES?

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Summary: Surveillance and monitoring systems are central to governments' responses to the COVID-19 pandemic. This article focuses on assessing differences in mortality recording across countries and over time, to inform country comparisons. We show that variations in definitions, testing policies and changes over time affect international and intra-country comparability. Estimating excess deaths is therefore increasingly used to monitor the impact of COVID-19, with early evidence showing a major increase in excess mortality in countries most affected. Enhanced monitoring of the impact of COVID-19 on mortality using multiple data sources, with data published in a timely and accessible manner, is thus important.

Keywords: *Mortality, Excess Deaths, COVID-19*

Cite this as: *Eurohealth* 2020; 26(2).

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Introduction

The COVID-19 pandemic has created a revolution in health data. Once, anyone wanting to discover how a country was doing in terms of improving the health of its population would have to wait for months or, in many cases, years to find out. No more. Now they can consult online dashboards such as those published online by the World Health Organization (WHO), Johns Hopkins University, and Worldometer, among others, and find daily numbers and rates of COVID-19 cases and deaths. But can they rely on what they see? These dashboards rely on summary data mostly supplied by national governments. Yet, even in a single country, figures for COVID-19 related deaths can vary among different sources and there are large variations in the proportion of additional deaths that countries list as due to COVID-19 since the onset of the pandemic. If those using the dashboards are to make meaningful comparisons, they must first understand how each country conducts surveillance and monitoring of deaths. This article, based on the information collected from the COVID-19 Health Systems Response Monitor (HSRM) network, explores how COVID-19 mortality is recorded in countries in Europe and North America.

How are COVID-19 deaths defined?

Headline figures for COVID-19 (those reported daily by official Government sources for the current or previous day) of cases and deaths have the benefit of being real-time or near real-time. However, in many cases they have been gathered using systems set up specially to track the pandemic, for example by gathering data from hospitals or long-term care homes. It is therefore important to distinguish the resulting figures from those reported by national statistical offices (or other agencies/authorities) that use data from

Table 1: Definition of COVID-19 deaths in headline figures

Country	Diagnosis-based	Test-based	Other issues affecting comparisons
Belgium	✔	–	Only lab-confirmed deaths (largely in hospital) reported until 31st March
Bulgaria	✔	–	All reported deaths had +ve test result
Canada	✔	–	Figures include deaths from other causes "with" COVID
Croatia	✔	–	Those 'probable' can only be included if test +ve
Cyprus	✔	✔	Test result has to be recent
Estonia	✔	–	–
France	✔	–	–
Germany	✔	–	Figures include deaths "with" COVID
Greece	✔	✔	–
Ireland	✔	–	Only lab-confirmed deaths were reported until 21st April, but all subsequent figures also include probable deaths from the start of the pandemic
Israel	✔	–	–
Latvia	✔	–	All reported deaths had +ve test result
Lithuania	✔	–	–
Malta	✔	–	Those 'probable' can only be included if test +ve
Poland	✔	–	–
Portugal	✔	–	Probable deaths are tested for COVID-19
Romania	✔	✔	–
Serbia	✔	✔	–
USA	✔	–	Only lab-confirmed deaths reported until mid-April
Austria	–	✔	–
Bosnia and Herzegovina	–	✔	–
Hungary	–	✔	–
Iceland	–	✔	–
Italy	–	✔	– due to +ve test requirement most are hospital deaths; – likely underestimate as alternative sources (e.g. statistical office) report higher numbers
Netherlands	–	✔	– due to +ve test requirement most are hospital deaths; – likely underestimate as alternative sources (e.g. statistical office) report higher numbers
Norway	–	✔	–
Slovenia	–	✔	– widespread testing performed with all patients with moderate/severe respiratory symptoms hospitalised and tested
Spain	–	✔	– due to +ve test requirement most are hospital deaths; – likely underestimate as alternative sources (e.g. statistical office) report higher numbers
Sweden	–	✔	–
Switzerland	–	✔	– may differ from data reported by cantons, where deaths also include those clinically diagnosed
United Kingdom	–	✔	– until 29th April only hospital deaths were included for England; – likely underestimate as alternative sources (Office for National Statistics, which publishes weekly data) report higher numbers

Note: Diagnosis-based definition is that based on clinical diagnosis of cause of death, both confirmed and probable; test-based definition is that where positive COVID-19 test is the required for death to be attributed to COVID-19. This information is based on country expert opinion collated within HSRM initiative as of June 2020. These are also based on publicly available information and may be subject to change.

the normal death registers, but take longer to be processed. For a number of reasons (see below), deaths reported daily in headline figures may not be entirely comparable across countries.

Table 1 shows the two main ways in which COVID-19 deaths are reported in headline figures. *The first, based on clinical diagnosis of the cause of death,* counts clinically confirmed or probable COVID-19 cases that have died (e.g. Belgium, Canada, France, Germany) and are not dependant on the availability of laboratory tests. *The second, in contrast, is reliant primarily on a positive laboratory*

test (e.g. Austria, Italy, the Netherlands, Spain, the United Kingdom). However, the distinction is not always clear cut. Some countries include probable COVID-19 deaths in the definition but still, in practice, require laboratory confirmation (e.g. Cyprus, Greece, Romania, Serbia), while there are also countries that primarily use clinical diagnosis of cause of death, but also include any death among positive cases (e.g. Canada). Occasionally, countries distinguish deaths *with* COVID-19 and deaths *from* COVID-19 in the headline figures (e.g. Lithuania).

> resulting in many years of life expectancy being wiped out

The international standard for the definition of COVID-19 death based on clinical diagnosis was published by WHO on 16th April 2020 and updated guidelines on 7th June.[1] According to these guidelines, death due to COVID-19 is defined as:

"a death resulting from a clinically compatible illness, in a probable or confirmed COVID-19 case, unless there is a clear alternative cause of death that cannot be related to COVID disease (e.g. trauma). There should be no period of complete recovery from COVID-19 between illness and death. A death due to COVID-19 may not be attributed to another disease (e.g. cancer) and should be counted independently of pre-existing conditions that are suspected of triggering a severe course of COVID-19. Deaths due to COVID-19 are the ones that are counted in cause of death data collection (for the purposes of COVID-19 death reporting)".

Following from this, diagnosis- or cause-based approach requires reported COVID-19 deaths to be identified on a death certificate by a clinician as an underlying cause where the disease caused, or is assumed to have caused, or contributed to death. It served as a basis for many national diagnosis-based definitions (Column 2 in **Table 1**), although there may be variable delays in reporting due to the length of death certification process. The June update added the last sentence to the abovementioned definition to ensure that all deaths due to COVID-19 in all countries are identified, including in countries that may not follow WHO guidance for death certification.

The other definition relies on a positive test, and as a consequence, on rigorous testing policies and availability of accurate tests. As a result, the following issues must be considered:

- Testing policies vary widely across countries; moreover, they have evolved over the course of the pandemic.[2] Once community spread began, population groups in some countries with limited testing capacity eligibility for tests was restricted (e.g. to people with severe symptoms). This resulted in limiting reporting mainly to hospital deaths (e.g. Italy, the Netherlands, Spain, the United Kingdom (England)) as those attributed to COVID-19. At the same time, deaths in long-term care institutions and residential setting have often been underreported.[3]
- In addition to absolute number of deaths, the case-fatality ratio for COVID-19 is also affected by testing. Countries with very narrow testing criteria, for example those only testing severe cases that present in hospital, are likely to have comparatively high case-fatality rates as a result of the smaller volume of tests.

In terms of testing accuracy, PCR (polymerise chain reaction) test sensitivity can be as low as 54%,[4] with results also depending on the timeliness and expertise of sample collection. This means that a number of cases were not detected due to false negatives. However false positives are extremely rare.

Implications for interpreting the headline COVID-19 mortality figures

Given the variation in defining COVID-19 deaths in the headline figures, caution is needed when making comparisons of COVID-19 mortality across countries.

Where the clinical diagnosis-based definition is used, it is more likely that a greater share of COVID-19-associated deaths will be captured, unlike in countries relying solely on positive tests – for reasons mentioned above. However, there are further caveats: recording of cause of death on the death certificates can vary due to differences in implementation of international and national guidelines, as well as death certification and coding practices. For example, some countries using the clinical diagnosis-based definition still require a positive test result (e.g. Greece), while others (e.g. Canada) include any death in a person with COVID-19, even if it was not triggered by the virus (e.g. trauma). There may also be changes in guidelines over time, which is particularly relevant during this pandemic, as it involves the emergence on a novel cause of death. The complexity of tracking COVID-19 mortality, accounting for changing definitions and different sources of data, especially where there are differences among sub-national units, can be seen in the United Kingdom (**see Box 1**).

Monitoring excess deaths can more accurately highlight the scale of COVID-19 impact

The issues discussed above limit comparability of the headline COVID-19 mortality figures among countries. Therefore, both WHO and the European Centre for Disease Prevention and Control (ECDC) recommend European countries monitor total, as well as excess mortality (compared with what would be expected at that time of year) by age at least on a weekly basis.[5] Tracking all deaths has several advantages. Most importantly, it includes deaths among those who probably had COVID-19. It also provides a more comprehensive picture of the scale of mortality during the crisis and facilitates comparisons across countries. Excess deaths would include all causes, and therefore include any increase in mortality from other conditions, including those where people were not able to access timely care (but would also be reduced where deaths fell, for example from fewer road traffic injuries when people were under lockdown).

Box 1: Counting COVID-19 deaths – an example from the United Kingdom

Challenges in maintaining coherent mortality dataset can be illustrated by looking at the UK, which has undergone several iterations in definition of COVID-19 deaths, coupled with variations across the UK countries of England, Northern Ireland, Scotland and Wales (**Table 2**). First, until 29th April, the official daily COVID-19 death count for England only included deaths in hospitals, but not in any other settings. Second, the breadth of definition across countries still varies. Third, the Office of National Statistics (ONS) reports a parallel set of figures for England and Wales, using the definition based on clinical diagnosis. Fourth, in July it transpired that for England figures include deaths from causes not related to COVID-19 if a person ever tested positive for COVID-19. This led to change in definition in August and recalculation of deaths reported in the headline figures.[5]

The impact of differences in assessing the impact of COVID-19 mortality can be illustrated using the figures from England and Wales, as reported by the ONS for 2020.[6] From the week ending 13th March to week ending 17th July, a total of 245,007 deaths were registered. Of these, a quarter (57,886) were excess deaths (those above the average of corresponding weeks for the preceding 5 years). The number of deaths where COVID-19 was mentioned on a death certificate (i.e. probable, suspected or confirmed) amounted to 50,800. These, however, may be an underestimate, as in England doctors were not required to mention COVID-19 on the death certificate.[7] Deaths with a COVID-19 positive lab test represent an even smaller number, about 42,000, suggesting a further degree of underestimation, despite the possibility of inclusion of some deaths from other causes while a person also tested positive for COVID-19.

Table 2: Definitions of death from COVID-19 in the UK's headline figures

Country	Source	Definition of COVID-19 death
UK	UK Government (Gov.uk)	Figures are the total of COVID-19 deaths reported by the four devolved administration.
England	Public Health England (PHE)	From 12/08/2020: Deaths are only included if the deceased had had a positive test for COVID-19 and died within 28 days of the first positive test. From 29/04/2020 to 12/08/2020: deaths of people who have had a diagnosis of COVID-19 confirmed by a PHE or NHS laboratory. Before 29/04/2020: deaths in NHS-commissioned services (e.g. hospitals) of patients who have tested positively for COVID-19.
Wales	Public Health Wales	From 12/08/2020: deaths of hospitalised patients in Welsh Hospitals or care home residents where COVID-19 has been confirmed with a positive laboratory test and the clinician suspects this was a causative factor in the death. The majority of deaths included occur within 28 days of a positive test result. Before 12/08/2020: A death in a hospitalised patient or care home resident where COVID-19 has been confirmed with a positive test and the clinician suspects this was a causative factor in death (does not include deaths in other settings).
Scotland	Scottish Government (Gov.scot)	A confirmed COVID-19 death of an individual who dies within 28 days of their first positive COVID-19 laboratory report.
Northern Ireland	Department of Health Northern Ireland	Deaths reported to the Public Health Agency where the deceased has had a positive test for COVID-19 and died within 28 days, whether or not COVID-19 was the cause of death.

A number of initiatives to facilitate international comparisons using excess deaths have been developed. The Financial Times has been an especially valuable source. Its analysis, on 13th July 2020, reports an increase in mortality in comparison to levels of previous years of over 40% in several countries (e.g. in Italy, Spain, Belgium, the United Kingdom).[9] However, the situation varied markedly among regions within countries. It is also important to bear in mind that there is variation by age group, deprivation level, sex and ethnicity, with higher mortality rates in men compared to women and in older age groups. Evidence from the UK and USA also shows that death rates are also disproportionately higher among people with Black and some Asian ethnic backgrounds; however, very few other countries in Europe record information on ethnicity, meaning these groups are essentially invisible in the statistics.[10] Weekly figures reported by the Economist [11] suggest that there were weeks in the spring of 2020 where mortality exceeded historical levels in Belgium, France, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Excess mortality not only makes it possible to better understand the overall

impact of COVID-19 on population health, it also facilitates tracking the impact of the pandemic in real time, if reported with a minimal delay and at least on a weekly basis. This shows the important role of Statistical Offices or equivalent agencies in timely collection and publication of all-cause mortality data. As an analysis by the UK's Health Foundation shows, during the peak of the pandemic, the number of deaths in Spain, Italy and the United Kingdom has more than doubled in comparison to the average figure for the corresponding week in the preceding 5 years.[12] A recent study from Sweden shows that from the first week of April onwards the country experienced an increase in excess mortality among people over 60 years of age, with those over 80 being particularly affected with a 75% increase in mortality in men and 50% in women.[13] That study also finds that this is leading to a rapid drop in life expectancy at age 50 – by 3 years in men and 2 years in women. Unfortunately, however, these crucial data are not routinely reported or tracked via dashboards in the same way as COVID-19 headline figures in most countries, even within the European Union.

The exception is a subset of countries (18 European Union/European Economic Area (EU/EEA) countries, Berlin region of Germany and the 4 countries of the United Kingdom) whose agencies contribute to the EuroMOMO project.[14] Despite the approximately 4 weeks delay in publishing a complete dataset and the scale of excess deaths for individual countries or regions being expressed as a z score (with each z unit being one standard deviation) rather than the more intuitive figure of the percentage of excess mortality (or ideally, the actual figures to allow for more detailed inspection), it still shows that in spring 2020 mortality in Belgium, France, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the 4 countries of the United Kingdom was significantly higher than the levels seen between 2015 and 2019 for all ages (**see Figure 1**). The highest increases in deaths were seen in people over 65 years of age, but high excesses ($z > 10$) were also seen in France, Spain and particularly in England among younger age groups.

Figure 1: Excess mortality in the peak of the COVID-19 pandemic in Europe

Note: Figure shows excess deaths in Week 15 (beginning of April) 2020.

Source: Data from Euromomo

Conclusions

In summary, national definitions of COVID-19 deaths fall broadly into two groups: clinical diagnosis-based (confirmed and probable) and test-based. This may result in a substantial lack of comparability of COVID-19 related mortality across countries. In addition, issues such as testing policies, places of death included, changes over time, and regional variations in practices can further complicate mortality monitoring.

Where headline figures are subject to laboratory test confirmation, there often is evidence from statistical offices or research agencies of substantial under-reporting of COVID-19 mortality. In contrast, figures that are based on death certificates are widely recognised as more reliable, but take longer to be reported, and therefore are subject to varying, but often considerable delays. In addition, accuracy may vary depending on the implementation of international guidelines and recording practices within countries.

Estimations of excess deaths are increasingly used to monitor the true scale of the impact of the COVID-19 pandemic with minimal time lag. Early evidence already shows close to two-fold increase in excess mortality in countries most affected, resulting in many years of life

expectancy being wiped out. However, it seems remarkable that there are so many difficulties in obtaining comparable and timely data on the deaths of the people of Europe. The current pandemic must lead national governments to place a higher priority on timely collection, analysis, and reporting of mortality in the future. For now, however, they should concentrate on ensuring that we can see the impact of COVID-19 on mortality using a variety of data sources, published in a timely and accessible manner.

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Building on value-based health care: Towards a health system perspective

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Copenhagen: World Health Organization 2020 (acting as the host organization for, and secretariat of, the European Observatory on Health Systems and Policies)

Observatory Policy Brief 37

Number of pages: 31; **ISSN:** 1997-8073

Freely available for download at: https://apps.who.int/iris/bitstream/handle/10665/336134/policy-brief-37-1997-8073-eng.pdf?sequence=1&isAllowed=y

Preoccupation with the value created by health systems has been longstanding, and will likely only intensify given the ongoing health systems strains and shocks such as the COVID-19 pandemic. But the focus so far has usually been limited to value as seen from the perspectives of certain actors in the health system and/or to certain dimensions of value.

In this policy brief, the authors call for a shared understanding of value that embraces the health system in its entirety, including preventive services and other public health functions. They then define value to be the contribution of the health system to societal wellbeing.

The authors find that any meaningful formulation of the concept of wellbeing includes health, and by extension health systems, as an important contributor to wellbeing. Health improvement, responsiveness, financial protection, efficiency and equity are widely accepted as health systems' core contributions to wellbeing. Health systems can also contribute to wellbeing indirectly through the spillover effects that its actions have on other sectors.

Moreover, effective governance of the whole health system is needed to ensure that stakeholder perspectives and policy levers are aligned to promote a common concept of health system value and, ultimately, of societal wellbeing. There are governance tools, such as the TAPIC framework, that can help achieve this.