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MESTRADO INTEGRADO EM MEDICINA

2019/2020

Jorge Manuel Félix Cardoso

Excess mortality during COVID-19 in five European countries and a critique of mortality data analysis

abril, 2020

FMUP

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Excess mortality during COVID-19 in five european countries and a critique of mortality data analysis

Mestrado Integrado em Medicina

Área: Epidemiologia

Tipologia: Dissertação

Trabalho efetuado sob a Orientação de:

Professor Doutor Ricardo João Cruz Correia

E sob a Coorientação de:

Professor Doutor Pedro Pereira Rodrigues

Trabalho organizado de acordo com as normas da revista:

Eurosurveillance

abril, 2020

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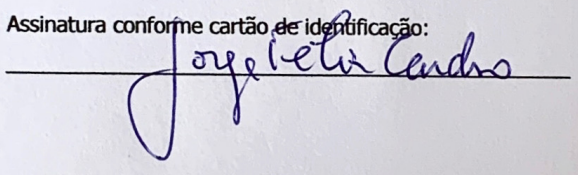

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UC Dissertação/Projeto (6º Ano) – DECLARAÇÃO DE REPRODUÇÃO

NOME

JORGE MANUEL FÉLIX CARDOSO

NÚMERO DE ESTUDANTE	E-MAIL
201305459	UP201305459@MED.UP.PT

DESIGNAÇÃO DA ÁREA DO PROJECTO

EPIDEMIOLOGIA

TÍTULO DISSERTAÇÃO

EXCESS MORTALITY DURING COVID-19 IN 5 EUROPEAN COUNTRIES AND A CRITIQUE OF MORTALITY DATA ANALYSIS

ORIENTADOR

PROFESSOR DOUTOR RICARDO JOÃO CRUZ CORREIA

COORIENTADOR (se aplicável)

PROFESSOR DOUTOR PEDRO PEREIRA RODRIGUES

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"Dê-me um remédio, senhor doutor. Um remédio que me ponha a mão como a tinha. Assim grande, assim funda, assim, assim..."

Vergílio Ferreira, *Aparição*

Agradecimentos

À Helena, por todos os dias me perguntar pela tese, e aos meus pais, por nunca o fazerem. Dois atos simétricos movidos pelo mesmo combustível. O silêncio pode ser espelho de uma confiança enternecedora, e as perguntas inquietam na direção certa.

Ao Henrique e à nossa futura viagem astronómica ao Gana. Um braço direito e outro esquerdo em todo este trabalho, feito em tempo record e em contexto pandémico, e em tantas outras coisas. Aos Dr. Pêra Vasconcelos e Professor δημυς Βουμιταστις.

Ao Ricardo e ao Pedro, por muito mais do que esta tese, que representa a última iteração de um constante fluxo de ideias e desafios que não se ficarão por aqui. Para o bem e para o mal, devo-vos muito daquilo que sou e serei. A vida é feita de sorte, e ter-vos como mentores é uma das sortes que não esquecerei de creditar, elogiar e aconselhar.

À Faculdade de Medicina, que acabou por se tornar uma casa, e em particular ao MEDCIDS, um departamento perfeito para qualquer estudante curioso e motivado, onde o pensamento é livre e a crítica é a regra. Ao Professor Altamiro, que por cá me acolheu em 2016, e na sua pessoa a todos os outros elementos do departamento, sem exceção.

À MM e equipa, por sempre me obrigarem a não pôr este trabalho académico (e tudo o mais que ele representa) em segundo plano.

Ao António e ao Francisco, os grandes parceiros nos 6 anos de curso (que acabaram por ser 7). Convosco falei sobre tudo, às vezes sem dizer qualquer palavra. É incalculável o valor de um abrigo intelectual para quem se perde, como foi o meu caso, ainda que temporariamente. Espero ter-vos retribuído na medida suficiente.

Table of Contents

Excess mortality during COVID-19 in five European countries and a critique of mortality data analysis

Introduction

The COVID-19 pandemic is an ongoing event disrupting lives, health systems, and economies worldwide. Clear data about the pandemic's impact is lacking, namely regarding mortality. This work aims to study the impact of COVID-19 through the analysis of all-cause mortality data made available by different European countries, and to critique their mortality surveillance data.

Methods

European countries that had publicly available data about the number of deaths per day/week were selected (England and Wales, France, Italy, Netherlands and Portugal). Two different methods were selected to estimate the excess mortality due to COVID19: (DEV) deviation from the expected value from homologue periods, and (RSTS) remainder after seasonal time series decomposition. We estimate total, age- and gender-specific excess mortality. Furthermore, we compare different policy responses to COVID-19.

Results

Excess mortality was found in all 5 countries, ranging from 10.6% in Portugal (DEV) to 98.5% in Italy (DEV). Furthermore, excess mortality is higher than COVID-attributed deaths in all 5 countries.

Discussion

The impact of COVID-19 on mortality appears to be larger than officially attributed deaths, in varying degrees in different countries. Comparisons between countries would be useful, but large disparities in mortality surveillance data could not be overcome. Unreliable data, and even a lack of cause-specific mortality data undermine the understanding of the impact of policy choices on both direct and indirect deaths during COVID-19. European countries should invest more on mortality surveillance systems to improve the publicly available data.

Introduction

2020 started with news about a strange pneumonia virus in Wuhan, China. Since then, it has been declared a Pandemic by the World Health Organization (WHO), and it has caused, as of April 19th, 2 281 714 confirmed cases and 159 511 deaths of COVID-19, of which 1 018 221 cases and 159 511 deaths in Europe [1].

COVID-19 is a clinical entity caused by a novel coronavirus, SARS-CoV-2. Its epidemiology is still uncertain. Person-to-person spread of SARS-CoV-2 is thought to occur mainly via respiratory droplets [2]. Mean incubation period ranges from 4 to 6 days and the mean serial interval ranges from 4 to 8 days [3]. There is probably an early peak of infectiousness, with probable presymptomatic transmission for some cases [4]. Median time from onset of symptoms to intensive care unit (ICU) admission is around 10 days [5]. WHO reported that the time between symptom onset and death ranged from about 2 weeks to 8 weeks [6]. Case Fatality Rate is estimated to range from 0.87 to 9.36 (updated 21st April) [7].

Its novelty and characteristics make this virus' impact hard to measure, and a lack of comparable and reliable data is not helping. The number of officially confirmed cases is highly dependent on testing policy and capacity. Some countries only test patients in need of hospitalization. Others have policies that recommend testing everyone that presents with a set of symptoms, regardless of their need of hospital care. However, to our knowledge, no country has been able to test every patient with suggestive clinical presentation, due to a global shortage of tests. Thus, the number of infected individuals will inevitably be larger than the number of confirmed cases of COVID-19.

Deaths attributed to COVID-19 are also difficult to measure accurately. Problems with testing affect not only confirmed cases but also attributed deaths. Besides, testing is not enough to determine the cause of death, as some patients may die while infected with SARS-CoV-2, but not due to it. Due to constraints health systems are facing across the world, it is likely that a precise attribution of cause of death is not possible. Additionally, some patients die without there having been a suspicion of COVID-19.

We postulate that mortality surveillance can be of help in the everyday management of health systems, but especially during health crisis such as infectious disease outbreaks where an estimate of observed excess mortality could be informative. Compared to the ability to identify, test and attribute deaths to a novel pathogen, measuring mortality is relatively simple. Furthermore, contrary to novel pathogens, which may have specificities that require the collection of unusual data, it benefits from the possibility of having IT systems in place in advance.

The EuroMOMO network (www.euromomo.eu) monitors weekly all-cause age-specific excess mortality in countries in Europe through a standardised approach. At the moment, data is available for up to the 12th of April (week 15). In week 11, Italy had high excess mortality, and it has had very high excess since then. Portugal had "above expected" mortality in weeks 13 and 14. The Netherlands faced high mortality in week 12 and very high ever since, and England as well. For Wales, week 13 had high mortality, and week 14 very high. Lastly, France had high mortality in week 12, very high in weeks 13 and 14, but no excess this last week. Beyond this qualitative analysis, we found four studies of excess mortality during COVID-19. Switzerland has a mortality surveillance system in place with data from the Federal Statistical Office [8] that estimates 892 excess deaths for those above-65 up to April 12th. Instituto Carlos III in Spain found a 56,5% all-cause mortality excess from March 17th - April 7th (13 954 excess deaths), mostly in individuals older than 75 and males [9]. Researchers familiar with the Spanish mortality surveillance system mentioned some concerns about data reliability for the last few days, so it's likely that this may be revised upwards [10]. Cancelli and Foresti found increases in overall mortality in several Italian regions ranging from 4 to 10 times the amount of COVID-19 reported deaths [11]. They conclude that deaths attributed to COVID-19 are underestimated, and end their paper calling for more, better data on the pandemic. Galeotti et al. use a self-titled "rule of thumb calculation" pointing to a 1:1 to 1:3 COVID-19 to unexplained excess death count, a number not meant to be interpreted as an epidemiological model, but only as an insight into a potentially disregarded information gap [12]. These last two studies have strong limitations, most of all regarding the estimation of excess deaths, but it's reasonable to assume that their conclusions stand.

Our aim is to quantitatively characterize all-cause mortality in selected European countries in an effort to better measure the impact of COVID-19, and to critique mortality surveillance data. We also confront mortality data with policy decisions.

Methods

We estimated excess mortality during COVID-19 in 5 European countries, using two different methods and comparing it to COVID-19 attributed deaths, and analysed policies undertaken by each country.

Data sources

We searched for daily or weekly data on all-cause mortality for most European countries, particularly those participating in EuroMOMO. We could find suitable data for Portugal, Italy, France, England and Wales, and the Netherlands. We define suitable data as data available for a period matching the start of the COVID-19 outbreaks in Europe, publicly available, timely updated, and with daily or weekly resolution. Datasets are described in Table 1.

Table 1 - Data sources and characteristics

Country	**France**	**Italy**	**Netherlands**	**England and Wales**	**Portugal**
Sources*	INSEE[13]	ISTAT[14]	CBS[15]	ONS[16]	DGS[17]
Timespan	2010-2020	2015-2020	2010-2020	2010-2020	2010-2020
Temporal resolution available	Daily	Weekly*	Weekly	Weekly	Daily
Recorded event	Date of death	Date of death	Date of death	Date of registration	Date of death
Last available date	6th April	28th March	12th April	3rd April	17th April

Delay in reporting	11 days	12 days	5 days	11 days	2 days
Gender data	Yes	Yes	Yes	Yes	No
Age groups	0-64 65-74 75-84 85+	0-14 15-64 65-74 75+	0-64 65-80 80+	Under 1 year 01-14 15-44 45-64 65-74 75-84 85+	Under 1 year 01-04 05-14 15-44 45-64 65-74 75+ unknown

* data for Italy is reported in fixed intervals for every year, not coincident with calendar weeks.

We checked every dataset for internal consistency, comparing age and gender-specific totals and checking for strange values comparing different years/datasets available.

We collected data on COVID deaths from Johns Hopkins University CSSE Repository [18], except for England and Wales, where we used data from ONS [19] to use date of registration, as use for all-cause mortality.

Data harmonization

Datasets selected for this work are diverse and required some harmonization work. We can divide them according to several characteristics. Portugal and France have daily data, which we've decided to adapt into weekly data to have a common data unit and smoothen daily

variations that may disturb the analysis. Italy, the Netherlands, and England and Wales already have weekly data. All countries report their weekly mortality differently, with the Netherlands using Monday as the first day of their week, England and Wales using Saturday, and Italy using a first, 11-day week, and 7-day weeks for the rest, regardless of the day of the week (and with one 8-day week for bissextile years). We used England and Wales as a template to adapt Portuguese and French data. Regarding age-groups, all countries report it differently, with under and over-65 as the only age group with comparable data. Thus, we created a dataset with age-specific mortality for under- and over-65 for all 5 countries. We've corrected Italian data for the last week of February, since they have 8-day weeks every bissextile year. We've considered only ⅞ of deaths reported for that week, both for 2016 and 2020. Stratified data from the Netherlands presented an artefact every year-end, which resulted in some years ending with 53 weeks (last one incomplete). For these, data from week 53 was aggregated with week 1 (also incomplete) from the following year. Portugal has no data on gender mortality.

Our datasets are accessible on GitHub [20].

Data analysis

We calculated excess mortality based on two different statistical methods, which were applied to total all-cause mortality and to four subtotals: under-65, male and female, and over-65, male and female. We started our analysis on the day of the first COVID-19 death in each country, naming the first full week after that "week 1". We calculated the amount of excess deaths that could be explained by COVID-19, and we also looked at week-to-week trends in total mortality for each country, using "week 0" as a baseline to chart a comparative evolution of weekly mortality in each country.

Deviation from the expected value from homologue periods (DEV)

Mortality is relatively stable across the years for all analysed datasets. Thus, we calculate the expected mortality using the homologue mean for previous years and adding a standard deviation to account for normal variation. This may lead to an underestimation of excess deaths, as it sets a high threshold. Other authors use a higher threshold (3 z-scores for the

EuroMOMO algorithm, for instance) but usually discount previous periods of excess mortality.

For this method, we present the results as the number of excess deaths for the timespan beginning with the first full week since the country's first death and consider only weeks with excess deaths for computing excess deaths as a percentage of expected deaths.

Remainder after seasonal time series decomposition (RSTS)

The second method we used for estimating excess mortality considers the series of weekly number of deaths explicitly as a time series and applies a seasonal decomposition [21] to adjust observed mortality for seasonality and trend, exposing an irregular component (remainder) that should be an indication of the excess mortality in that period. It works by using LOESS [22] polynomial smoothing iteratively on the seasonal sub-series, after which the remainder is smoothed to find the trend. The remainder component is the residual from the seasonal plus trend fitted using weighted least squares. Remainders were found using a yearly seasonality and a 10-years long trend, using two models for each country: one where only the trend is explicitly included in the regression, and another where seasonality was also explicitly included in the regression. R was used to perform the data and statistical work, including the STL function of package 'stats' (R software, version 3.6.2, R Foundation for Statistical Computing). Results for RSTS are presented as an interval (defined by the result of both models), and the entire analysed time period is considered for reporting excesses in mortality. Analysis for different age and gender strata was also performed (if specific data were available). This method was not applied to Italy, since its dataset is not a year-long dataset but contains data just for the January-April period.

Policy analysis

We use the Oxford Covid-19 Government Response Tracker [23] and its Stringency Index to extract a date for main policy decisions in all five countries, and compare it to the timeline for

all-cause mortality. Like elsewhere in this work, we use the 1st COVID-19 death as a reference. We chose three policies as the most relevant: school closure, cancelling of public events, and domestic travel restrictions.

Results

Data quality

Data quality is particularly contrasting among data sources.

Internal coherence is lacking in some datasets. For Portugal, on 6th March 2020 the sum of the district specific mortality for all districts does not equal the national total for the day, the only such mistake we were able to find. French data included deaths with no attributed date of death, which were naturally excluded from the total. These accounted for a total of 204 out of 5,988,702 entries (0.0034%). Italy also reports very incomplete data: only 1450 of the 7904 Italian counties. England and Wales have missing data on subtotal deaths (unknown age or gender).

We also found poor data structure for some countries. Italy groups the first 11 days of the year together as a "week", and uses the same calendar days for every year, even for bissextile years. Dutch datasets presented with ambiguous information regarding weeks at the end of a year which had less than 7 days: some years would draw on the truncated weeks for the previous year and solely update the rest of the days as their first week death count, and some others would present a total for a 7 day period.

We did our best to mitigate the impact of these data quality issues with corrections as light as possible.

Mortality trends

As seen in Figure 1, mortality does not evolve the same way since week 1 of COVID-19 in all countries. For most countries, week 1 is still close to normal, but week 2 starts showing increases in all-cause mortality. Largest week-on-week (WoW) increases happen on week 2 in Portugal and Italy, week 3 in the Netherlands, and week 4 in England and Wales. In France, the largest increase in mortality WoW happens on week 7.

Figure 1 - All-cause mortality data for selected countries, mean and 2020

Table 2 presents data on excess deaths with breakdown by age and gender when possible, alongside the amount of deaths attributed to COVID-19, according to the DEV method. We found excess deaths in all studied countries. Italy stands out from the rest for its large excess mortality, almost doubling the upper limit of expected deaths. The percentage of excess deaths explained by COVID-19 in weeks of increased mortality varies substantially, from almost all excess deaths (England and Wales, 92.9%) to less than half (Netherlands, 46.1%). Age and gender differences were found, with excess mortality predominantly in elderly males, and with Portugal and France showing no excess mortality in under-65 populations.

Table 2 - Total, age- and gender-specific excess mortality results with DEV method, selected countries, February-April 2020

DEV - Deviation from the expected value from homologue periods; [a] Data for subgroups missing for week 15 in the Netherlands. Timespan for this data is 3 weeks, not 4.

Country			Portugal	England and Wales	France	Netherlands	Italy
Day of 1st death			16th March	5th March	15th February	6th March	21st February
Full weeks since 1st death			4 weeks	4 weeks	7 weeks	5 weeks	5 weeks
DEV excess deaths	Total	Excess deaths	934	6265	8610	5890	14670
		%	(+10.6%)	(+29.5%)	(+23.4%)	(+48.2%)	(+98.5%)
		Timespan	4 weeks	2 weeks	3 weeks	4 weeks	4 weeks

		COVID-deaths	675	5821	6428	2717	9994
		(% of deaths in weeks with excess)	(72.3%)	(92.9%)	(74.7%)	(46.1%)	(68.1%)
	Under 65	**Male**	0	388	0	64	514
		%		(+19.7%)		(+8.1%)[a]	(+45.4%)
		Female		196	0	21	131
		%		(+14.9%)		(+3.6%)[a]	(+18.6%)
	Over 65	**Male**	852 (+11%)	3724	4343	2225	8046
		%		(+44.1%)	(+45.9%)	(+59.0%)[a]	(+107.3%)
		Female		1816 (+18.8%)	3396 (+31.1%)	1287 (+30.4%)[a]	6157 (+66.4%)
		%					

Table 3 presents data on excess deaths with breakdown by age and gender according to the RSTS method. Results are similar to the DEV method. Excess mortality can be observed in all 4 countries, ranging from single digit increases for France and Portugal to double digit increases in England and Wales and the Netherlands. As with the DEV method, we find excess mortality happens mostly in males over 65. Both France and Portugal present no excess deaths for under-65

Table 3 - Total, age- and gender-specific excess mortality results with RSTS method, selected countries, February-April 2020

RSTS - Remainder after seasonal time series decomposition (RSTS); [a] Data for subgroups missing for week 15 in the Netherlands. Timespan for this data is 4 weeks, not 5

Country			**Portugal**	**England and Wales**	**France**	**Netherlands**
Day of 1st death			16th mar	5th mar	15th feb	6th mar
Full weeks since 1st death			4 weeks	4 weeks	7 weeks	5 weeks
RSTS Excess deaths	**Total**		567; 1115	6833; 7251	3590; 7911	5385; 6253
	%		(+6.2; 12.9%)	(+16.1; 17.3%)	(+4.0; 9.2%)	(+33.8; 41.5%)
	COVID-deaths		657	3475	6507	2737
	(% of deaths in weeks since 1st death)		(58.9; 115.9 %)	(47.9; 50.9 %)	(82.3; 181.3 %)	(43.8; 50.8 %)
	Under 65	**Male**	0	441; 447	0	124; 164[a]
		%		(+11.2; 11.3%)		(+12.8; 17.6%)
		Female		207; 226		0; 35[a]
		%		(+8.0; 8.7%)		(+0.0; 5.0%)

	Over 65	**Male**		3894;3901	2917; 4704	1841; 2223[a]
		%	353; 802	(+22.6; 22.7%)	(+8,1; 13.8%)	(+33.5; 43.4%)
		Female	(+4.3; 10.3%)	2396; 2443	664; 3579	1125;1526[a]
		%		(+13; 13.2%)	(+1.6; 9.2%)	(+18.8; 27.4%)

Looking at Figure 2, we can divide countries in two groups: those whose mortality is still growing - France and England and Wales - and those who are currently experiencing a plateau or a decrease - Netherlands and Portugal, and Italy, respectively. Growth happens earlier in the Netherlands, Italy and Portugal, and later in England and Wales. Italy is a clear outlier, with 2 weeks of extreme excess mortality, more than doubling the baseline of week 0. The country who acted earlier – Portugal, as can be seen in Table 4 - presents the best results with week 4 showing a downward trend towards values similar to baseline mortality, and a smaller amount of excess deaths, both in absolute and relative terms.

Figure 2 - All-cause mortality trends, week 0 as baseline for all selected countries

Week 0 is the week before the 1st full week after the first COVID-19 death in each country

Table 4 - Policies enacted by countries relative to time of first death by COVID-19

	Date of first death	**School closure**	**Cancelling public events**	**Restrictions on internal movements**
Portugal	16th March	-3	-4	24

United Kingdom	5th March	18	16	18
France	15th February	30	14	31
Netherlands	6th March	9	4	17
Italy	21st February	2	2	0

Discussion

Our main aim was to study all-cause mortality data across different European countries. Specifically, we aimed to characterize mortality during COVID-19, including excess mortality, to compare different policy options and possible impacts on mortality, and to describe and critique mortality surveillance data.

All 5 studied countries present excess mortality during COVID-19, with large differences between the one who presents only a slight increase, Portugal, and those with large increases, such as Italy and England and Wales. Plus, excess mortality is larger than the amount of COVID-19 attributed deaths in all 5 countries, raising questions about the causes of excess mortality and about the reliability of cause of death attribution for such a novel and undertested disease. For some countries, it is particularly hard to understand how much of the excess mortality can be directly attributed to COVID-19, since deaths occur in large amounts outside hospitals. COVID-19 deaths happening in care homes range from 42% in Belgium to 57% in Spain [24]. Besides untested COVID-19-caused deaths, which are not quantified, other deaths may be happening due to the disruption of societies and health systems. Additionally, lower mortality rates during January and February, mostly due to a warm winter season in Europe and a light influenza season, may help explain some of this excess mortality, in an effect commonly called harvesting.

As would be expected considering data from COVID-19 deaths, the largest increase in mortality is felt in the elderly. Men over 65 are the most affected population group, with around twice the increase in deaths compared to that of women over 65. This may reflect a higher degree of frailty in elderly men, compared to elderly women, when exposed to the direct and indirect effects of the pandemic.

Indirect effects of the COVID-19 pandemic are felt due to, among others causes, a shift in healthcare resources and fund allocation towards pandemic containment. Acute care patients

may also be less likely to go to an A&E service, fearing a higher risk of contagion. This would be confirmed by data from A&E. Poor strata of society may see communitarian help they rely on severely hampered. Conversely, some other changes due to COVID-19 reaction by the authorities may result in saved lives: traffic reduction decreases the chances of fatal road casualties; social distancing measures will lower the number of risky outdoors activities; a reduction of working hours leads to a decrease in chances of job accidents; and increased hand and respiratory hygiene decreases the rate of other infections, including influenza and other respiratory tract infections.

We compare our method with EuroMOMO for previous periods of the year to check our threshold against theirs, as EuroMOMO is a well-calibrated international tool [25]. EuroMOMO alerts for excess mortality in 2020 in Portugal (above normal (AN) in week 1 and 2, and high excess (HE) mortality in week 3), in England and Wales (AN in week 1), in the Netherlands (AN in week 2) and in Italy (AN in week 3). Our DEV method returns no excess mortality for any of these weeks. Our RSTS method reports increased mortality for week 3 in England and Wales, but no further periods of excess mortality. We find this to be sufficiently coherent to state that we have a higher threshold than EuroMOMO and are not overestimating excess mortality.

Countries who acted earlier relative to their first COVID deaths seem to have had better results for overall mortality. This is the case for Portugal, which has seen a smaller increase in overall mortality and a faster return to baseline mortality. However, poor data quality makes it difficult to propose any relationship between policy and mortality. Data for England and Wales must be interpreted carefully, since it does not represent date of death, but date of registration, which can account for such a delayed increase in excess mortality. France provides data with low reliability, as can be confirmed through the extensive delays in the reporting of deaths - the file for March, available in April, added deaths to January and February, thus making it possible that we'll have to wait until June to truly quantify the mortality in France during the month of March. These two countries are the ones who present a delayed growth in mortality, which may be an artefact due to poor data quality.

Relevance of this work

COVID-19 cases and mortality have been heavily scrutinized by public opinion. There has been great interest in this topic in the media, with some articles mentioning the unreliability of data thus far [26]. Scientists in some European countries have asked for access to better data in order to help fight the pandemic. This includes efforts to improve open data initiatives [27,28], but also collaboration between government and academia in topics in which open data is not possible (detailed clinical records, for instance).

No country has publicly available mortality surveillance data accurate and detailed enough to answer important questions during the ongoing pandemic. The one who comes closest is Portugal, with a shorter delay, and more coherent and more refined data, but without detailed gender-specific or regional data and lacking causes of death. Monitoring excess mortality and its causes would also allow for a better balance between avoiding damage from the pandemic and damage caused by the measures taken to fight the pandemic. Some policymakers worry about the impact of social distancing and lockdown measures and having up-to-date mortality data would be a useful tool to achieve the difficult balance between fighting an outbreak and avoiding larger than needed negative impacts for the population.

Despite the existence of regional data in most surveyed countries, it faces increased data problems compared to nationwide data. Italy has timely available data for less than half its regions; Portugal is only updating its “Districts”, which do not geographically match the health regional administrations that are responsible for COVID-19 data reporting. England and Wales, the Netherlands and France have detailed regional data, but it suffers from the same constraints as country data.

Appropriate EU-level guidance on mortality surveillance and reporting would solve many of the problems we identify. Recently, the EU Commission has adopted a toolbox for coordination on mobile contact tracing apps [29]. Despite this being an important step, we find it more useful to have coordinated COVID-19 case and death reporting, as well as all-cause mortality data. Without accurate, pan-European, data, it is difficult to compare different policy strategies and prioritize resources for most-affected regions. This is particularly important considering the wide variety of policy responses during this crisis, which will be difficult to study without comparable, reliable, transparent data.

This study has several limitations related to the quality of data or methods that are important to mention. As previously stated, data has many problems, and this greatly limits its interpretations. For this reason, limitations cannot be overcome, and thus we chose to be conservative in estimating excess mortality, as one can confirm when comparing our results to other results, such as those mentioned in this paper.

Regarding future work, we aim to include a regional analysis of each country and to add other countries. Data on causes of death would also help us understand collateral damages from the pandemic. Lastly, collecting data on hospital usage, especially A&E services, would provide good clues to whether excess deaths from non-COVID-19 causes could be avoided by strengthening other health services.

Main findings and recommendations

An excess of mortality was found in all studied countries in the period after the first COVID-19 attributed death, beyond those deaths directly confirmed as COVID-19. However, mortality surveillance systems in the five studied countries presented several data quality issues that hindered a more in-depth analysis, relevant both for pandemic and normal

contexts. Therefore, as members of the international community of researchers that seek to work on European COVID-19 issues, the following recommendations are highly suggested:

1. Very few European countries have up-to-date, publicly available, mortality data.
   Each European country should have a public mortality surveillance site (Portuguese site EVM is a good template)

2. Some countries take weeks to publish their mortality data, making it difficult to follow the evolution and analyse data in time to help decisions.
   The delay to make public data available should be the minimum possible (< 5 days)

3. Each country uses a different rule to group data into time periods (deaths per day; per week, starting in different weekdays, and with weeks having more than seven days in one country).
   Share data on daily number of deaths (not just grouped in weeks)

4. Relevant hypotheses are very difficult to test due to a lack of data, namely regarding causes of excess mortality.
   Add causes of death, using an international terminology standard, to the reports

5. Gross errors can be found in available data
   Improve internal automatic verification methods to detect and correct data problems before publishing data.

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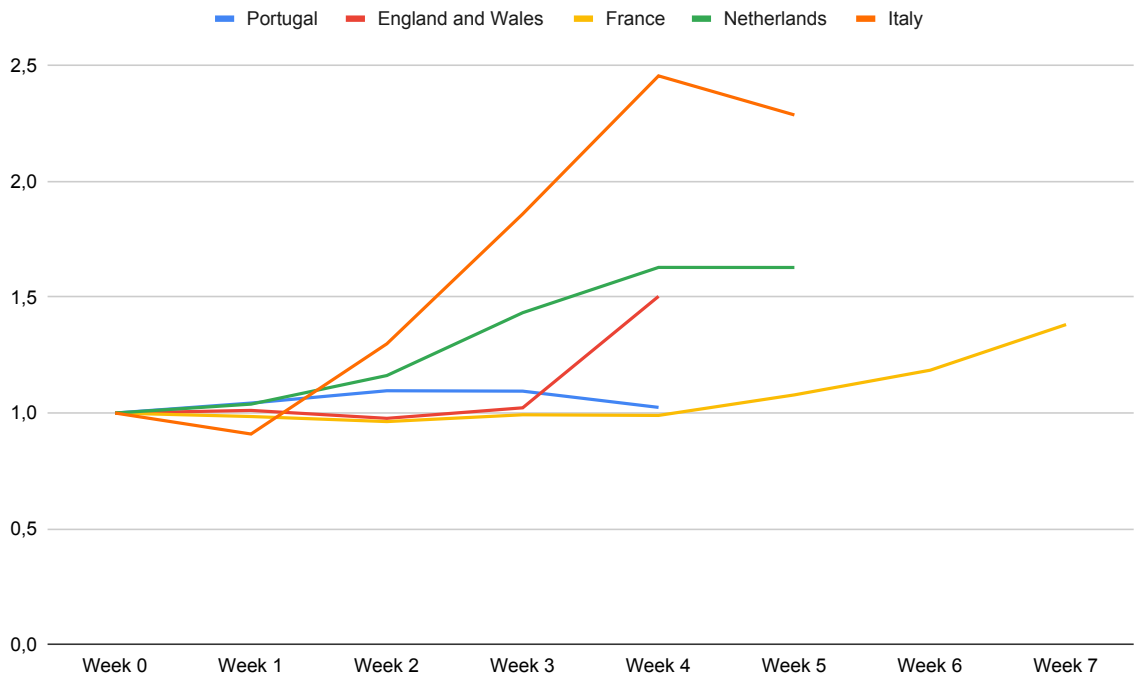
Attachments

Figure 1 - All-cause mortality data for selected countries, mean and 2020

Figure 2 - All-cause mortality trends, week 0 as baseline for all selected countries

Week 0 is the week before the 1st full week after the first COVID-19 death in each country



Anexos

A - NORMAS DE PUBLICAÇÃO DA REVISTA *EUROSURVEILLANCE*

For authors

Eurosurveillance is a weekly electronic publication. It is published online every Thursday (with the exception of e-alerts). The current issue's table of contents is sent by email to all subscribers who sign up to receive the weekly alert. Pdf versions of the weekly issues as well as the individual articles can be downloaded from the *Eurosurveillance* website from the week following publication.

In addition to the online publication, special issues and topical compilations of selected material from the online issues are published in printed form with a limited number of copies.

Article formats

Rapid communications

Rapid communications are timely, authoritative short reports on important communicable disease findings and events where rapid dissemination of information could potentially lead to a prompt change in an ongoing public health situation or create awareness for topics we consider to be of timely relevance. These articles are usually published within two weeks from submission, but when necessary, publication can be arranged within hours of submission (see e-alerts). They undergo rapid independent peer review by at least one expert in the field.

To allow for such rapid processing, these articles are short, usually around 1,200 words, and have a minimum of eight and up to about 20 references and four illustrations (figures or tables). The abstract should not exceed 75 words.

Rapid communications should not have an IMRaD (Introduction, Methods, Results and Discussion) structure. Subheadings as appropriate for the content should be used instead and rapid communications should start with a brief description of the current event (a few lines only) and the aim of the study. Necessary

background information should be integrated with the discussion where authors put their data into context with other data for their country and Europe and other relevant literature.

E-alerts are published ad hoc to disseminate information about an important event that should not wait until the next regular publication of *Eurosurveillance*.

Regular articles

Research articles provide original results from studies on any aspect of communicable disease epidemiology, prevention and control. These papers should include new data or insights of public health importance and consist of ca 3,500 words, a minimum of 15 and up to around 30 references and six illustrations (figures or tables). We require authors to follow the CONSORT guidelines for reporting randomised controlled trials and to include the respective filled in CONSORT checklist in the submission. For economic evaluations of health interventions, we require authors to follow the CHEERS guidelines and to include the respective filled in CHEERS checklist in the submission. Research articles should usually follow the IMRaD structure (Introduction, Methods, Results and Discussion) and have a structured abstract that should not exceed 250 words.

Surveillance articles should focus on the analysis and interpretation of epidemiological trends regarding a specific disease, pathogen or health event based on data from a national or international surveillance system. They could also present the evaluation of a surveillance system or the establishment of a new system.

These articles may present data from a (regional) national or international surveillance and should contain a meaningful analysis of specific aspects of the data and put these in a wider context.

Surveillance articles should have an IMRaD (Introduction, Methods, Results and Discussion) structure and a structured abstract (Background, Aim, Methods, Results and Conclusion).

The **Introduction** should describe the public health importance of the disease/pathogen/health event, the rationale for the surveillance and the purpose and the objectives of the study. The **Methods** should provide a detailed description of the system (can also be brief if described elsewhere and referenced), applied case definitions, data collection (voluntary/mandatory), processing and validation. An ethical statement should be included. The **Results** should be presented in a similar sequence as the methods. Data should span several years to assess trends; however, the time span could be shorter for emerging diseases or new systems. Data should be analysed by age and sex, when relevant. The **Discussion** should put findings into (European) perspective and highlight lessons learnt and good practices. The impact of implemented or lack of prevention and control measures on trends and the possible need for resource allocation should be discussed. For description of surveillance systems, results should be interpreted taking into account key attributes such as stability, sensitivity, representativeness and usefulness. Limitations and data quality should also be discussed.

Surveillance articles can be up to ca 3,500 words long. They can have a minimum of 15 and up to ca 30 references, and a maximum of six illustrations (figures or tables). The abstract should not exceed 250 words.

Outbreak reports on national or international outbreaks should be submitted once fully investigated and focus on new or unexpected aspects and on lessons learnt. They should have the following structure: A **Background** that describes very briefly the pathogen and its transmission, puts the outbreak into context in terms of incidence in Europe and/or in the country or region. The following **Outbreak detection** passage should describe details of the signal followed by what is presented in the report. The **Methods** should present the data source(s), case definition, epidemiological (case–control study etc.) and environmental/trace-back investigations as well as microbiological investigations. Data should be analysed by sex and where applicable gender. **Results** should be presented in a similar sequence as methods and an

epicurve and – where applicable, a graphical timeline for the sequence of events should be added. A specific **Outbreak control measures** section should present measures taken and highlight the difficulties encountered and/or the successes following their implementation. The **Discussion** should put the findings into (European) perspective and highlight lessons learnt.

The length of the outbreak reports is up to ca 3,500 words, with a minimum of 15 and up to around 30 references and six illustrations (figures or tables) and the abstract should not exceed 200 words. We encourage authors to follow the STROBE guidelines that were set up for observational studies and to include the respective filled in STROBE checklist in the submission.

Review articles provide a comprehensive state-of-the-art overview of issues of major public health importance within the field of communicable disease surveillance, prevention or control. They usually are about 4,000 words in length, and contain up to 80 references and six illustrations (figures or tables). All review articles should explain the search strategy and selection criteria, justify the inclusion/exclusion of material and state the sources. Review articles should have a structured abstract that should not exceed 250 words.

For systematic reviews, we require authors to follow the PRISMA guidelines and to include the respective filled in PRISMA checklist in the submission.

Euroroundups should provide an analysis of a contemporary specific aspect or function of communicable disease surveillance, prevention or control in at least five European countries, and present an in-depth comparison of systems and/or data. The average length of these articles is 3,500 words with a minimum of 15 and up to around 30 references and six illustrations (figures or tables). The abstract should not exceed 200 words.

Perspectives provide an insightful analysis of practices, policies and guidance on communicable disease prevention and control, as well as guidance on developments in the field of vaccines and immunisation. These articles have an average length of ca 2,000

words, and contain a minimum of 10 and up to 20 references and four illustrations (figures or tables). They do not follow an IMRaD structure and are structured by meaningful subheadings. The abstract should not exceed 200 words.

Other material

The following materials are not peer-reviewed. However, we may consult an expert for advice on the content of such items.

Editorials are written by experts invited to comment on articles and special topics covered by *Eurosurveillance* and usually have a maximum of two authors. Editorials are usually 1,500 words long and contain a maximum of 20 references and four illustrations (figures or tables). As the editorial reflects the personal opinion of the author, the sections Funding information and Authors' contributions are not required. A Conflict of interest statement should be included.

Letters to the editor comment on recent *Eurosurveillance* articles and should be submitted within 12 weeks after the publication of the article in question. They are intended to stimulate scientific discussion and are not a format for the publication of original data. Their average length is 600 words, with five or fewer references. As Letters to the editor do not contain original data, a section with an Ethical statement is not required. A section on Authors' contributions and a Conflict of interest statement should be included.

Meeting reports should provide a synopsis of the content of the presentations and have up to 2,000 words, 10 references (including, when possible, links to full reports of conference activities) and no illustrations. Before submitting a meeting report, please contact the editorial team.

Addenda provide new information after publication of an article in cases where such information is relevant but has no bearing on the study outcome and conclusions. Moreover, the information should

neither have been available at the time of publication of the article nor justify the publication of a second full article. Addenda should be very short and may contain maximum one illustration.

For example:

Addendum for Euro Surveill. 2016;21(46)

Eurosurveillance editorial team

In the article entitled 'Outbreak of enterovirus D68 of the new B3 lineage in Stockholm, Sweden, August to September 2016' by R Dyrdak et al., published on 17 November 2016, the GenBank accession numbers of the enterovirus D68 sequences were added on 23 November 2016 at the request of the authors.

How to submit material

All submissions should be sent through the *Eurosurveillance* online submission system. An online author tutorial is available, if you have any difficulties during the submission process.

In the submission system you will have to provide the following information:

- the article category;
- a declaration that the material is original and has not been submitted elsewhere;
- a declaration that all authors have seen and approved the final manuscript;
- a declaration that the corresponding author, on behalf of all co-authors, has read and agreed to the terms of the *Eurosurveillance* data protection notice;
- a declaration that informed consent has been obtained from persons whose details are described in articles (or from the persons' guardians) that this information may be published;
- a statement on funding and potential competing interests of the authors;
- where appropriate, information on approval of the work by an ethics committee;
- proof of permission to use figures or tables that are adapted

or reproduced from other publications.

The following material should be uploaded as separate files:

- a Title page (Word format) including the title, authors (please ensure that the first name is given in full), affiliations (including equal contributions if applicable), corresponding author information, abstract (use the heading 'Abstract' on the previous line); this document will be used to populate the relevant fields;
- a covering letter;
- an anonymised manuscript text in Word format (pdf files cannot be evaluated) without line numbers and with a minimum of eight references for rapid communications and 15 for regular articles. All author-identifiable information – authors' names, affiliations and contributions, as well as any acknowledgements – should NOT be included in the document;
- if a collective author is included (e.g. a working group or disease-specific network) and if the persons comprising the group are to be included at the end of the article, please list them in the relevant field; the contribution of the collective author should be stated in the Authors' contributions section which will be published at the end of the article;
- all figures in an appropriate format (see details in the section Figure formatting); The following file formats are automatically converted into the PDF: Word, RTF, TXT, LaTeX2e, AMSTex, TIFF, GIF, JPEG, EPS, Postscript, PICT, PDF, Excel, and PowerPoint. Other file types are not automatically supported, but can be included as hyperlink items in the PDF file;
- a scan of the agreement with authors signed by the corresponding author on behalf of all authors.

File names of uploaded files must not contain any author-identifiable information that may lead to identification of the author.

After all files and information have been uploaded in the submission system, the corresponding author is responsible for checking and approving the pdf. Approval of the pdf is required for the article to be sent to the editorial office.

Submissions should conform to the *Recommendation for the Conduct, Reporting, Editing and Publication of Scholarly work in Medical Journals*, detailed by the International Committee of Medical Journal Editors.

Supplementary material

Materials that are not essential for the reader to understand the methodology and results of an article, and to follow the logic of the text, can be submitted as supplementary materials. Such materials may comprise questionnaires, search strategies for systematic reviews, models, sensitivity analyses etc. that help increase transparency and reproducibility of presented findings. Large sets of raw data are generally not considered supplementary materials and these should be deposited preferably in publicly funded open access repositories that would allow citing them. Supplementary material should not be used for additional discussion, analysis, or interpretations of the findings in the article.

Supplementary materials will be made available on the *Eurosurveillance* website alongside the article, on behalf of the authors who remain responsible for the accuracy of the content. If any of the supplemental material has been previously published, the authors are responsible for obtaining the required permissions and attributing the source material. The supplementary materials will not be edited.

Authors may submit PDFs, Excel files, images and audio-visual materials. Pdf format is preferred. If possible, all material should be combined in one file. They should be referred to in the manuscript text as Supplementary Table S1, S2.., Supplementary Figure S1, S2..., or Supplement S1, S2..., as appropriate for its content.

The supplement files themselves should be headed with a short descriptive title and contain the following disclaimer:

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Please note: a name should not be displayed upon submission because *Eurosurveillance* uses double-blind review and reviewers will have access to the supplementary material. Supplementary materials should be submitted in English unless otherwise agreed with the editorial team. Authors should format the text and tables etc. using the following instructions: Supplement style and formats. The length of supplementary materials should be reasonable and generally not exceed 20 pages in total. The supplementary materials will not undergo formal peer review. They will be made available to reviewers as supporting information and the editors expect authors to take possible reviewer comments into account where appropriate. Models submitted as supplementary materials will undergo an initial check by board members with respective expertise before they are sent together with the manuscript to the peer-reviewers.

These materials are not included in the manuscript maximum word and reference counts and reviewers will be asked systematically if the submitted article contains passages that can become supplementary material. They will be also asked if materials

submitted as supplement are essential for the reader to understand the methodology and results and should be moved into the manuscript.

Formatting and style

Articles should be written in clear, appropriate and scientific language that is free of jargon. Avoid abbreviations when possible and define them when you first use them. Please use United Kingdom English spelling.

Titles should be interesting, informative, accurate and as short as possible. They should contain the place/country and the time period covered in the paper.

Keywords: A maximum of eight keywords suitable for indexing should be provided. Please select from the list provided and add others if needed. Separate the keywords by a semi-colon (;).

Abstracts of regular articles should stay within the limit of 150 to 250 words, those of rapid communications should not exceed 75 words. Abstracts for research articles and reviews should be structured.

Main text: An introduction should put the topic into perspective using up-to-date references, and clearly state the objective of the work and its relevance. The relevant methods should be presented at an appropriate level of detail; molecular diagnostic techniques that are published or standard, for example, can be named and referenced and do not need to be described in detail. It is important to make it clear at all times which results are the work of the authors, presented as part of the article, and which are already known and given as background or for comparison. If tables and figures are provided, the text should shortly describe and summarise the content, but not unnecessarily repeat the information; the reader should be able to understand text and illustrations independently of each other. The European and international relevance should be discussed with relevant references, and where appropriate, lessons learnt and recommendations for the future should be presented.

Tables and figures

Table formatting

Tables must be created in Word. The full table (title, table, notes) should be inserted in the manuscript directly after the first paragraph in which it is mentioned. As tables must be editable, images are not acceptable.

Numbers and percentages should be split into separate columns. To aid readability in both the online and .pdf versions of the article, portrait-oriented tables are preferred whenever possible.

Figure formatting

A figure's title and notes should be inserted in the manuscript directly after the first paragraph in which it is mentioned. Figure files should not be inserted in the manuscript, but should be uploaded as separate, editable files.

Figures should always be provided as vector files (.pdf, .eps, .wmf, .emf, .svg) and should not include bitmap elements (i.e. a map as a picture in the background). Bitmap files (.jpg, .bmp, .gif, etc) cannot be used because they cannot be edited and are not linked to the original data.

For .pdf files, be sure to export the figure as a pdf directly from the programme in which it was created; do not export the figure in another format and then save it as a pdf or it will not be a vector file.

Graphs should be provided in Excel format, whenever possible. If this is not possible, please follow the general guidelines for figure file types.

Photographs should be given as high-resolution bitmap files (.jpg, .tif, etc.). These should be provided as stand-alone original files, not within Word or PowerPoint documents.

Pie charts are generally not used in *Eurosurveillance*. Unless otherwise agreed with the editor, please choose a different type of graph.

Titles, notes and references

In general, table/figure titles should be short and follow the format: disease, stratification, town, country, date (n = #). Abbreviations should be avoided unless necessary in particularly long titles.

Any additional information needed to understand a table/figure should be given below the table/figure in the following order:

(i) all abbreviations used in the table (in alphabetical order)

(ii) all footnotes used in the table (using a lettered list format, alphabetically by row)

(iii) any further notes

(iv) data source (if applicable)

All tables/figures should be able to stand alone outside the context of the manuscript; the reader should be able to understand the information without referring to explanations in the text.

Any references cited within a table/figure should be numbered chronologically, following the last reference number cited in the manuscript.

Previously published material

Tables and figures that have already been published can only be accepted under specific circumstances. When appropriate, authors are required to obtain permission from the copyright holder to reproduce the material in question; this should be done ahead of submission. The original source of the material needs to be clearly acknowledged and/or referenced. Copyright also needs to be observed, for example, for maps used as a background in figures.

References

Citations are numbered in the order of appearance in the text. Reference numbers are placed in square brackets [1] in the text. References cited in a table or figure legend should be numbered after the citations in the text.

Papers that are accepted for publication can be cited as forthcoming. Papers not yet accepted for publication cannot be cited. The source of such information can be indicated in parentheses in the text, either as data not shown, if the information comes from one of the authors, or as personal communication, if the information comes from someone else. Personal communications must include the name of the person and the date the communication took place.

References should be formatted according to the uniform requirements for manuscripts submitted to biomedical journals'(Vancouver style). Do not use italics, bold or underlining.

#. Author of article AA, Author of article BB, Author of article CC. Title of article. Abbreviated Title of Journal. Year;vol(issue):page number(s).

For example:

1. Geck MJ, Yoo S, Wang JC. Assessment of cervical ligamentous injury in trauma patients using MRI. J Spinal Disord. 2001;14(5):371-7.

If there are more than six authors, list the first six authors followed by et al. For example:

1. Rose ME, Huerbin MB, Melick J, Marion DW, Palmer AM, Schiding JK, et al. Regulation of interstitial excitatory amino acid concentrations after cortical contusion injury. Brain Res. 2002;935(1-2):40-6.

More samples of reference formats can be seen at: http://www.nlm.nih.gov/bsd/uniform_requirements.html

Authors and acknowledgements

All listed authors should have made substantive intellectual contributions to the article, be aware of its submission to *Eurosurveillance* and able to account for its content. The contribution of each author to the article must be stated: this information will be shown at the end of the published article.

We do not limit the number of authors, but for the rapid communications it may be more appropriate to list the names of people who have not contributed directly to the production of the article in the acknowledgements. You may acknowledge anyone who has helped you with any aspect of the report, but it is always the corresponding author's responsibility to obtain permission from anyone being acknowledged.

Please include complete information about each author (full name, affiliation and the name of the institution, city and country in which the work was done). Clearly identify and provide telephone number and email address for the corresponding author.

In our submission system, authors can also include an ORCID (Open Researcher and Contributor ID), if they have one. We encourage authors to use this system.

It is possible to provide a collective name as an author (working group, disease-specific network, etc.). The members of such a group can be listed at the end of the article and will appear in PubMed/MEDLINE indexation. In the online submission system, the corresponding author will be asked whether there is a collective author and for any names of members of the group or network to be listed.

A statement on funding for the work described in the manuscript should be included.

Ethical statement

For articles reporting outcomes from studies involving humans and related data, *Eurosurveillance* requests authors to declare that the planning conduct and reporting of studies was in line with the Declaration of Helsinki, as revised in 2013.

Approval to conduct the study should be obtained from an independent local, regional or national review body (e.g. ethics committee, institutional review board). The name of the board and the number/ID of the approval(s) should be given.

The *Eurosurveillance* editors reserve the right to judge whether the conduct of the study/research was appropriate.

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GISAID sequences

Although the database of the Global Initiative on Sharing All Influenza Data (GISAID) is publicly accessible, attention should be paid to correct attribution of the data used. You should acknowledge the authors, originating and submitting laboratories of the sequences from GISAID's EpiFlu database on which the research is based, and to refer to the GISAID website. In addition to an appropriate acknowledgement, we recommend including a table in the Methods section, listing all sequences with the respective background information, unless there is an unmanageable number of them. Examples of how to do this can be found here: Article 1, Article 2

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Contacting the editorial team

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