

Вебинар. Международная лаборатория исследований населения и здоровья.
Высшая школа экономики.

9 апреля 2020 г.

COVID-19: количественная оценка пандемии и ее воздействия на уровень смертности

COVID-19: quantification of the pandemic and its impact on the level of mortality

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Covid-19 cases and deaths: comparability of the data



Covid-19 pandemic

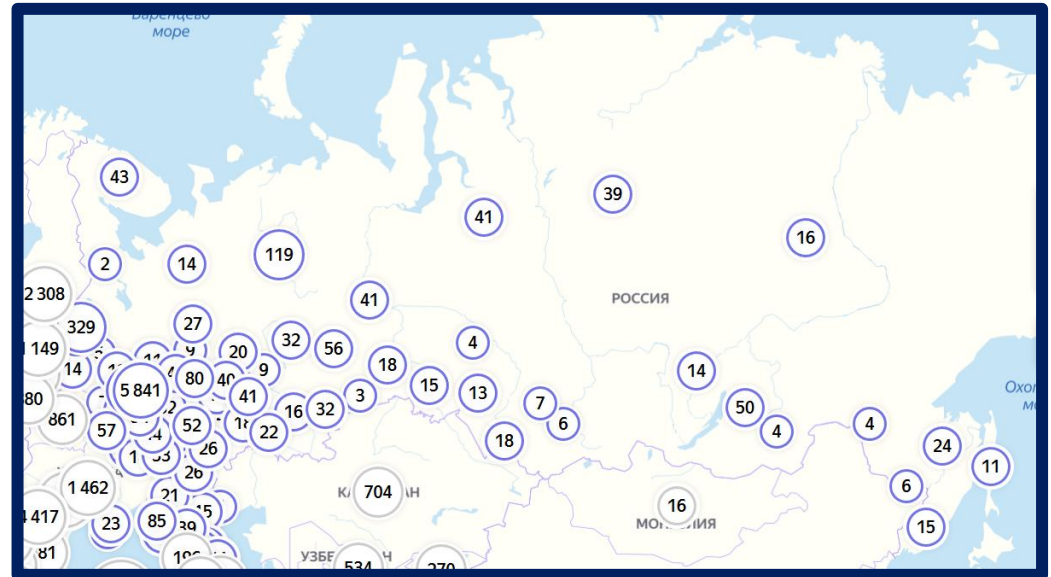
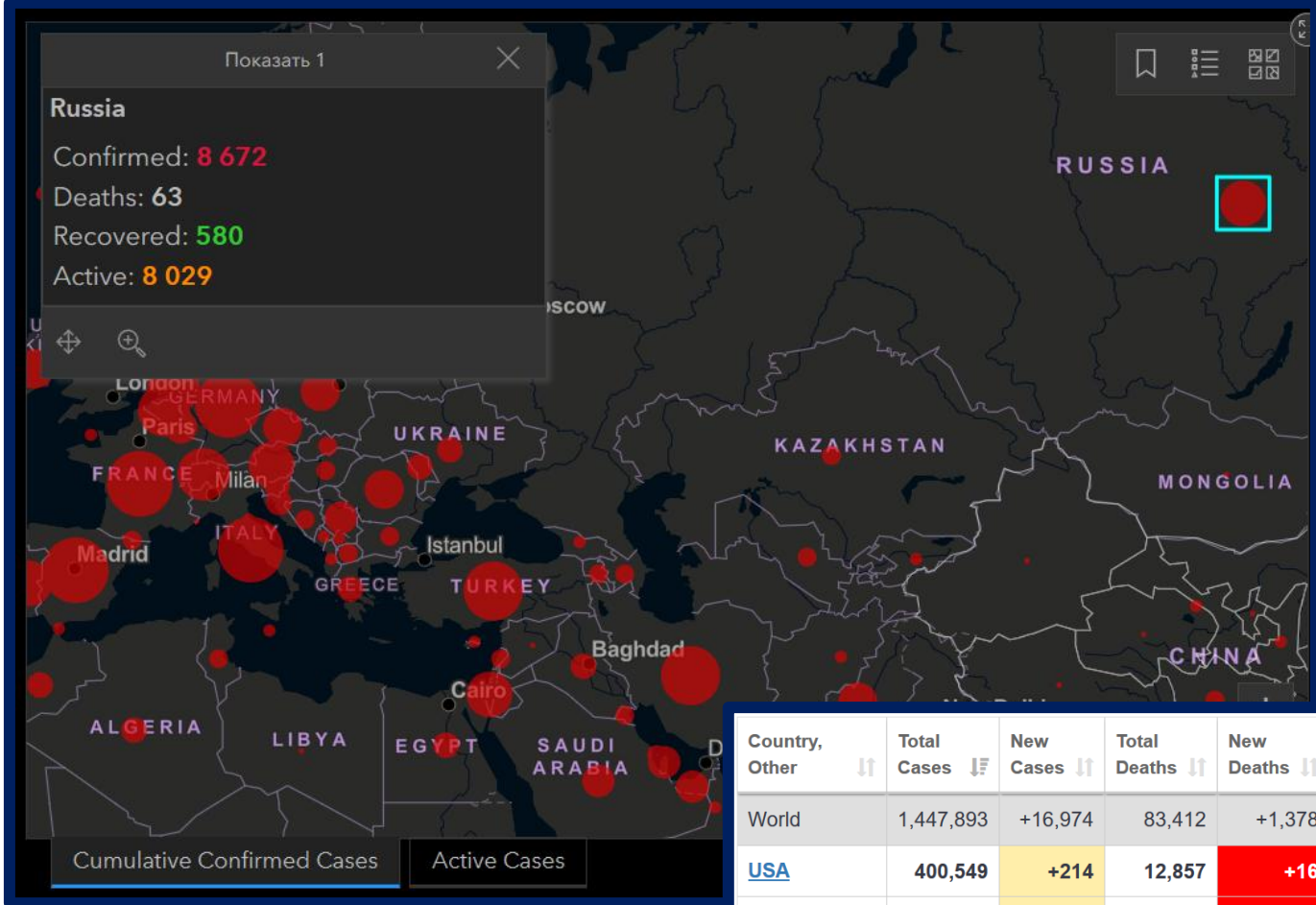
31 December 2019 – the cases of pneumonia of unknown cause reported to WHO by China

7 January 2020 – a novel coronavirus (2019-nCoV -> SARS-CoV-2) was identified

11 March 2020 – WHO announces a pandemic

First pandemic since 2009 (influenza A (H1N1))

First pandemic caused by a coronavirus



Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop
World	1,447,893	+16,974	83,412	+1,378	309,183	1,055,298	47,994	186	10.7		
USA	400,549	+214	12,857	+16	21,711	365,981	9,169	1,210	39	2,082,443	6,291
Spain	146,690	+4,748	14,555	+510	48,021	84,114	7,069	3,137	311	355,000	7,593
Italy	135,586		17,127		24,392	94,067	3,792	2,243	283	755,445	12,495
France	109,069		10,328		19,337	79,404	7,131	1,671	158	224,254	3,436
Germany	107,663		2,016		36,081	69,566	4,895	1,285	24	918,460	10,962
China	81,802	+62	3,333	+2	77,279	1,190	189	57	2		
Iran	64,586	+1,997	3,993	+121	27,039	33,554	3,987	769	48	211,136	2,514
UK	55,242		6,159		135	48,948	1,559	814	91	266,694	3,929
Turkey	34,109		725		1,582	31,802	1,474	404	9	222,868	2,643
Belgium	23,403	+1,209	2,240	+205	4,681	16,482	1,276	2,019	193	80,512	6,947

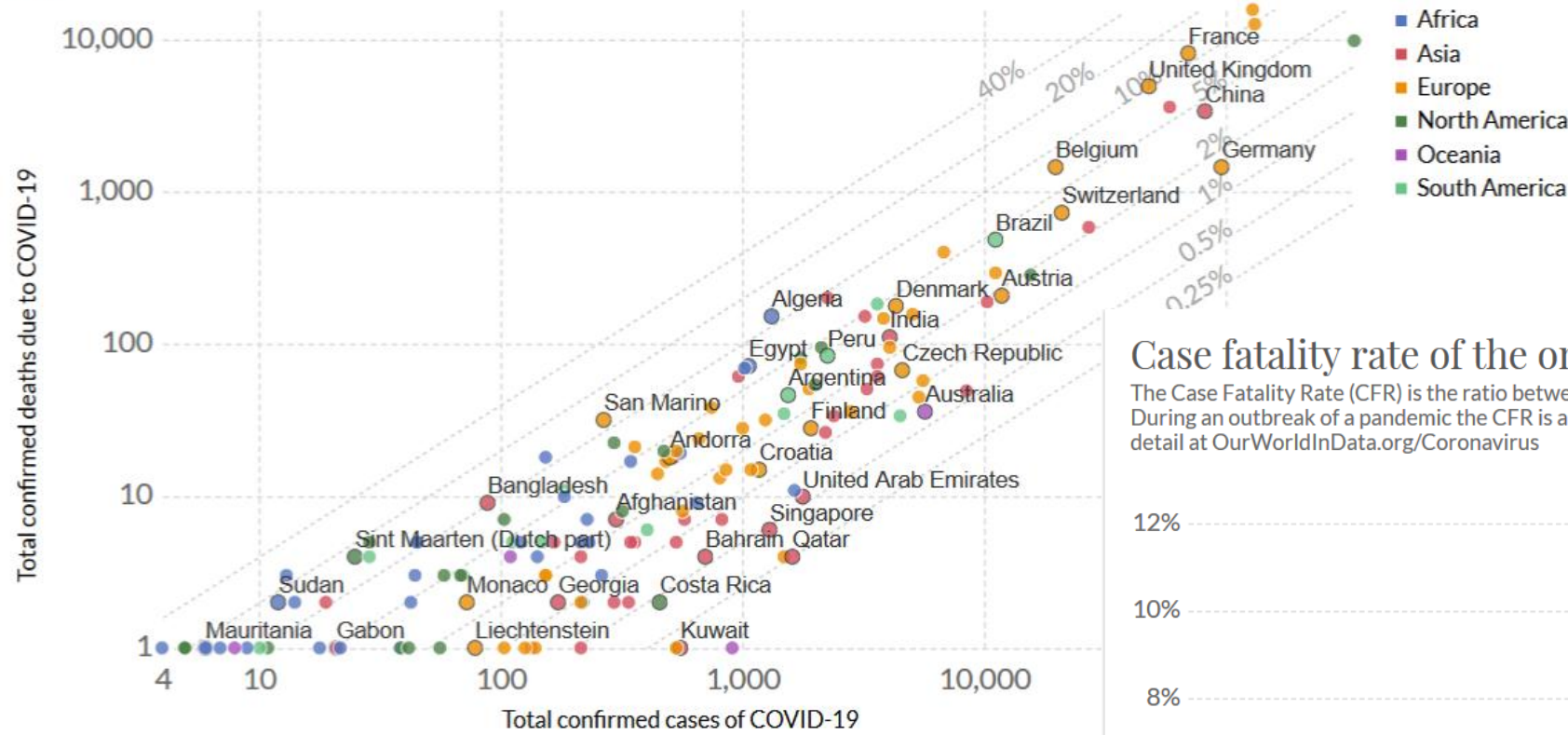


COVID-19: Total confirmed cases vs. Total confirmed deaths, Apr 6, 2020

The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing. The grey lines show the corresponding case fatality rates, CFR (the ratio between confirmed deaths and confirmed cases).



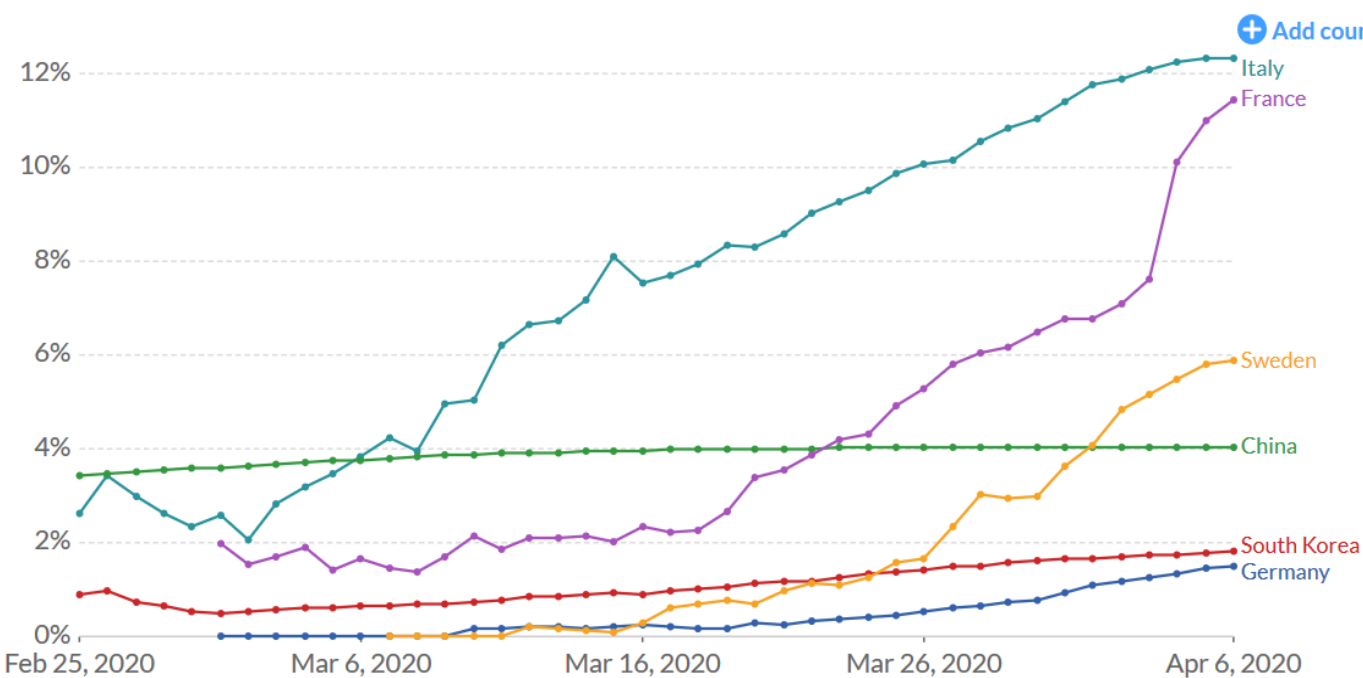
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Source: European CDC – Situation Update Worldwide – Last updated 6th April, 12:00 (London time)

Case fatality rate of the ongoing COVID-19 pandemic

The Case Fatality Rate (CFR) is the ratio between confirmed deaths and confirmed cases. During an outbreak of a pandemic the CFR is a poor measure of the mortality risk of the disease. We explain this in detail at OurWorldInData.org/Coronavirus



Source: European CDC – Situation Update Worldwide – Last updated 6th April, 12:00 (London time)

Note: Only countries with more than 100 confirmed cases are included.



Key indicators

Spread of the disease:

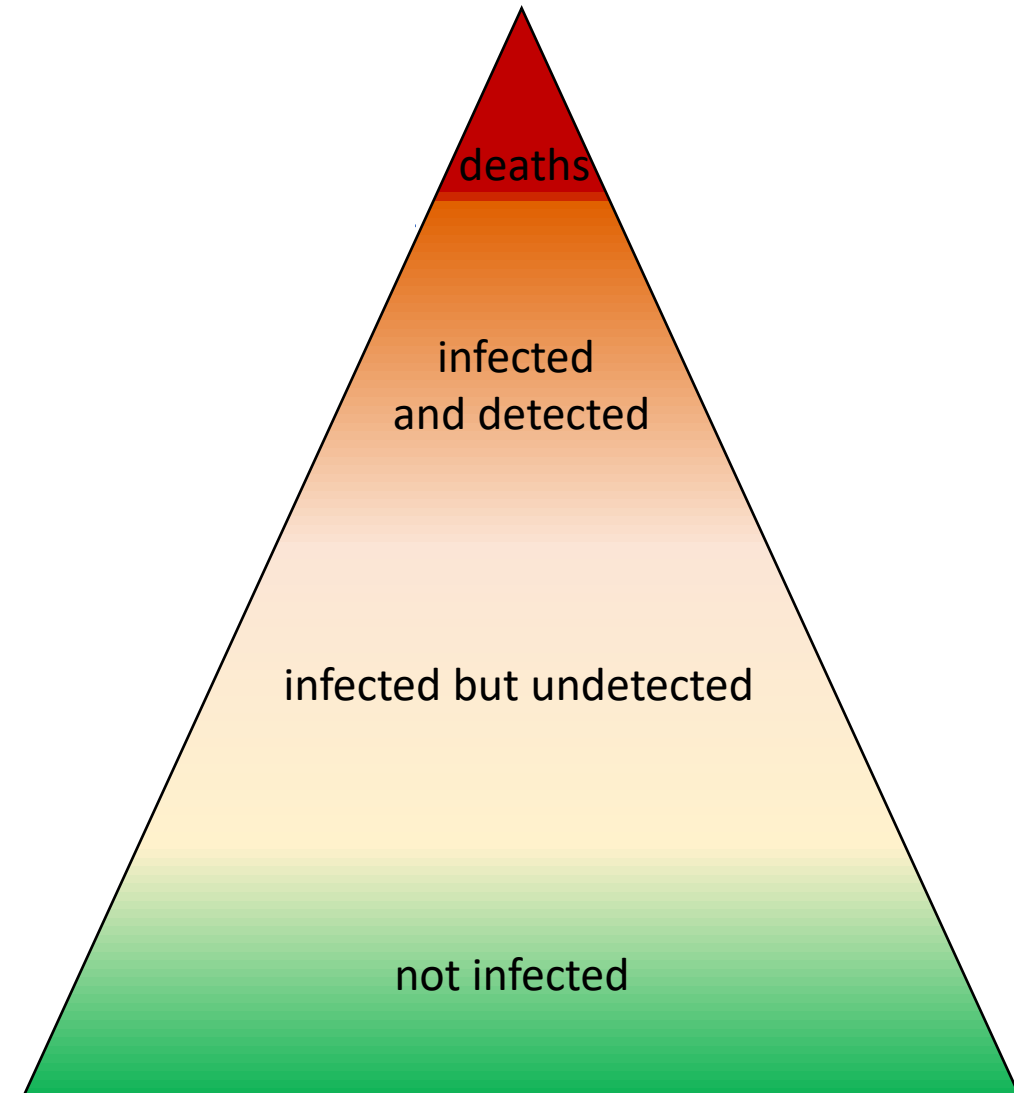
How many are infected in the population? How it evolves in time?

Lethality:

How many of those infected will die?
How it depends on age and sex?

Mortality:

How many deaths will appear in the population due to the disease outbreak?
How will it affect mortality and life expectancy trends?





Confirmed cases

WHO definition (for Global surveillance purposes):

Confirmed case A person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms.

Colorado. U.S.

Positive cases include people who tested positive, as well as cases where epidemiological investigation has determined that there is a high likelihood that an untested individual has COVID-19 due to their symptoms and close contact with someone who tested positive for COVID-19. The number of untested positive individuals included in the total positive sum is a very small portion of the total positives reported.



Testing capacities

Three months since the new virus was identified

Countries had to ramp up their testing and laboratory capacities in a short time

A huge gap between countries

“intensified COVID-19 molecular testing has led to shortages of molecular testing reagents globally for COVID-19 and for other molecular diagnostics” [WHO, 21 March 2020]

WHO Testing strategy recommendations



Countries that have not yet reported cases
Countries dealing with sporadic cases
Countries dealing with clusters of cases } All suspected cases

Suspect case

- a) Acute respiratory illness AND a travel in a location reporting community transmission
- b) Acute respiratory illness AND contact with Covid-19 case
- c) Severe acute respiratory illness AND requiring hospitalization AND in the absence of alternative diagnosis

Countries dealing with community transmission

Testing constraints should be anticipated, and **prioritization will be required**

Different testing strategies might be needed within the same country



Testing strategies

Testing only those who fits the criteria (decision is made by doctors):

- Most of the countries

Testing all interested:

- Iceland. 32623 samples tested as of April, 8 (NUHI + deCode Genetics voluntary screening)
- Russia. Commercial labs in large cities offer tests for SARS-CoV-2, positive or inconclusive tests are sent to governmental laboratories to be checked
- U.S. Drive-thru testing sites. For those with symptoms (including self-reported). Currently closed (?)

How criteria change in time. Example of Germany

21.01.2020

Clinical, radiological or histopathological evidence of pneumonia + stay in risk area
(China, Wuhan, Hubei Province)

Acute respiratory symptoms + Covid-19 contact

23.01.2020

Clinical or radiological evidence of acute infection of the lower respiratory tract + stay
in risk area

Acute respiratory symptoms + Covid-19 contact

10.02.2020

Non-specific general symptoms or acute respiratory symptoms + Covid-19 contact

Acute respiratory symptoms + stay in risk areas



How criteria change in time. Example of Germany

26.02.2020

Non-specific general symptoms or acute respiratory symptoms + Covid-19 contact

Acute respiratory symptoms + stay in risk areas

Acute respiratory symptoms + stay in regions with Covid-19 cases

Clinical or radiological evidence of viral pneumonia without alternative diagnosis

24.03.2020

Acute respiratory symptoms + Covid-19 contact

Clinical or radiological evidence of viral pneumonia with increased pneumonias in nursing homes/hospitals

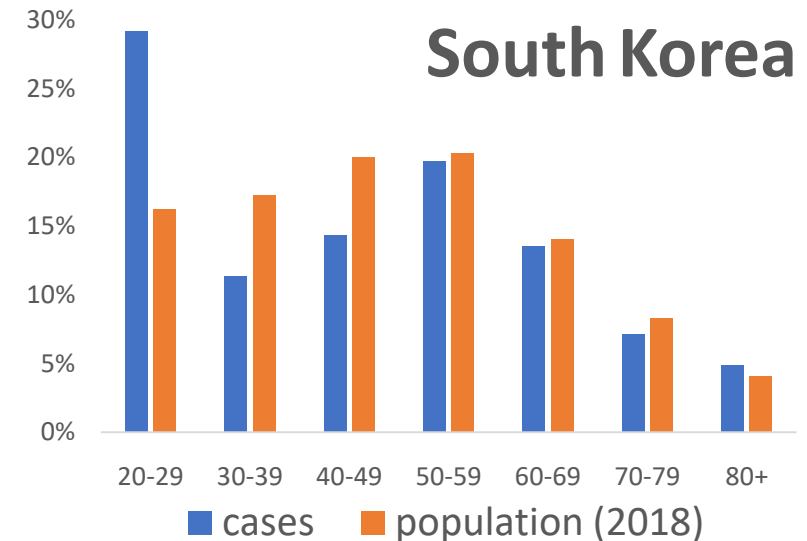
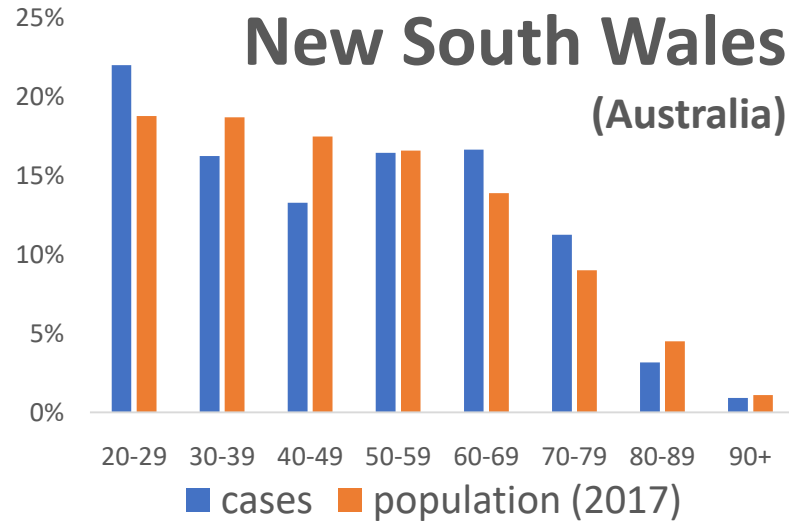
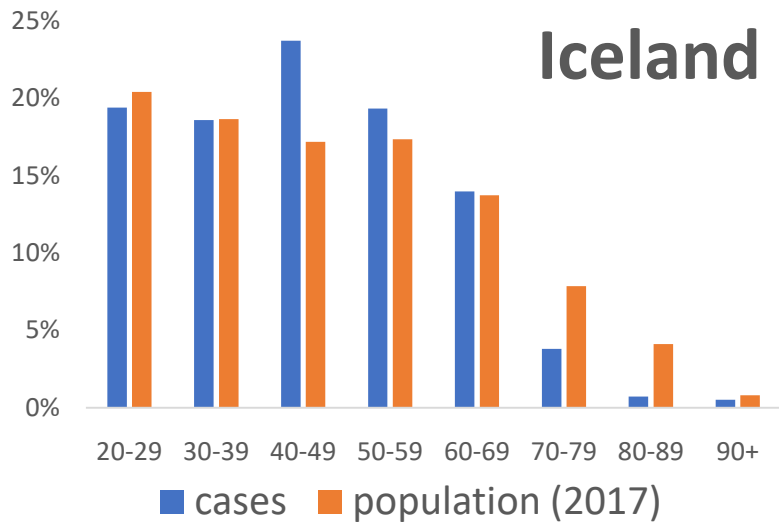
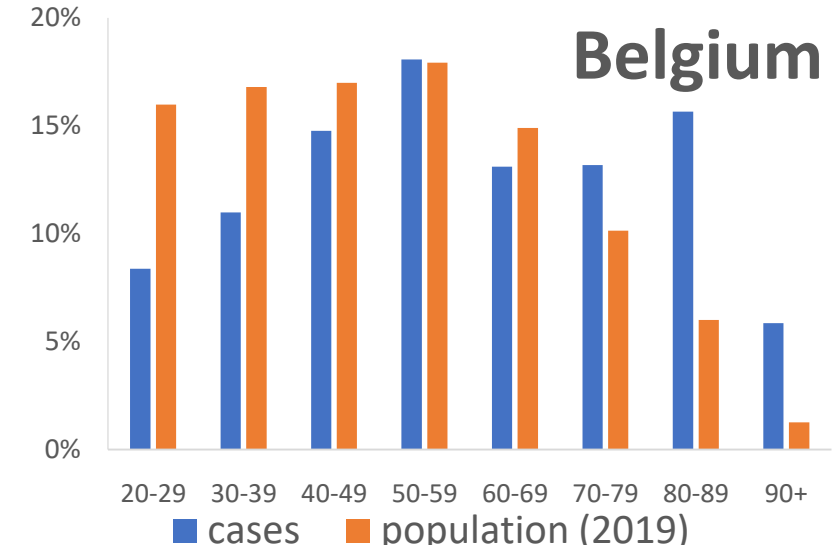
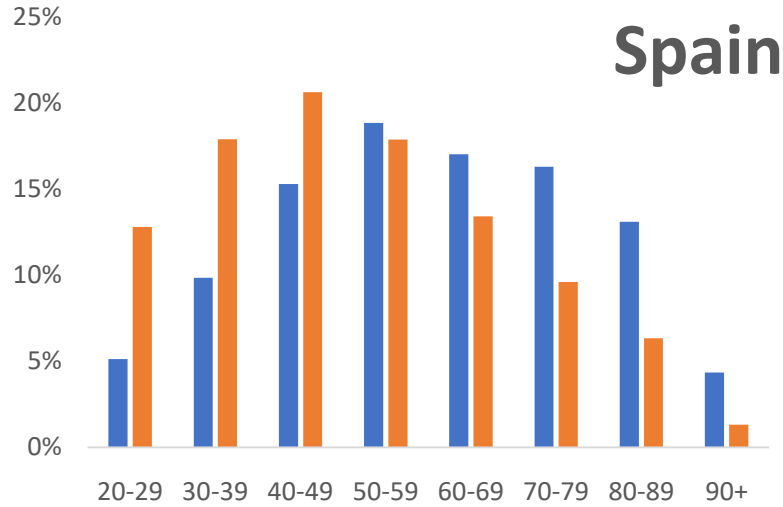
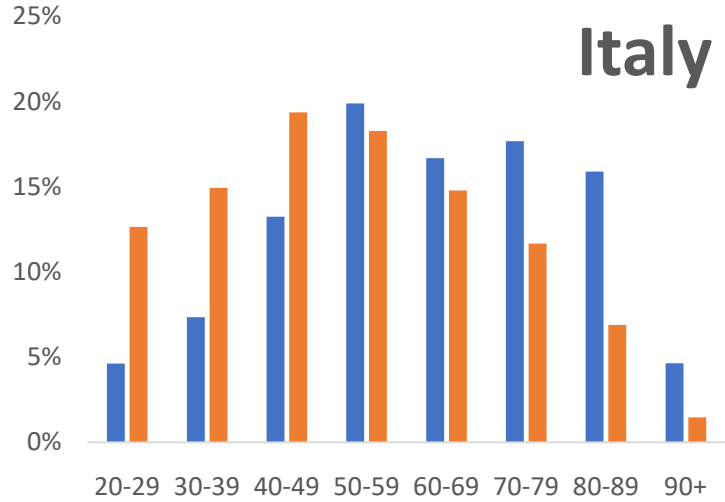
Clinical or radiological evidence of viral pneumonia without alternative diagnosis

Acute respiratory symptoms + work in nursing, medical practice or hospital
+ belonging to a risk group

Acute respiratory symptoms w/t known risk factors - COVID-19 diagnostics only with sufficient test capacity



Do testing criteria produce different bias for different age groups?

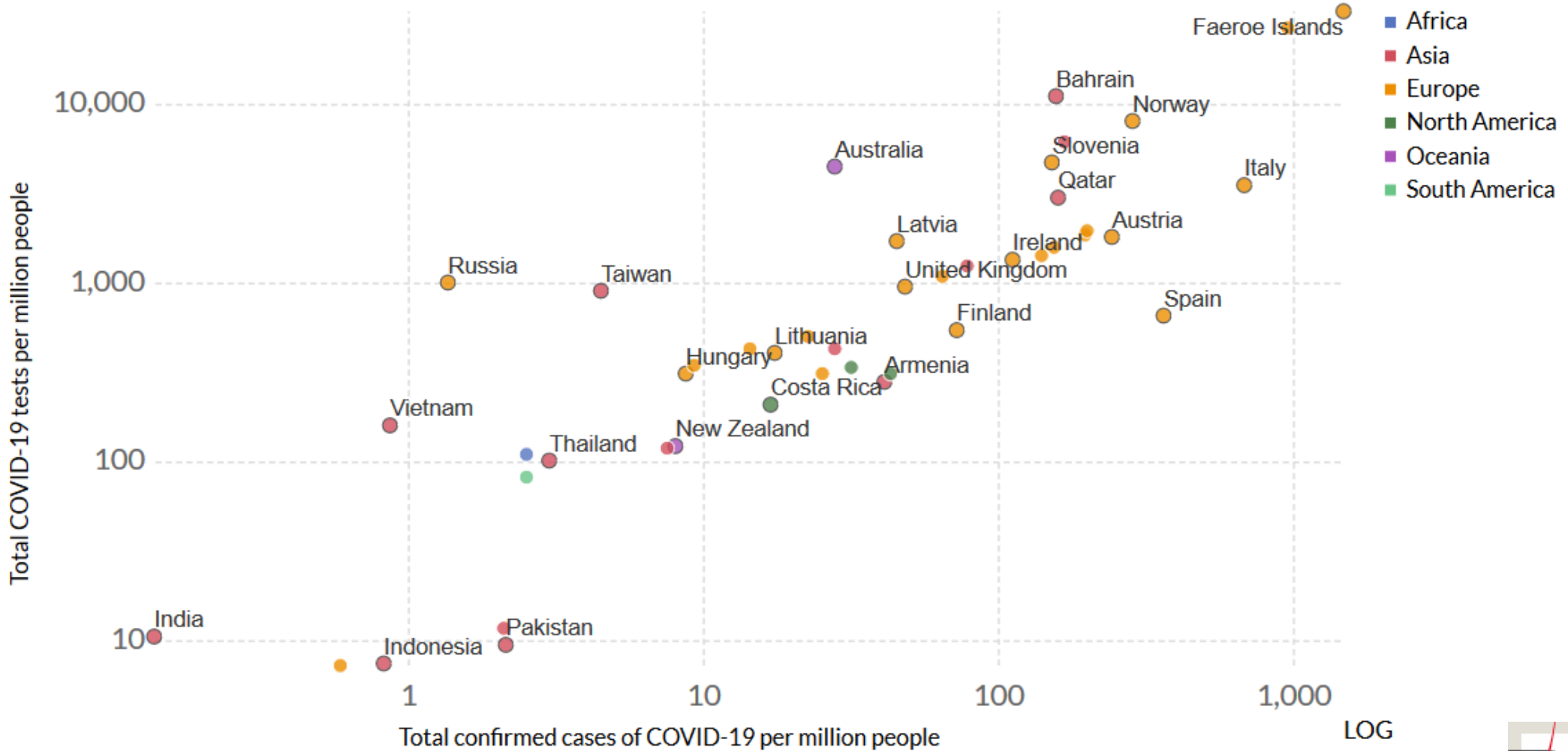


COVID-19 data as of 20 March: Tests conducted vs. Total confirmed cases per million people

Data collected by Our World in Data from official country reports.

For some countries the number of tests corresponds to the number of individuals who have been tested, rather than the number of samples.

LOG



Source: Our World in Data based on official sources

Note: Data for the US corresponds to estimates from the COVID-Tracking Project



Post-mortem testing *(Influences both: cases and deaths)*

U.S.

Postmortem collection of the swabs to be tested for the presence of SARS-CoV-2 in persons under investigation for Covid-19. Can be adapted by state and local health departments depending on the situation *[CDC]*

Ideally, testing for COVID-19 should be conducted, but it is acceptable to report COVID-19 on a death certificate without this confirmation if the circumstances are compelling within a reasonable degree of certainty *[CDC]*

England and Wales

If death can be due to COVID-19 (criteria on possible COVID-19 case in living is applied), the decision on post-mortem collection of swabs or further postmortem examination should be taken on a case-by-case basis depending on the needs of the coroner and other relevant parties *[The Royal College of Pathologists]*

For example, if before death the patient had symptoms typical of COVID-19 infection, but the test result has not been received, it would be satisfactory to give 'COVID-19' as the cause of death, tick Box B and then share the test result when it becomes available. In the circumstances of there being no swab, it is satisfactory to apply clinical judgement *[Office for National Statistics]*



Post-mortem testing *(Influences both: cases and deaths)*

Norway

A post-mortem test for COVID-19 should be performed if a patient dies of acute respiratory tract infection of unknown cause in a healthcare institution *[Norwegian Institute of Public Health]*

Germany

“We don't consider post-mortem testing to be a deciding factor. We assume that patients are diagnosed before they die” *[RKI to AFP, 20.03.2020]*

Those who had not been tested for COVID-19 during their lifetime but who are suspected of having died of COVID-19 can be examined for the virus postmortem - i.e. after their death. *[BR24, 21.03.2020, according to RKI Spokesperson]*

The RKI says those who were not tested for Covid-19 in their lifetime but are suspected to have been infected with the virus “can” be tested after death, but in Germany’s decentralised health system this is not yet a routine practice *[The Guardian, 22 March 2020]*

Reporting deaths. Dying with or dying from?



Italy

"I would like to point out that these are not deaths "by" coronavirus. These are people who have died and among the various pathologies they also had the coronavirus" *[A. Borelli, Head of the Italian Civil Protection Agency, 10 March 2020]*

"...we put all the deaths to the numerator without that maniacal attention to the definition of the causes of death that have for example French and Germans, who before attributing a death to the Coronavirus perform a series of checks and evaluations that even in some cases had led to the removing deaths from the list" *[W. Ricciardi, the ECHR member, consultant of the Italian Ministry of Health on the Covid-19, 10 March 2020]*

"The way in which we code deaths in our country is very generous in the sense that all the people who die in hospitals with the coronavirus are deemed to be dying of the coronavirus. On re-evaluation by the National Institute of Health, only 12 per cent of death certificates have shown a direct causality from coronavirus, while 88 per cent of patients who have died have at least one pre-morbidity - many had two or three" *[W. Ricciardi, The Telegraph, 21 March 2020]*

Reporting deaths. Dying with or dying from?



U.S.

"There are other countries that if you had a pre-existing condition, and let's say the virus caused you to go to the ICU [intensive care unit] and then have a heart or kidney problem. Some countries are recording that as a heart issue or a kidney issue and not a COVID-19 death. [...] The intent is ... if someone dies with COVID-19 we are counting that"
[D. Brix, the response coordinator for the White House coronavirus task force, 7 April 2020]



Germany

“Bei uns gilt jemand als Corona-Todesfall, bei dem eine Corona-Infektion nachgewiesen wurde.“ *[L.Wieler, RKI President, 20.03.2020]*

Newspaper BR24

Der #Faktenfuchs hat beim RKI nachgefragt, wer nun genau als Corona-Todesfall zählt.

Das RKI zählt laut Angaben einer Sprecherin als Corona-Todesfälle alle Menschen, die mit einer COVID-19-Erkrankung in Verbindung stehen.

Dazu gehören erstens Menschen, die direkt an der Erkrankung gestorben sind ("gestorben an"). Und zweitens Patienten mit Grundkrankheiten, die mit COVID-19 infiziert waren und bei denen sich nicht klar nachweisen lässt, was letzten Endes die Todesursache war ("gestorben mit"). *[according to RKI Spokesperson]*



Iceland

“A foreign tourist who yesterday came to the Health Care Institution of North Iceland with a serious illness turned out to be infected with the virus that causes the COVID-19 illness. The man died shortly after he arrived at the institution. The cause of death is not known, but his symptoms were not typical for COVID-19. The cause of death is not yet known. *[Office of the Medical Director of Health, 17 March 2020]*

“Two of the people diagnosed with COVID-19 in Iceland have passed away.” *[Office of the Medical Director of Health, 24 March 2020]*

Russia

“Причиной смерти стала массивная двусторонняя тромбоэмболия легочной артерии. Несмотря на то что пациентка была госпитализирована с начинающимися признаками пневмонии и у нее при жизни подтвердился положительный результат анализа на коронавирусную инфекцию, причиной смерти стала не пневмония, а оторвавшийся тромб. На момент смерти изменений в легких не было. Тяжелые сопутствующие хронические заболевания подтвердились, среди них сахарный диабет, цереброваскулярная болезнь, ишемическая болезнь сердца” *[О. Зайратьянц, главный патологоанатом Москвы]*

Covid-19 in medical death certificate



New ICD-10 codes for COVID-19

- U07.1 COVID-19, virus identified
- U07.2 COVID-19, virus not identified
 - o *Clinically-epidemiologically diagnosed COVID-19*
 - o *Probable COVID-19*
 - o *Suspected COVID-19*

Mortality Coding of COVID-19 with ICD-10

Both categories, U07.1 (COVID-19, virus identified) and U07.2 (COVID-19, virus not identified) are suitable for cause of death coding. [...] COVID-19 is reported on a death certificate as any other cause of death, and rules for selection of the single underlying cause are the same as for influenza (COVID-19 not due to anything else). For recording on a death certificate, no special guidance needs to be given. The respiratory infection may evolve to pneumonia that may evolve to respiratory failure and other consequences. Potentially contributing comorbidity (immune system problem, chronic diseases...) is reported in part 2, and other aspects (perinatal, maternal...) in frame B, in line with the rules for recording. A manual plausibility check is recommended for certificates where COVID-19 is reported, in particular for certificates where COVID-19 was reported but not selected as the single underlying cause of death.

WHO. COVID-19 coding in ICD-10, 25 March 2020

10. Причины смерти:

- I. а) _____
(болезнь или состояние, непосредственно приведшее к смерти)
- б) _____
(патологическое состояние, которое привело к возникновению вышеуказанной причины)
- в) _____
(первоначальная причина смерти указывается последней)
- г) _____
(внешняя причина при травмах и отравлениях)

II. Прочие важные состояния, способствовавшие смерти, но не связанные с болезнью или патологическим состоянием, приведшим к ней, включая употребление алкоголя, наркотических средств, психотропных и других токсических веществ, содержание их в крови, а также операции (название, дата)



Influenza in medical death certificate



ICD. Volume II.

- I (a) Acute myocardial infarction
- (b) Atherosclerotic heart disease
- (c) Influenza

After applying Rule I and then Modification Rule C, Acute myocardial infarction should be coded as an underlying cause of death.

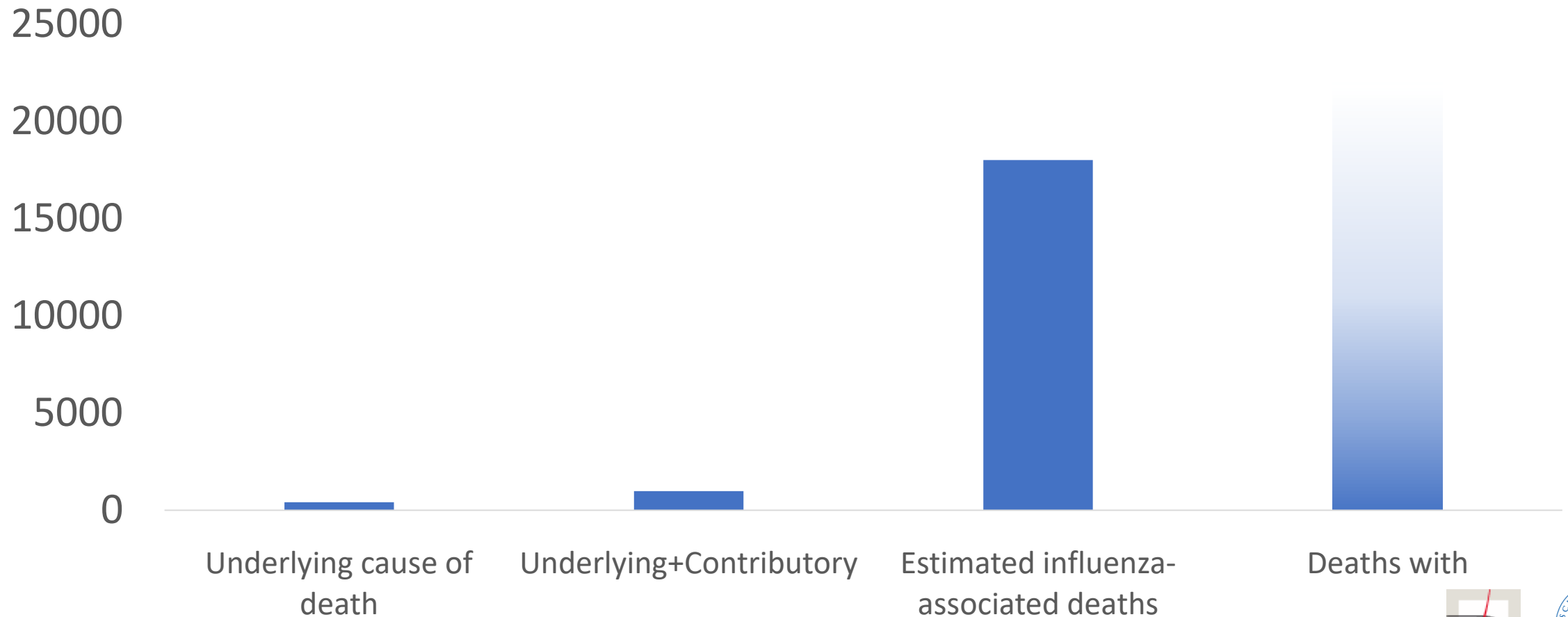
CDC. ICD-10-Mortality Manual 2a

- I (a) 1. Coronary occlusion
- (b) 2. Diabetes, chronic, severe
- (c) 3. Hypertension and arteriosclerosis
- 4. Renal disease
- II 5. Influenza, 1 week

Code to coronary occlusion (I219) by applying Selection Rule 2

How the concept of “deaths with” is different from our usual cause-of-death mortality estimates?

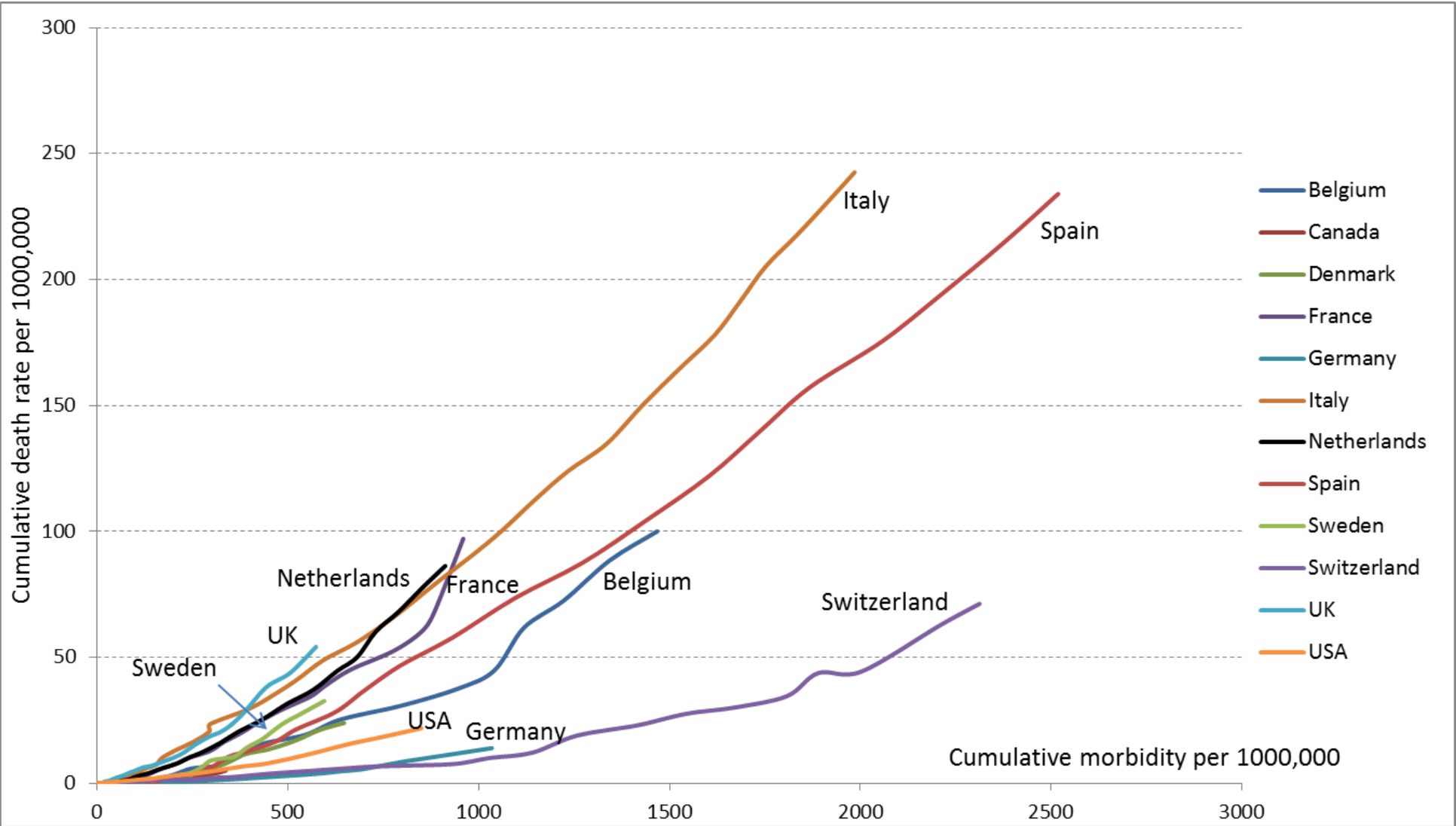
Influenza deaths in England, 2016-2017 season





An alternative method of estimation:
excess mortality from all causes
by week or month

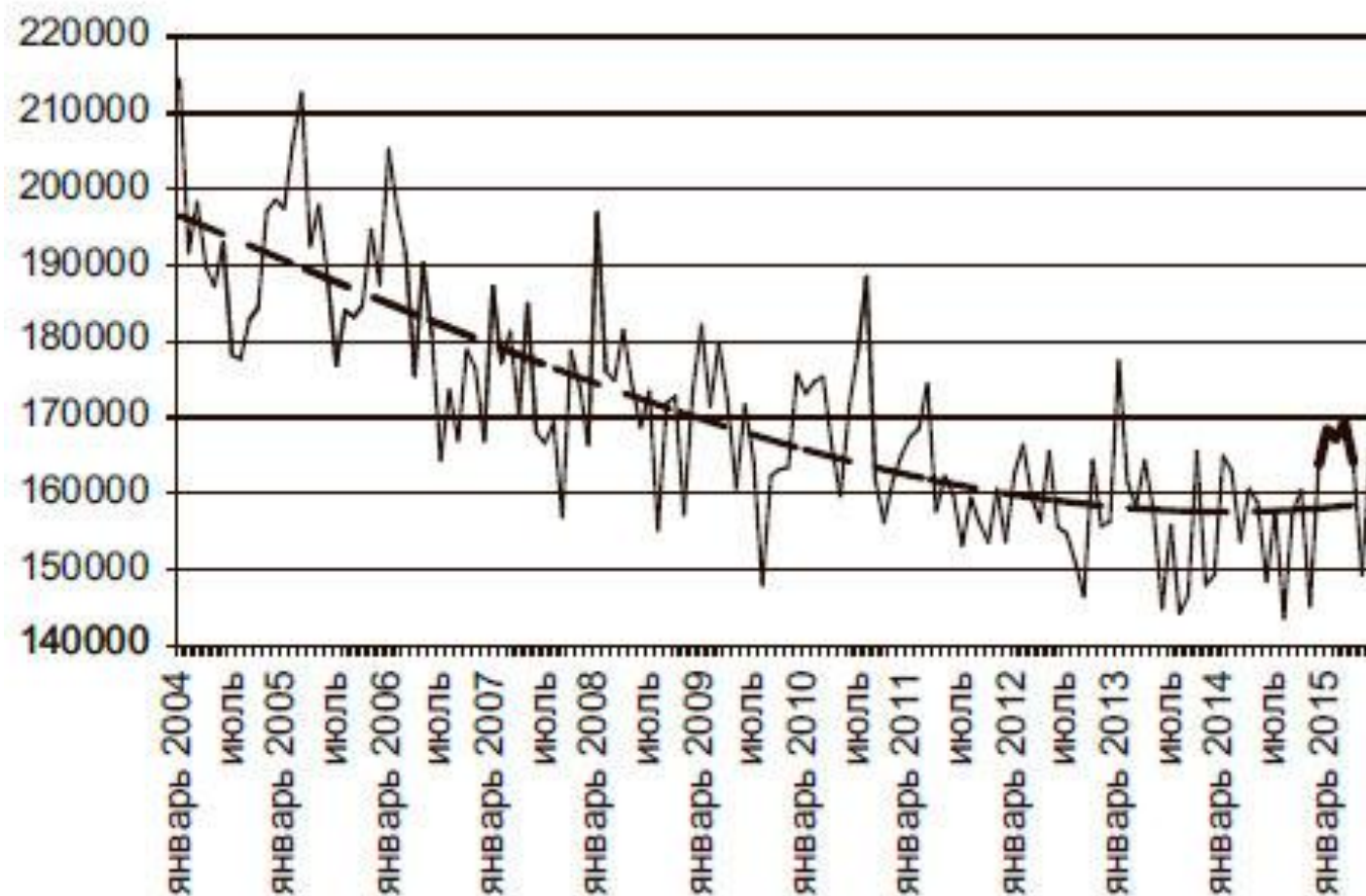
Cumulated COVID-19 incidence vs. cumulated COVID-19 mortality: huge variation in countries' trajectories per 1 mln. (1.03-4.04.2020)



Danilova, Shkolnikov, Jdanov. HSE Webinar: COVID-19: Quantification



An old idea: assessment of mortality fluctuations across months (weeks, days)



Andreev & Shkolnikov 2016

<http://www.demoscope.ru/weekly/2016/0683/analit01.php>

Tracks of flu on the mortality surface: England and Wales vs. median mortality in other high income countries

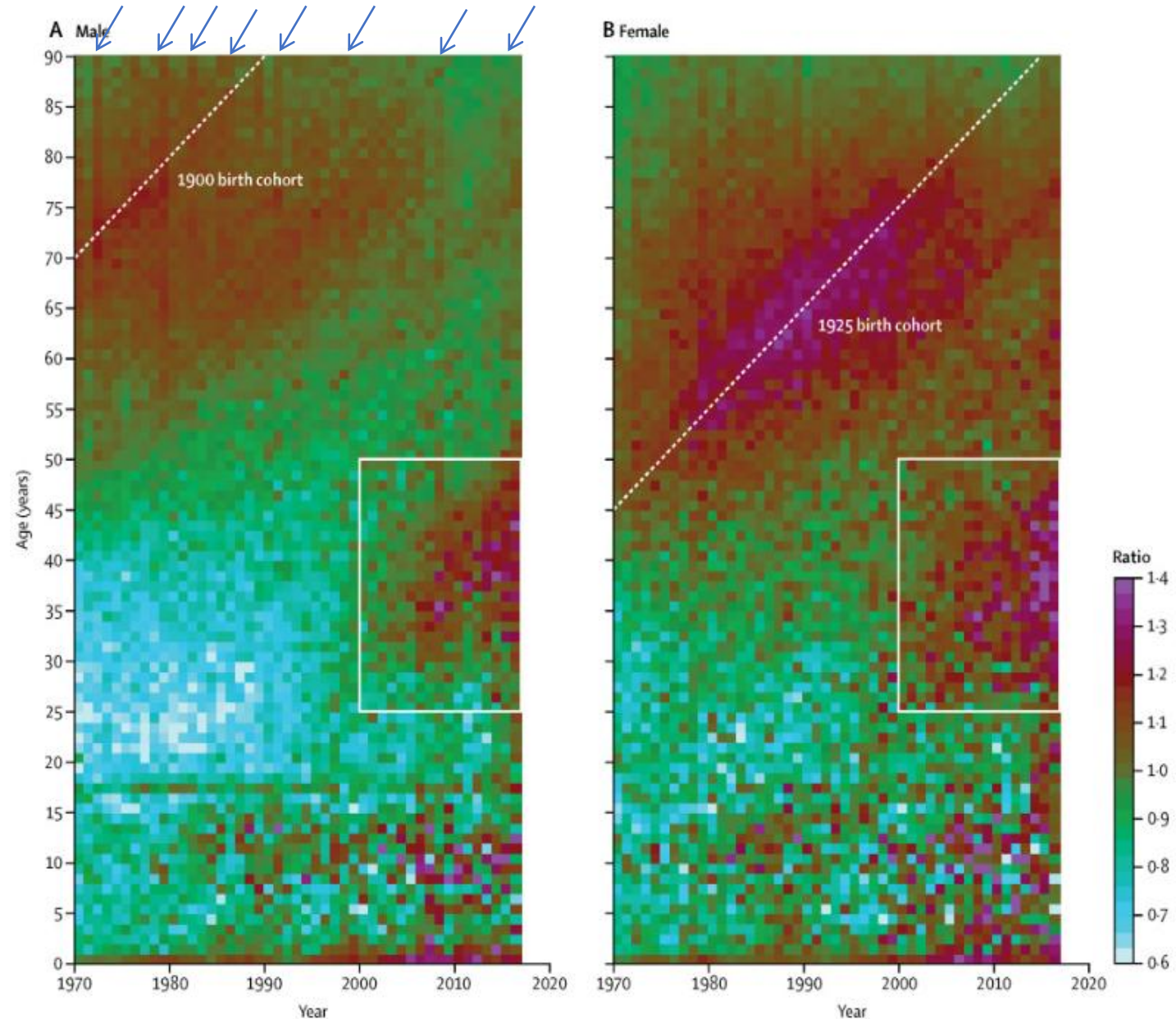


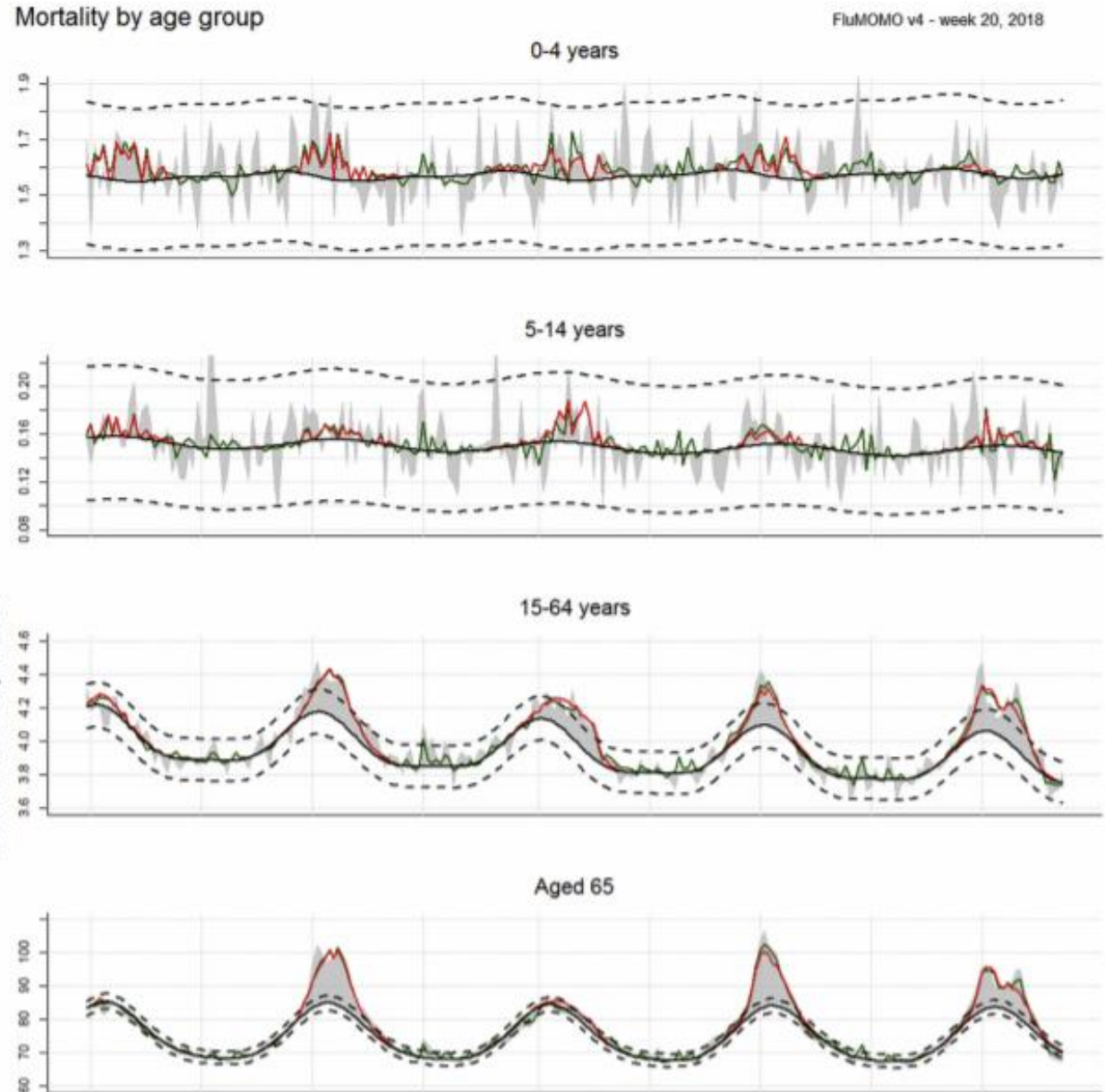
Figure 2 Mortality rate ratios in England and Wales relative to the median for 22 comparator countries by age, year, and sex

Leon, Shkolnikov, Jdanov 2019

<https://pubmed.ncbi.nlm.nih.gov/31677776/>



EuroMOMO project: an analysis of weekly mortality in 24 countries and within-country regions of Europe

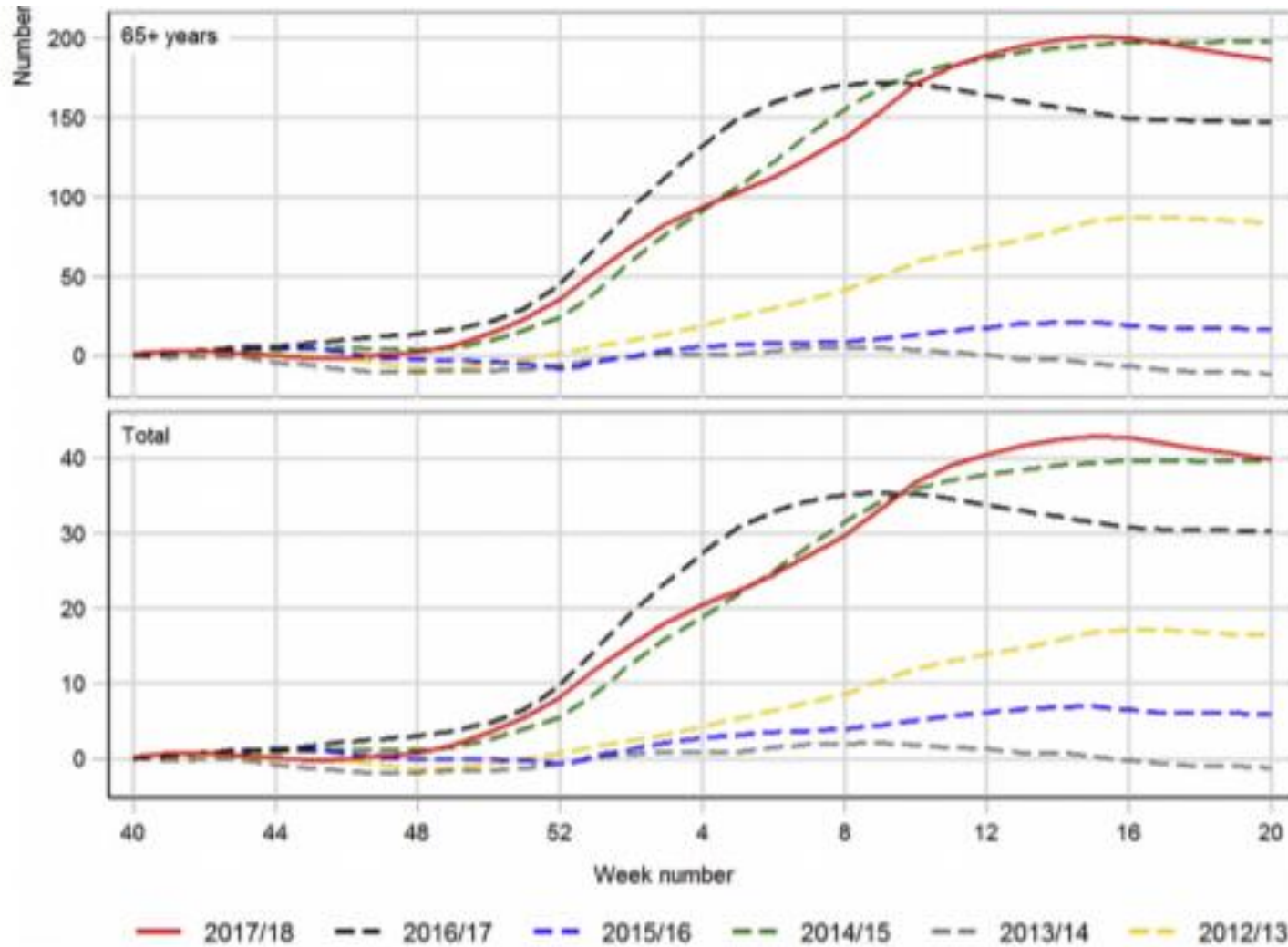


Nielsen et al. 2019

http://www.euromomo.eu/methods/pdf/european_excess_mortality_2017_18.pdf



Deadly influenza epidemics of the 2010s



H3N2: 2014-15, 2016-17
B/Jamagata&H3N2:
2017-18

H1N1: 2012-13, 2015-16

Nielsen et al. 2019

http://www.euromomo.eu/methods/pdf/european_excess_mortality_2017_18.pdf



How it applies to time series of 2020

Trends in COVID-19 deaths in England and Wales: NHS vs. ONS



Statistical bulletin

Deaths registered weekly in England and Wales, provisional: week ending 27 March 2020

Provisional counts of the number of deaths registered in England and Wales, including deaths involving the coronavirus (COVID-19), by age, sex and region, in the latest weeks for which data are available.



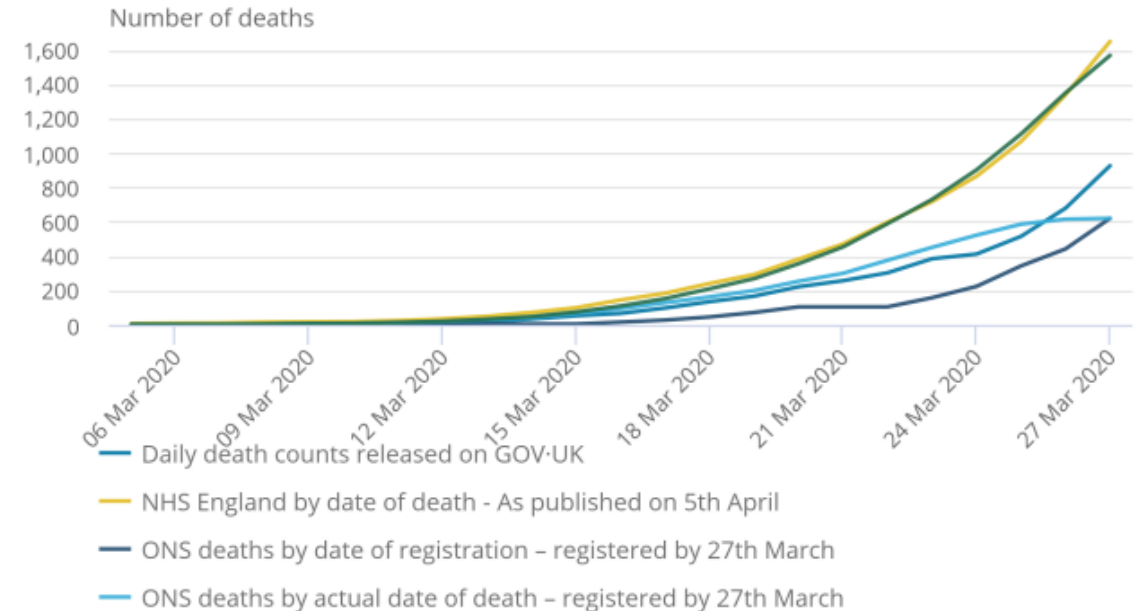
Contact:
Sarah Caul
health.data@ons.gov.uk
+44 (0)1633 456 490

Release date:
7 April 2020

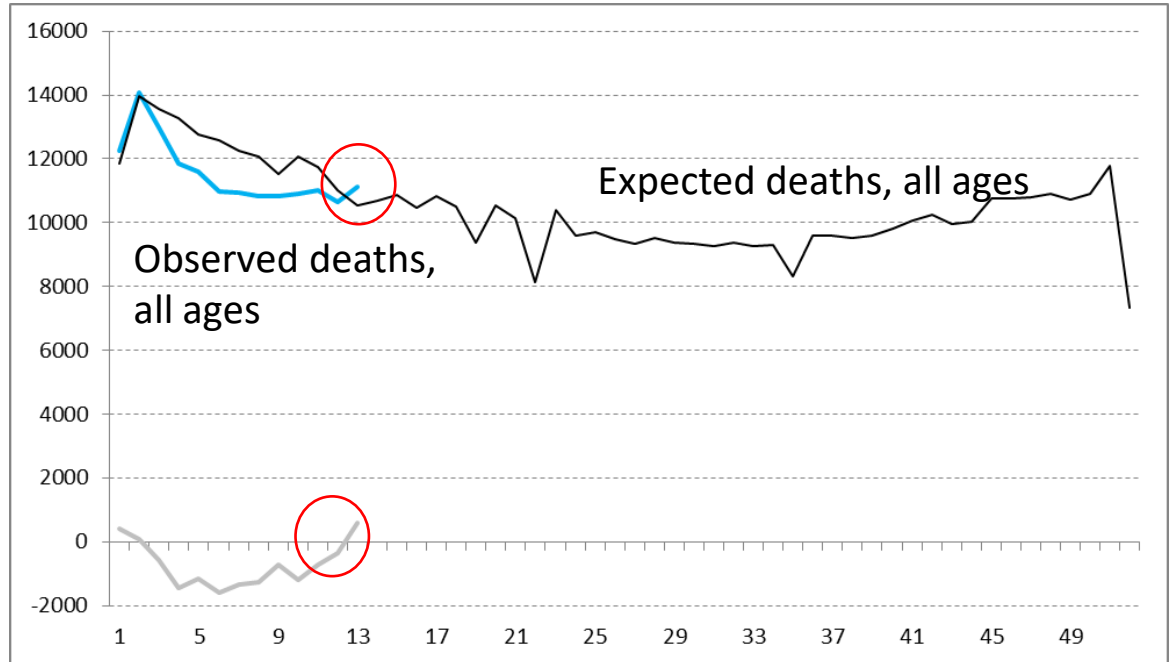
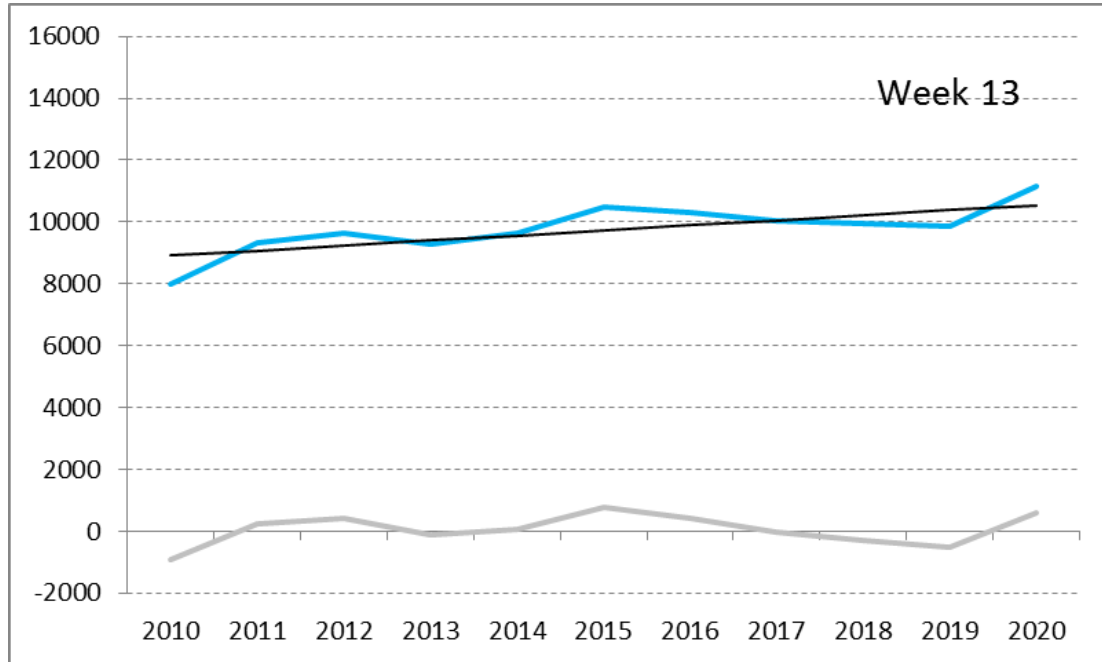
Next release:
14 April 2020

Figure 1: The cumulative number of deaths involving COVID-19 in England using different data sources, up to 27 March 2020

Cumulative number of deaths involving COVID-19 in England



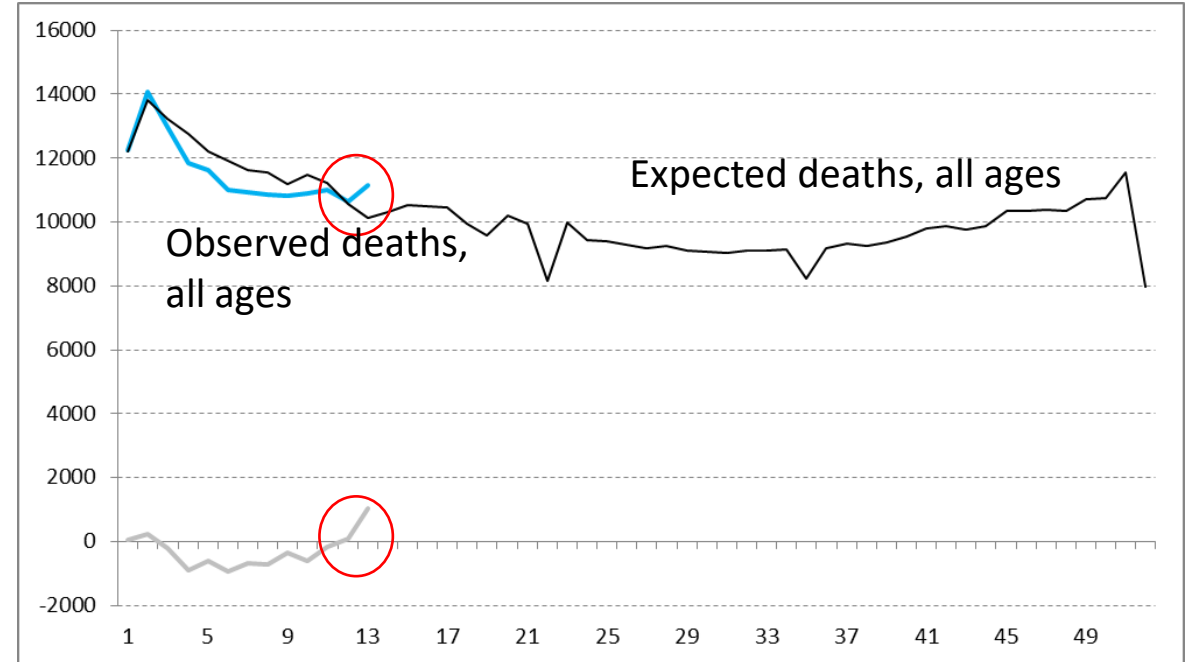
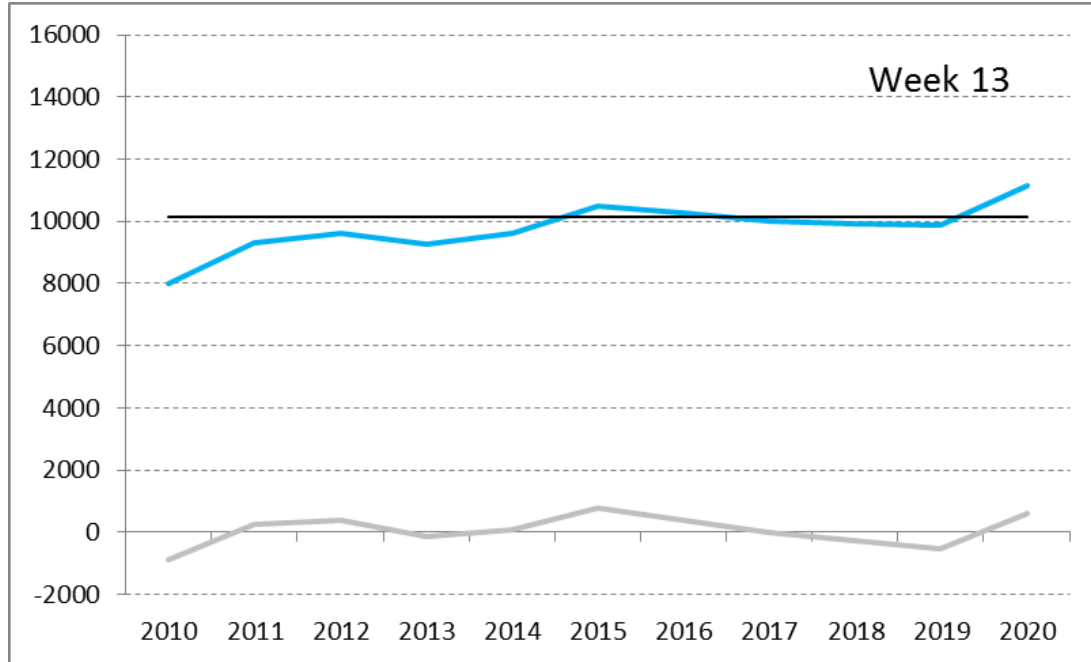
Assessment of weekly deaths on data from England and Wales for weeks 1 to 13 (March 27) (Method 1)



Expected Deaths 1 (Week N, age, 2020) =
= Linear trend_extrapol (Week N, age, 2010-2019)

Total excess (weeks 1-12) =	-9178
Total excess since March 1 =	-1679
Week 13	
NHS deaths	1314
Observed	11141
Expected	10547
Observed-Expected	594

Assessment of weekly deaths on data from England and Wales for weeks 1 to 13 (March 27) (Method 2)



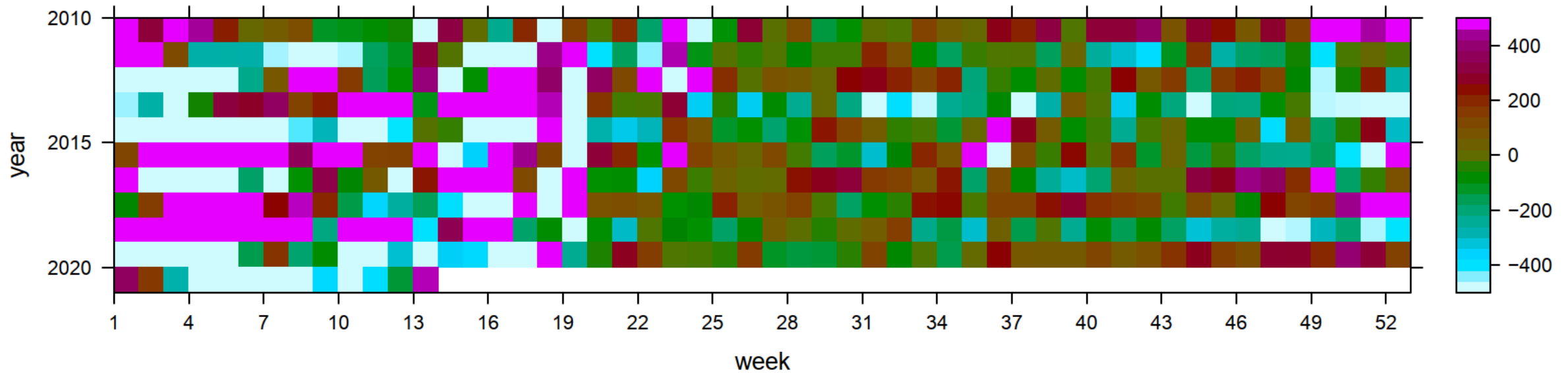
**Expected Deaths 2 (Week N, age, 2020) =
= Average (Week N, age, 2015-2019)**

Total excess (weeks 1-12) =	-3806
Total excess since March 1 =	-1069
Week 13	
NHS deaths	1314
Observed	11141
Expected	10123
Observed-Expected	1018

Maps of excess mortality: England and Wales, weeks 1 to 13, all ages



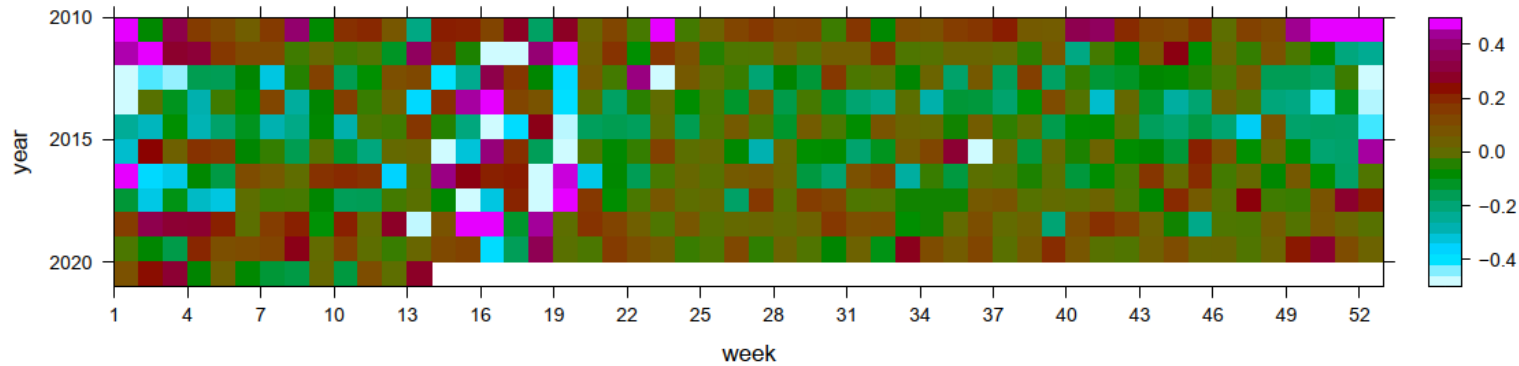
fluctuation in deaths (absolute numbers) by week, E&W, all ages



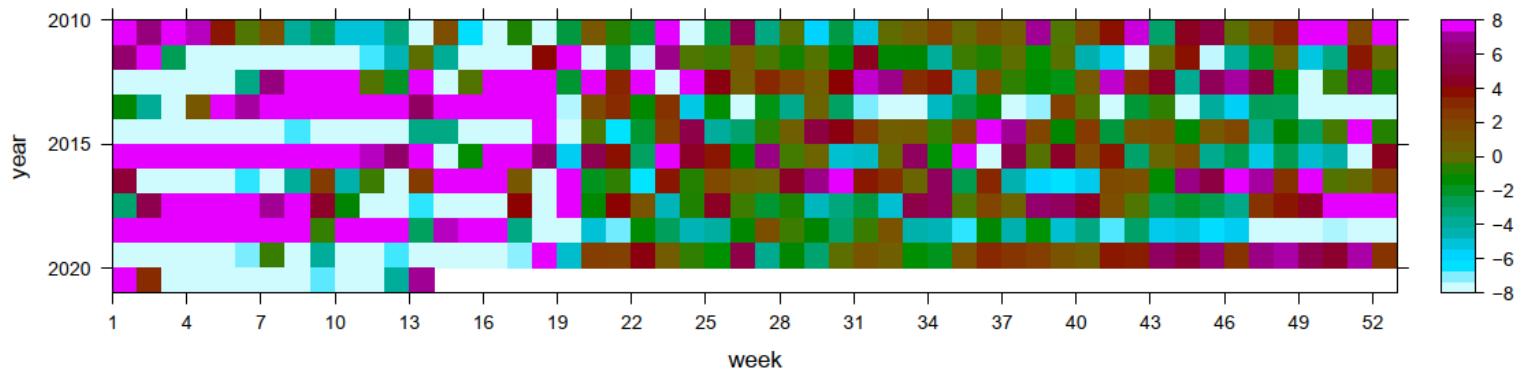
Maps of excess mortality: England and Wales, weeks 1 to 13, age groups 45-64 and 85+



mortality fluctuation by week, E&W, ages 45-64, both sexes



mortality fluctuation by week, E&W, ages 85+, both sexes





Weekly deaths by country by EuroMOMO (1)

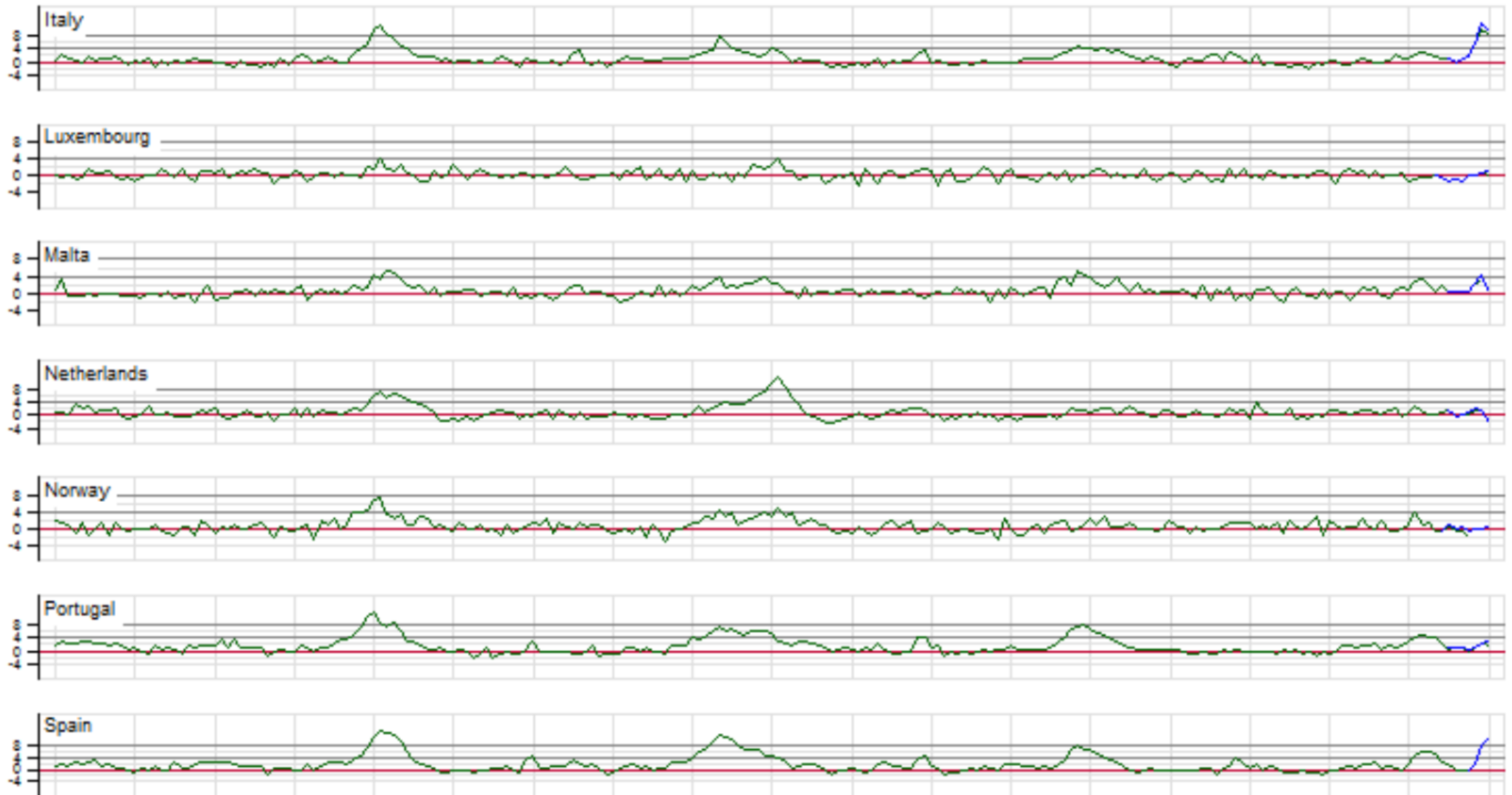


Z-scores below -4 has been cut off

Year week



Weekly deaths by country by EuroMOMO (2)



Спасибо за внимание!

Other types of data to quantify the pandemic



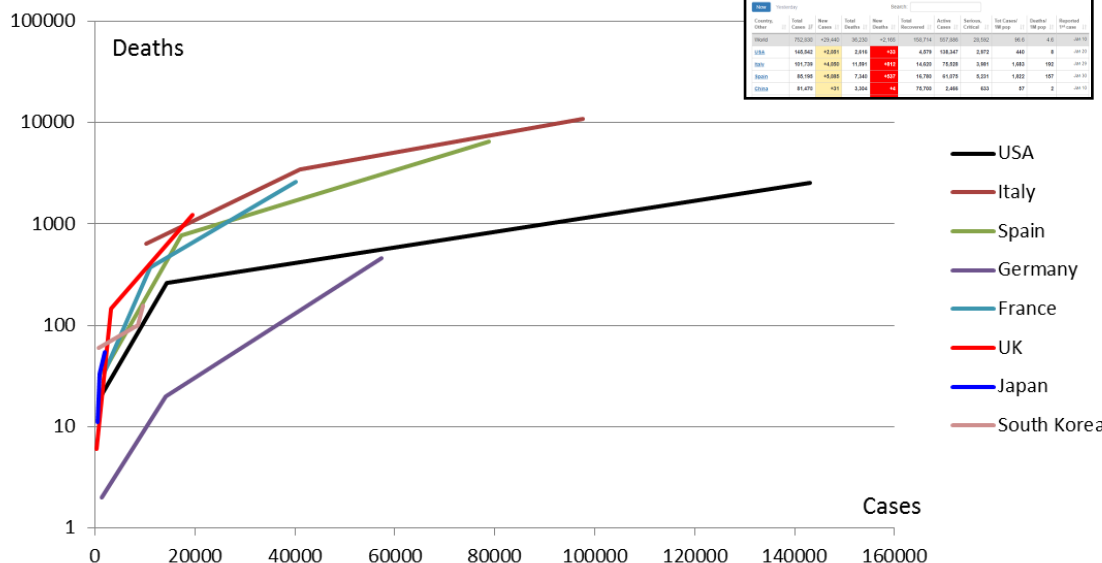
Confirmed Cases & Deaths

Confirmed Cases and Deaths by Country, Territory, or Consequence

The visualization COVID-19 is affecting 191 countries and territories around the world and 2 international organizations. For Diamond Princess cruise ship the statistics in Statistics, Japan, and the related Diamond Princess cruise ship. The data was last updated 04/04/2020.

Report COVID-19 cases

Country	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Severely Critique	Total Cases / 1M pop.	Deaths / 1M pop.	Reported 1st case
USA	102,267	12,244	2,200	141	100,764	102,267	26,882	640	4.8	04-01-20
Italy	148,842	42,991	23,916	1,414	4,879	108,247	2,972	440	8	03-01-20
Spain	191,738	14,600	11,951	1,912	14,600	78,838	3,981	1,883	100	03-11-20
Japan	85,196	15,881	7,240	1,637	14,769	61,879	5,221	1,822	107	04-01-20
South Korea	81,479	1,911	3,244	174	78,769	3,498	423	97	2	02-01-20



Quality data from special sites: Diamond Princess cruise ship

Age Range	cIFR	cCFR	Hospitalisation-to-death Distribution
All ages combined	0.91% (0.11% - 4.3%)	1.9% (0.60% - 4.3%)	Non-truncated (Figure 1A)
	1.2% (0.39% - 2.7%)	2.3% (0.75% - 5.3%)	Truncated (Figure 1B)
70+	7.3% (3.0% - 14%)	14% (6.0% - 27%)	Non-truncated (Figure 1A)
	9.0% (3.8% - 17%)	18% (7.3% - 33%)	Truncated (Figure 1B)

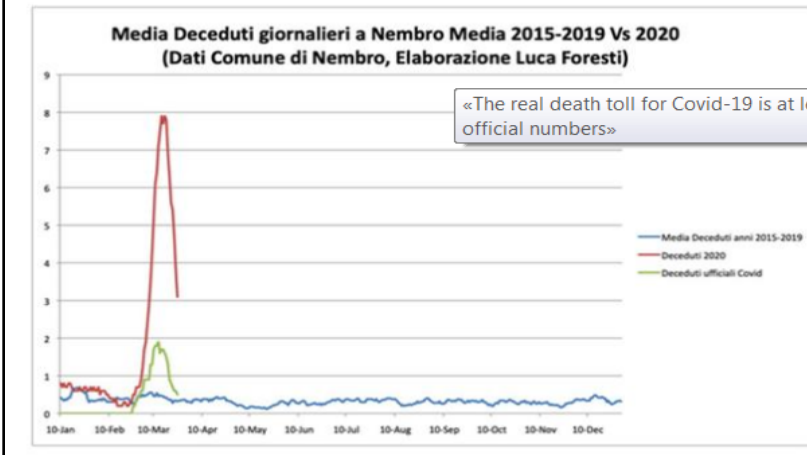
Table 1: cIFR and cCFR estimates calculated using the reported case and death data on the Diamond Princess cruise ship [2]. Correction was performed using equation (1) and the hospitalisation-to-death distribution in [6].

Media reports: Corriere Della Sera

«The real death toll for Covid-19 is at least 4 times the official numbers»

Nembro, one of the municipalities most affected by Covid-19, should have had - under normal conditions - about 35 deaths. 158 people were registered dead this year by the municipal offices. But the number of deaths officially attributed to Covid-19 is 31

di Claudio Cancelli Luca Foresti



«The real death toll for Covid-19 is at least 4 times the official numbers»

Weekly deaths: ONS and EuroMOMO

Public Health England
All-Cause Mortality Surveillance
 26 March 2020 – Week 13 report (up to week 12 data)

