Coronavirus Disease (COVID-19) – Statistics and Research

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Cite this research

*Note: To inform yourself and understand the risk to the public we recommend to rely on your government body responsible for health and the World Health Organization – **their site is here**.*

The mission of *Our World in Data* is to make data and research on the world's largest problems understandable and accessible.

Read more about our mission →

While most of our work focuses on large problems that humanity has faced for a long time – such as child mortality, natural disasters, poverty and almost 100 other problems (see here) – this article focuses on a new, emerging global problem: the ongoing outbreak of the coronavirus disease [COVID-19].

The outbreak started in late 2019 and developed into a global pandemic by March 2020.

This article covers a developing situation and the Our World in Data team is regularly updating it: **The last update was made on March 14, 2020** (21:00 London time).

About this page

Limitations of current research and limitations of our presentation of current research

The purpose of this article on COVID-19 is to aggregate existing research, bring together the relevant data and allow readers to make sense of the published data and early research on the coronavirus outbreak.

Most of our work focuses on established problems, for which we can refer to well-established research and data. COVID-19 is different. All data and research on the virus is preliminary; researchers are rapidly learning more about a new and evolving problem. It is certain that the research we present here will be revised in the future. But based on our mission we feel it is our role to present

clearly what the current research and data tells us about this emerging problem and especially to provide an understanding of what can and cannot be said based on this available knowledge.

As always in our work, one important strategy of dealing with this problem is to always link to the underlying original research and data so that everyone can understand how this data was produced and how we arrive at the statements we make. But scrutiny of all reported research and data is very much required. We welcome your feedback. In the current situation we read and consider all feedback, but can not promise to reply to all.

Our World in Data relies on data from the World Health Organization

In this document and the associated charts we report and visualize the data from the 'Situation Reports', which the World Health Organization (WHO) publishes daily. The WHO reports this data for each single day and they can be found here at the WHO's site.

According to the WHO the data published in these reports is correct as of 10am (CET; Geneva time) each time.

We – the *Our World in Data* team – went back through all the daily Situation Reports and found several minor errors in WHO's data. We immediately notified the WHO and are in close contact with the WHO's team to correct the errors that we pointed out to them. We document all errors we found.

We should emphasize that while there are errors in the published WHO data, all of these errors are minor and do not affect our or the public's understanding of the evolving COVID-19 outbreak in a significant way. As can be seen in our documentation these errors should be corrected (and will be), but they are small.

Here is our detailed documentation of where the WHO's data is sourced from and how we corrected its data – we also provide several options to **download all corrected data** there.

Why do we rely on the data from the World Health Organization?

The World Health Organization is the UN agency concerned with global health. National health agencies report their data on COVID-19 to the World Health Organization who collects and aggregates this data from countries around the world.

The most up-to-date data for any particular country is therefore typically earlier available via the national health agencies than via the WHO.

This lag between nationally available data and the WHO data is not very long as the WHO publishes new data daily.

We rely on the WHO data for two reasons. It is the authoritative source for this information. And as they collect data from around the world the WHO data allows us to compare what is happening in different countries, it provides a global perspective.

Not only the World Health Organization publishes COVID-19 data

A number of other organizations – including Johns Hopkins University and other research teams – publish their own lists of the number of confirmed cases and deaths. Johns Hopkins also publishes data on 'recovered cases' while the WHO does not.

At the end of this page we link to their visualizations and list links to other data sources.

Cases of COVID-19

The number of total cases is what we want to know, but their number is not known

To understand the scale of the COVID-19 outbreak, and respond appropriately, we would want to know how many people are infected by COVID-19. We would want to know the *total* number of cases.

However, the total number of COVID-19 cases is not known. When media outlets claim to report the 'number of cases' they are not being precise and omit to say that it is the number of *confirmed cases* they speak about.

The total number of cases is not known, not by us at *Our World in Data,* nor by any other research, governmental or reporting institution.

Confirmed cases is what we do know

What we *do* know is the number of *confirmed* cases.

A confirmed case is "a person with laboratory confirmation of COVID-19 infection" as World Health Organization (WHO) explains.[1]

Confirmed cases are therefore only a subset of the total number of cases. It is a count of only those people who have COVID-19 and for whom a lab has confirmed this diagnosis.

The WHO's daily Situation Reports list the number of confirmed cases and we rely on these reported numbers for the regular updates of our own datasets and their visualizations presented below.

Why is the number of confirmed cases lower than the number of total cases?

The number of confirmed cases is lower than the number of total cases because not everyone is tested. Not all cases have a "laboratory confirmation", testing is what makes the difference between the number of confirmed and total cases.

All countries have been struggling to test a large number of cases, which meant that not every person that should have been tested, has in fact been tested.

Since an understanding of testing for COVID-19 is crucial for an interpretation of the reported numbers of confirmed cases we have looked into the testing for COVID-19 in more detail.

You find our work on testing further below in this document (click **here** to scroll there).

Growth of cases: How long did it take for the number of confirmed cases to double?

In the section below we present the latest data on the *number* of confirmed cases by country.

But in an outbreak of an infectious disease it is important to not only study the number of cases, but also the **growth rate** at which the number of cases is increasing.

This is because even if the current numbers of cases and deaths are small when compared with other diseases, a fast growth rate can lead to very large numbers rapidly.

To report the rate of change we focus on the question: How long did it take for the number of confirmed cases to double?

Let's take an example: if the number of confirmed cases as of today is 1000, and there were only 500 cases three days ago then we would say that it took three days for the number of confirmed cases to double.[2]

The doubling time of cases has changed and it will change in the future. It would be wrong to extrapolate current growth into the future.[3]

It is important to understand what it means for cases to double. As long as cases are doubling at a constant rate the growth is exponential. We humans tend to think in linear growth processes even when the growth is exponential, as

psychological research has shown for decades. Below we give some intuition about exponential growth and provide the referenced psychological research on this.

Understanding exponential growth

It is helpful to remind ourselves of the nature of exponential growth.

If during an outbreak the number of cases is in fact doubling and this doubling time stays constant, then the outbreak is spreading exponentially.

Under exponential growth 500 cases grow to more than 1 million cases after 11 doubling times.[4] And after 10 more doubling times it would be 1 billion cases.

This is in no way a prediction for the number of cases we should expect; it is simply a reminder that exponential growth leads to very large numbers very quickly, even when starting from a low base. And it is important to be reminded of the nature of exponential growth because most of us do not grasp exponential growth intuitively. Psychologists find that humans tend to think in linear growth processes (1, 2, 3, 4) even when this is not appropriately describing the reality in front of our eyes. This bias – to "linearize exponential functions when assessing them intuitively" – is referred to as 'exponential growth bias'.[5]

Psychological research shows that "neither special instructions about the nature of exponential growth nor daily experience with growth processes" improved the failure to grasp exponential growth processes.[6]

The global average hides more than it reveals: why we show this data country by country

Some countries – like China and Korea – have very substantial counter measures in place and new daily confirmed cases have declined.

Many other countries do not have comparable measures in place and, as the table shows, numbers are rising fast.

Because of these large differences between countries it is crucial to not only study the global situation, but the situation in each country.

The global average hides the differences between countries that are successfully reducing the number of new daily confirmed cases and those that do not achieve this.

Growth: Country by country view

As just explained, it is crucial to not just look at the number of cases, but also their growth over time and to go beyond the global average and study each individual country.

For this reason the following table answers the following question for all countries: How long did it take for the number of total confirmed cases to double?

The table also shows – country by country – how the total number of confirmed cases has increased and how the number of daily new confirmed has changed over the last 14 days.

You can sort the table by any of the columns by clicking on the column header.

Data: The data shown here is published by the World Health Organization (WHO). Here is our documentation of the data and an option to download all data.

The figures shown are based on the WHO data **up to and including 14th March 2020**.

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
World	**doubled in 27 days**	**142,539 total** March 14	**+9,766 new** March 14
China	**doubled in 33 days**	**81,021 total** March 14	**+30 new** March 14
Italy	**doubled in 5 days**	**17,660 total** March 14	**+2,547 new** March 14
Iran	**doubled in 7 days**	**11,364 total** March 14	**+1,289 new** March 14
South Korea	**doubled in 13 days**	**8,086 total** March 14	**+107 new** March 14
Spain	**doubled in 3 days**	**4,231 total** March 14	**+1,266 new** March 14
France	**doubled in 3 days**	**3,640 total** March 14	**+780 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Germany	**doubled in 3 days**	**3,062 total** March 14	**+693 new** March 14
United States	**doubled in 3 days**	**1,678 total** March 14	**+414 new** March 14
Switzerland	**doubled in 3 days**	**1,125 total** March 14	**+267 new** March 14
Netherlands	**doubled in 3 days**	**804 total** March 14	**+190 new** March 14
United Kingdom	**doubled in 3 days**	**802 total** March 14	**+208 new** March 14
Denmark	**doubled in 3 days**	**801 total** March 14	**+127 new** March 14
Sweden	**doubled in 3 days**	**775 total** March 14	**+155 new** March 14
Norway	**doubled in 3 days**	**750 total** March 14	**+261 new** March 14
Japan	**doubled in 8 days**	**716 total** March 14	**+41 new** March 14
Belgium	**doubled in 3 days**	**599 total** March 14	**+285 new** March 14
Austria	**doubled in 3 days**	**504 total** March 14	**+143 new** March 14
Qatar	**doubled in 3 days**	**262 total** March 14	**+0 new** March 14
Bahrain	**doubled in 5 days**	**210 total** March 14	**+15 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Singapore	**doubled in 14 days**	**200 total** March 14	**+13 new** March 14
Australia	**doubled in 4 days**	**197 total** March 14	**+57 new** March 14
Malaysia	**doubled in 5 days**	**197 total** March 14	**+68 new** March 14
Canada	**doubled in 4 days**	**176 total** March 14	**+38 new** March 14
Czech Republic	**doubled in 3 days**	**150 total** March 14	**+34 new** March 14
Slovenia	**doubled in 1 day**	**141 total** March 14	**+84 new** March 14
Portugal	**doubled in 1 day**	**112 total** March 14	**+71 new** March 14
Finland	**doubled in 2 days**	**109 total** March 14	**+0 new** March 14
Israel	**doubled in 4 days**	**100 total** March 14	**+25 new** March 14
Kuwait	**doubled in 13 days**	**100 total** March 14	**+20 new** March 14
Brazil	**doubled in 3 days**	**98 total** March 14	**+21 new** March 14
Greece	**doubled in 7 days**	**98 total** March 14	**+0 new** March 14
Egypt	**doubled in 7 days**	**93 total** March 14	**+26 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Iraq	**doubled in 7 days**	**93 total** March 14	**+23 new** March 14
Ireland	**doubled in 2 days**	**90 total** March 14	**+20 new** March 14
United Arab Emirates	**doubled in 8 days**	**85 total** March 14	**+0 new** March 14
India	**doubled in 6 days**	**82 total** March 14	**+8 new** March 14
Estonia	**doubled in 1 day**	**79 total** March 14	**+66 new** March 14
Lebanon	**doubled in 5 days**	**77 total** March 14	**+11 new** March 14
Thailand	**doubled in 18 days**	**75 total** March 14	**+0 new** March 14
Indonesia	**doubled in 1 day**	**69 total** March 14	**+35 new** March 14
San Marino	**doubled in 6 days**	**66 total** March 14	**+3 new** March 14
Philippines	**doubled in 5 days**	**64 total** March 14	**+12 new** March 14
Poland	**doubled in 3 days**	**64 total** March 14	**+15 new** March 14
Romania	**doubled in 3 days**	**64 total** March 14	**+16 new** March 14
Saudi Arabia	**doubled in 1 day**	**62 total** March 14	**+41 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Iceland	**doubled in 8 days**	**61 total** March 14	**+0 new** March 14
Vietnam	**doubled in 6 days**	**48 total** March 14	**+9 new** March 14
Chile	**doubled in 3 days**	**43 total** March 14	**+10 new** March 14
Luxembourg	**doubled in 1 day**	**38 total** March 14	**+21 new** March 14
Palestine	**doubled in 6 days**	**35 total** March 14	**+4 new** March 14
Argentina	**doubled in 3 days**	**34 total** March 14	**+3 new** March 14
Russia	**doubled in 3 days**	**34 total** March 14	**+0 new** March 14
Albania	**doubled in 2 days**	**33 total** March 14	**+10 new** March 14
Serbia	**doubled in 3 days**	**31 total** March 14	**+12 new** March 14
Slovakia	**doubled in 2 days**	**30 total** March 14	**+9 new** March 14
Peru	**doubled in 3 days**	**28 total** March 14	**+6 new** March 14
Croatia	**doubled in 4 days**	**27 total** March 14	**+11 new** March 14
Panama	**doubled in 2 days**	**27 total** March 14	**+13 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Algeria	**doubled in 8 days**	**26 total** March 14	**+1 new** March 14
Mexico	**doubled in 1 day**	**26 total** March 14	**+14 new** March 14
Brunei	**doubled in 1 day**	**25 total** March 14	**+13 new** March 14
Georgia	**doubled in 6 days**	**25 total** March 14	**+0 new** March 14
Costa Rica	**doubled in 4 days**	**23 total** March 14	**+1 new** March 14
Ecuador	**doubled in 9 days**	**23 total** March 14	**+6 new** March 14
Belarus	**doubled in 3 days**	**21 total** March 14	**+9 new** March 14
Pakistan	**doubled in 5 days**	**21 total** March 14	**+1 new** March 14
Hungary	**doubled in 4 days**	**19 total** March 14	**+3 new** March 14
Oman	**doubled in 11 days**	**19 total** March 14	**+1 new** March 14
South Africa	**doubled in 3 days**	**17 total** March 14	**+0 new** March 14
Colombia	**doubled in 3 days**	**16 total** March 14	**+7 new** March 14
Latvia	**doubled in 3 days**	**16 total** March 14	**+0 new** March 14

Location	How long did it take for the number of **total confirmed cases to double**?	**Total confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.	**Daily new confirmed cases** WHO data. Up to date for 10 AM (CET) on March 14.
Tunisia	**doubled in 1 day**	**16 total** March 14	**+9 new** March 14
Cyprus	**doubled in 1 day**	**14 total** March 14	**+8 new** March 14
Malta	**doubled in 2 days**	**12 total** March 14	**+3 new** March 14
Azerbaijan	**doubled in 8 days**	**11 total** March 14	**+0 new** March 14
Bosnia and Herzegovina	**doubled in 1 day**	**11 total** March 14	**+7 new** March 14
Senegal	**doubled in 2 days**	**10 total** March 14	**+0 new** March 14

Countries with less than 10 confirmed cases are not shown. Cases from the Diamond Princess cruise ship are also not shown since these numbers are no longer changing over time.

Data source: WHO. Download the full dataset.

Confirmed COVID-19 cases by country

In our visualizations here you can explore the number of *total* confirmed cases and daily *new* confirmed cases for all countries with reported cases.

These charts are interactive: the data is shown as the worldwide figures by default but can be explored by country – by clicking on **+ Add Country** within the chart.

Data: The data shown here is published by the World Health Organization (WHO). We from Our World in Data found several minor errors in the WHO data – we documented these errors, corrected them, reported them to the WHO, and are in close contact with colleagues at the WHO. Here is the documentation of the data and an option to download all data.

Explanation of the the large number of cases in China on February 17th: You will notice a dramatic increase in the number of confirmed cases on 17th February 2020. As the WHO notes in its Situation Report 27, this is the result of a change in reporting methodology to include clinically-diagnosed cases in addition to laboratory-confirmed cases as previously reported.

This change in methodology only affected figures in the Hubei province in China, but due to the large number of cases in this region it had a significant impact on global figures too.[7]

The large apparent increase in confirmed cases in China, and globally, on 17th February therefore reflects this change in methodology rather than an actual sudden increase in cases on that particular day.

Total confirmed COVID-19 cases

Because of limited testing the number of total cases is not known as explained at OurWorldInData.org/Coronavirus
The number of confirmed cases is lower than the number of total cases.
Add country
Jan 21, 2020Jan 31, 2020Feb 10, 2020Feb 20, 2020Mar 1, 2020Mar 14, 2020020,00040,00060,00080,000100,000120,000140,000LINEARWorld
CC BY
Source: World Health Organization daily Situation Reports [COVID-19]
Note: The large increase in the number of cases globally and in China on Feb 17 is the result of a change in reporting methodology.
Jan 21, 2020
Mar 14, 2020

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Daily new confirmed cases of COVID-19

Because of limited testing the number of total cases is not known as explained at OurWorldInData.org/Coronavirus
The number of confirmed cases is lower than the number of total cases.
Add country
Jan 21, 2020Jan 31, 2020Feb 10, 2020Feb 20, 2020Mar 1, 2020Mar 14, 202005,00010,00015,000LINEARWorld
CC BY
Source: World Health Organization daily Situation Reports [COVID-19]

Note: The large number of cases globally and in China on Feb 17 is the result of a change in reporting methodology.
Jan 21, 2020
Mar 14, 2020

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Trajectories since the 100th confirmed case

Did the number of confirmed cases rise faster in China, Italy, South Korea, or the US?

The charts above are not very useful to answer these types of questions, because the outbreak of COVID-19 did not happen at the same day in all countries.

The chart shown here is designed to allow these comparisons.

This chart allows the reader to compare the trajectory of confirmed cases between countries. The starting point for each country is the day that particular country had reached 100 confirmed cases.

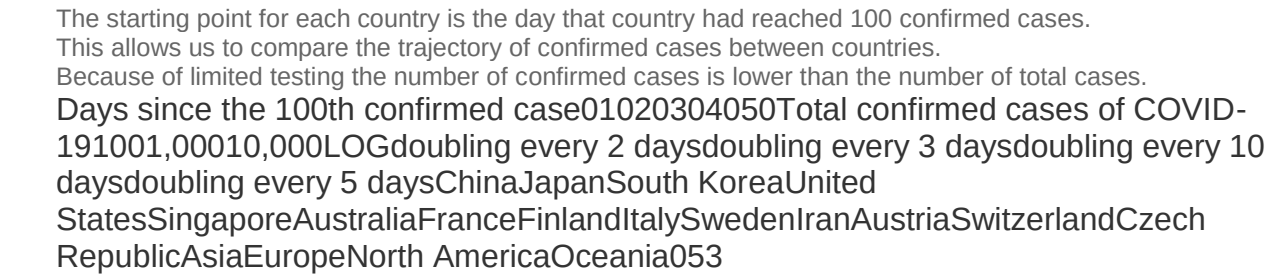
China had a particular fast rise. Just 10 days after the 100th confirmed case the country already confirmed the 10,000th case.

Other countries saw a much slower increase. The speed at which the number of confirmed cases increased in Singapore and Japan was much slower than in other countries.

The grey lines show trajectories for a doubling time of 2 das and a doubling time of 3 days. Countries that follow a steeper rise have seen a doubling time faster than that.

The trajectory of China and South Korea shows that the speed at which cases rise is not necessarily constant over time. Both countries saw a rapid initial rise but then implemented severe counter measures (see here). As the chart shows the trajectory became flatter, the speed of the outbreak has decreased.

Total confirmed cases of COVID-19



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Deaths from COVID-19

What we *want* to know is the total number of deaths and the mortality risk

To understand the mortality risk of the COVID-19 outbreak – the likelihood that someone who catches the disease will die from it – we would want to know the share of people who are infected with the disease that die from it. We want to know the final number of deaths that result for a given infected population.

However, in an ongoing outbreak the final outcomes (death or recovery) for all cases is not yet known. The time from symptom onset to death ranges from 2 to 8 weeks for COVID-19.[8] This means there are individuals who are in the early or mid-stages of infection who will die at a later date.

We therefore cannot give a definitive figure for the mortality risk of the disease.

Confirmed deaths to date is what we *do* know

What we do know is the total number of confirmed deaths *to date*. The World Health Organization (WHO) publishes updates on confirmed deaths to date in its 'Situation Reports', which can be found here at the WHO's site.

This means we can track how the number of deaths is changing over time. It does not inform us of the probability that someone infected with the diseases dies from it – to know this we would need to know the final outcome of all cases of the disease. Some individuals who are currently infected with COVID-19 are likely to die at a later date.

Confirmed COVID-19 deaths by country

In our visualizations here you can explore the number of *total* deaths and daily *new* deaths for all countries with reported deaths.

These charts are interactive: the data is shown as the worldwide figures by default but can be explored by country – by clicking on **+ Add Country** within the chart.

The data shown here is published by the World Health Organization (WHO). We from Our World in Data found several minor errors in the WHO data – we documented these errors, corrected them, reported them to the WHO, and are in close contact with colleagues at the WHO. Here is the documentation of the data and an option to download all data.

Total confirmed deaths due to COVID-19

Add country
Jan 21, 2020Jan 31, 2020Feb 10, 2020Feb 20, 2020Mar 1, 2020Mar 14, 202001,0002,0003,0004,0005,000LINEARWorld
CC BY
Source: World Health Organization daily Situation Reports [COVID-19]
Jan 21, 2020
Mar 14, 2020

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Daily new confirmed deaths due to COVID-19

Add country
Jan 21, 2020Jan 31, 2020Feb 10, 2020Feb 20, 2020Mar 1, 2020Mar 14, 2020010020030040LINEARWorld
CC BY
Source: World Health Organization daily Situation Reports [COVID-19]
Jan 21, 2020
Mar 14, 2020

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Testing for COVID-19

Why is testing important?

We want to know the *total* number of people infected with COVID-19. To know this, it is necessary to have widespread testing.

When testing is too low we do not have a clear picture of what's going on.

Testing is crucial as it allows the infected person to avoid infecting others and to quickly receive the care they need. And it is crucial for all of us to understand the prevalence of the disease, to understand how the disease evolves, and to allow us to take evidence-based decisions for counter measures that slow down the spread of the disease.[9]

This last point is very important: Testing is crucial to lower the rate of infection. When infected people do not know that they are infected, they might not stay at home – thereby running the risk of infecting others.

Unfortunately, there are two important reasons why testing is still low in many countries affected by COVID-19.

First, some people who are infected with COVID-19 have mild symptoms and therefore do not go to get checked (we explain what is known about the symptoms here and also discuss how many suffer from severe and critical symptoms).

The second reason is that in many places the capacity for COVID-19 testing is low.

How are COVID-19 tests done?

The most common diagnostic tests for COVID-19 are the so-called "PCR tests" that use swabbed samples from a patient's nose and throat.

The first PCR tests were developed within two weeks of the disease being identified, and are currently part of the protocol recommended by the WHO.[10]

Here you can find an explainer video on how the tests for coronavirus disease work.

What information about test coverage do we currently have?

Ideally, we would want to know how many people in the world are being tested for COVID-19 every day, and how the available tests are being allocated.

Unfortunately there is no centralized database by the WHO on COVID-19 testing and many countries in the world currently do not publish official reports on tests performed.

Several countries however do publish aggregate estimates on the total number of tests performed. These reports are published across individual websites, statistical reports and press releases – often in multiple languages and updated with different periodicity.

Because a global overview was not available, we at Our World in Data brought together a large number of data sources from individual national reports.

Below we show the most recent data **as of 13 March 2020, 09.00 GMT**. We will do our best to expand and update these estimates regularly.[11]

Current COVID-19 test coverage estimates

The two charts here show the most recent official estimates of tests we have been able to find **as of 13 March 2020, 09.00 GMT**.

Note that the estimates refer to different dates for each country, as indicated in the brackets.

The first chart shows the total number of tests up to the specified date.

The second chart shows the number of tests relative to the size of the population: it is the number of total COVID-19 tests per million people.

The available data shows that South Korea has done many more tests than any other country. This suggests that the number of confirmed cases in Korea is closer to the total number of cases than in other countries.

It is therefore particularly encouraging to see that the number of daily confirmed cases in South Korea has decreased – here you find our chart that shows the decline of confirmed new cases in South Korea.

The US, on the other hand, has experienced big problems rolling out their testing strategy and according to the US Centers for Disease Control and Prevention, only a total number of 13,624 samples had been tested by 12 March, 2020. The total number of tests conducted in South Korea up to the same date was nearly 18-times larger.

The low test coverage of the US is even starker if we look relative to the large population of the country. We see many smaller countries have been able to conduct more tests per million people.

[NB. We provide two estimates for the US. The estimate labelled "US – CDC samples tested" is from the Centers for Disease Control and Prevention, and refers to the number of tests conducted, not the number of individuals tested. The COVID Tracking Project tracks the cumulative number of people tested in the US by tallying individual state reporting. We report these figures under the label "US – COVID Tracking Project"]

The fact that South Korea has managed to expand testing so quickly shows that it is possible. Because testing is crucial it is important that in the coming days other countries follow.

Country by country estimates and sources

We list estimates country by country, including exact dates and links to the underlying source, in a companion page here.

Total COVID-19 tests performed by country

Most recent data available from official sources as of 13 March 2020 - 9.00GMT
Add country
050,000100,000150,000200,000250,000300,000China - Guangdong320,000 (Feb 24, 2020)South Korea248,647 (Mar 13, 2020)Italy86,011 (Mar 12, 2020)Russia76,963 (Mar 11, 2020)United Kingdom29,764 (Mar 12, 2020)Taiwan16,089 (Mar 13, 2020)United States - CDC samples tested13,624 (Mar 12, 2020)Japan10,205 (Mar 12, 2020)Bahrain9,201 (Mar 12, 2020)Australia - New South Wales8,008 (Mar 8, 2020)Norway8,000 (Mar 12, 2020)United States - COVID-Tracking project7,934 (Mar 12, 2020)France6,628 (Mar 5, 2020)Austria6,582 (Mar 13, 2020)Netherlands6,000 (Mar 7, 2020)Thailand5,232 (Mar 12, 2020)Vietnam4,588 (Mar 12, 2020)Canada - Alberta4,288 (Mar 12, 2020)Canada - Ontario4,185 (Mar 12, 2020)India4,058 (Mar 6, 2020)Malaysia4,010 (Mar 12, 2020)Denmark3,839 (Mar 13, 2020)Slovenia3,058 (Mar 12, 2020)Czech Republic2,353 (Mar 12, 2020)Poland2,234 (Mar 12, 2020)Canada - British Columbia2,008 (Mar 6, 2020)Ireland1,784 (Mar 9, 2020)Finland900 (Mar 11, 2020)Hungary858 (Mar 13, 2020)Iceland856 (Mar 11, 2020)Slovakia853 (Mar 12, 2020)Philippines717 (Mar 12, 2020)Australia - Australian Capital Territory649 (Mar 13, 2020)South Africa645 (Mar 11, 2020)Lithuania366 (Mar 13, 2020)Croatia344 (Mar 9, 2020)New Zealand338 (Mar 11, 2020)Armenia211 (Mar 9, 2020)

Source: Our World in Data based on official country reports

- CHART
- DATA
- SOURCES
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Total COVID-19 tests performed per million people

Most recent data available from official sources as of 13 March 2020 - 9.00GMT
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01,0002,0003,0004,0005,0006,000Bahrain6,164.5 (Mar 12, 2020)South Korea4,831.3 (Mar 13, 2020)China - Guangdong2,820.4 (Feb 24, 2020)Iceland2,508.2 (Mar 11, 2020)Norway1,514.5 (Mar 12, 2020)Slovenia1,479.6 (Mar 12, 2020)Italy1,420.5 (Mar 12, 2020)Austria747.2 (Mar 13, 2020)Taiwan676.6 (Mar 13, 2020)Denmark665.4 (Mar 13, 2020)Russia532.6 (Mar 11, 2020)United Kingdom450.8 (Mar 12, 2020)Ireland370.6 (Mar 9, 2020)Netherlands350.2 (Mar 7, 2020)Czech Republic222.2 (Mar 12, 2020)Finland163.3 (Mar 11, 2020)Slovakia156.8 (Mar 12, 2020)Lithuania129.4 (Mar 13, 2020)Malaysia126.8 (Mar 12, 2020)France98.8 (Mar 5, 2020)Hungary87.7 (Mar 13, 2020)Croatia83.4 (Mar 9, 2020)Japan80.5 (Mar 12, 2020)Thailand75.8 (Mar 12, 2020)Armenia72 (Mar 9, 2020)New Zealand70.5 (Mar 11, 2020)Poland58.8 (Mar 12, 2020)Vietnam48 (Mar 12, 2020)United States - CDC samples tested41.8 (Mar 12, 2020)United States - COVID-Tracking project24.4 (Mar 12, 2020)South Africa11.4 (Mar 11, 2020)Philippines6.8 (Mar 12, 2020)India3 (Mar 6, 2020)

Source: Our World in Data based on official country reports

- CHART
- DATA
- SOURCES

The COVID-19 pandemic

The name of the disease and the virus

The names for the virus and the disease it causes have been announced by the World Health Organization and the International Committee on Taxonomy of Viruses.[1][2]

The disease is called *coronavirus disease*. It is abbreviated as COVID-19.

The virus is called *severe acute respiratory syndrome coronavirus 2* and it is abbreviated as SARS-CoV-2. In the same statement the WHO also explains that they themselves also refer to the virus as “the virus responsible for COVID-19” or “the COVID-19 virus” when communicating with the public. We follow the same conventions here.

How did the outbreak start?

On 29 December 2019 Chinese authorities identified a cluster of similar cases of pneumonia in the city of Wuhan in China. Wuhan is a city with 11 million inhabitants and is the capital of the Hubei Province.

These cases were soon determined to be caused by a novel coronavirus that was later named SARS-CoV-2.[13]

Coronaviruses are a group of viruses that are common in humans and are responsible for up to 30% of common colds.[14] Corona is Latin for "crown" – this group of viruses is given its name due to the fact that its surface looks like a crown under an electron microscope.

Two outbreaks of new diseases in recent history were also caused by coronaviruses – SARS in 2003 that resulted in around 1,000 deaths[15] and MERS in 2012 that resulted in 862 deaths.[16]

The first cases of COVID-19 outside of China were identified on January 13 in Thailand and on January 16 in Japan.

On January 23rd the city of Wuhan and other cities in the region were placed on lockdown by the Chinese Government.

Since then COVID-19 has spread to many more countries – cases have been reported in all world regions. You can see the latest available data in the dashboards of cases and deaths which are kept up-to-date by Johns Hopkins University and the WHO discussed here.

Related work by Our World in Data:

- Pneumonia – Severe cases of COVID-19 can progress to pneumonia.[17] Our entry on pneumonia provides an overview of the data and research on this disease that kills 2.6 million annually.

- The Spanish flu (1918-20): The global impact of the largest influenza pandemic in history – We look at the global death toll and mortality rate of the Spanish flu and compare it with three other large influenza pandemics in the last century.

Strategies to respond to COVID-19

The intention of early containment

A lower peak of the outbreak allows the healthcare system to provide care for more people

The total mortality of an epidemic can be high even if the symptoms for the vast majority are mild. While it might not seem intuitive, it is possible for the following two things to be true at the same time:

- For the majority of people, symptoms are mild and in some cases similar to the common flu.
- An epidemic of the same disease can cause a very high number of deaths.

As we discuss here, the symptoms of COVID-19 can be very severe in many cases. Many of these patients require treatment in intensive care units (ICUs). The WHO reports that "about a quarter of severe and critical cases require mechanical ventilation."[18]

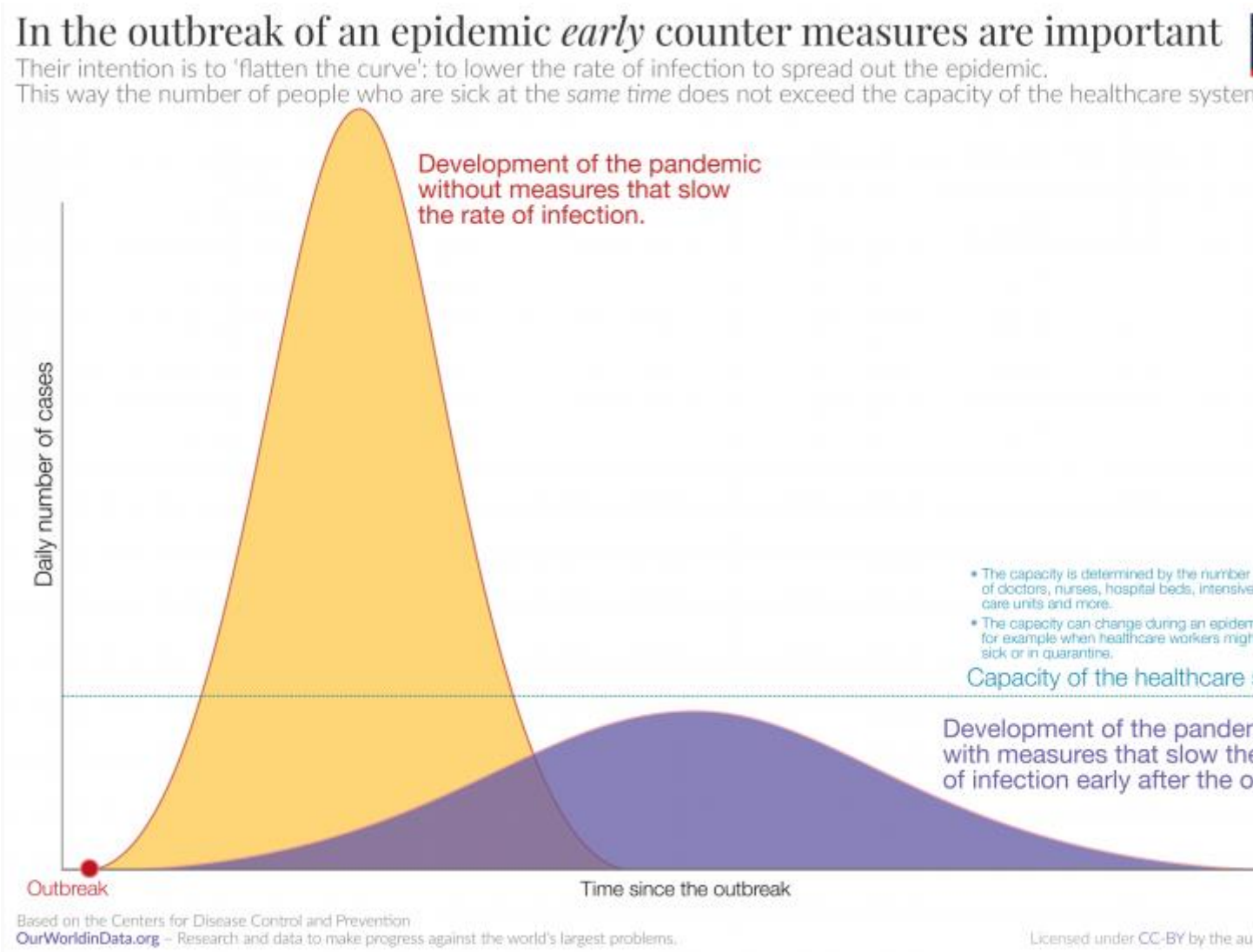
'Flattening the curve'

This is why early counter measures are important in an epidemic. Their intention is to lower the rate of infection so that the epidemic is spread out over time such that the peak demand on the healthcare system is lower.

Containment measures are intended to avoid an outbreak trajectory in which a large number of people get sick *at the same time*. This is what the visualization shows.

This is the reason that limiting the magnitude of peak incidence of an outbreak is important. Health systems can care for more patients across an outbreak when the number of cases is spread out over a long period rather than condensed in a very short period.

What such counter measures to the pandemic attempt to avoid is that the number of patients at one point in time is so large that health systems fail to provide the required care for some patients[19]



COVID-19: What are the symptoms? How does the disease progress?

If you suspect that you have COVID-19 please see the official guidance, information and advice provided by the WHO or the health agency of your country (COVID-19 information by the National Health Service of the UK is here; and by the US CDC here).

Why we need to study *data* to know the symptoms of COVID-19

COVID-19 leads to a number of symptoms, but from what is known currently some symptoms are much more common than others and for this reason we need to look at the available *data*.

The danger of relying solely on text and not on numbers is that crucial nuance can get lost. This is the case for the media coverage of the symptoms of COVID-19.

Coverage of the disease, even in reputable sources, includes long lists of symptoms without conveying to the reader how common or rare the listed symptoms are – here is a poor example from the BBC. It is crucial to know *how common* the various symptoms of COVID-19 are, as it allows a better assessment of whether one suffers from the disease or not. This is lost in reporting that relies on text – especially if the list of potential symptoms is long, and overlaps strongly with many other types of illness.

In a simple list of COVID-19 symptoms the reader might see that muscle pain is listed as a symptom and then wrongly conclude that they do not have the disease if they are not suffering from muscle pain. Knowing the frequency of symptoms means knowing that the vast majority of known cases (85% in the sample below) did *not* suffer from this symptom.

The symptoms of COVID-19

The WHO described the symptoms of 55,924 laboratory confirmed cases of COVID-19 in China in the period up to February 20.[20]

The visualization here shows this data.

It is most crucial to know **the common symptoms: fever and a dry cough.**

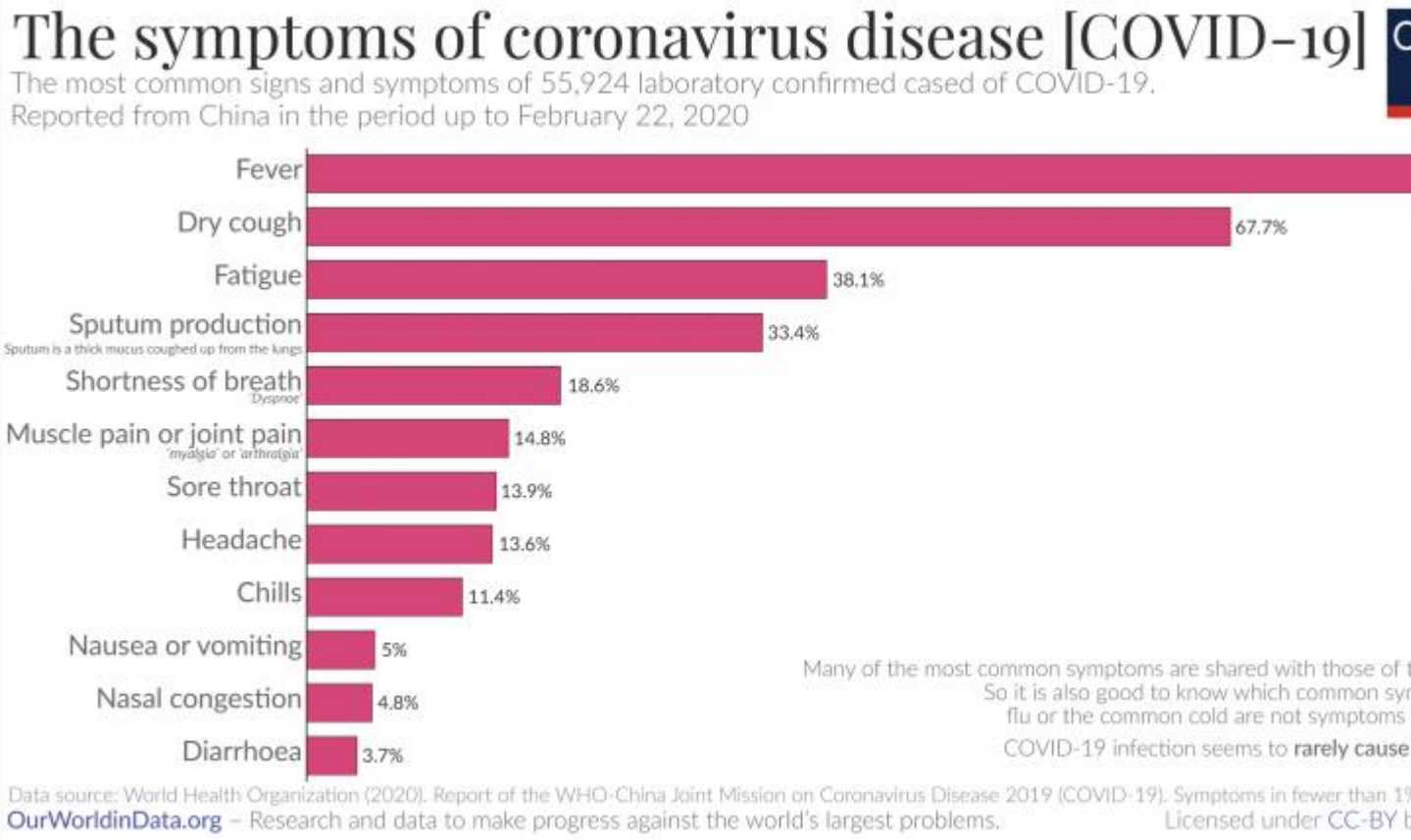
As the visualization shows, close to 90% of cases had a fever and two-thirds had a dry cough.

The third most common symptom was fatigue. Almost 40% of cases suffered from it.

'Sputum production' was experienced by every third person. Sputum is not saliva. It is a thick mucus which is coughed up from the lungs (see here).

Of the 55,924 cases fewer than 1-in-5 (18.6%) experienced shortness of breath ('dyspnoea'). An earlier study, reported that a much higher share (55%) of cases suffered from dyspnoea, but this was based on a much smaller number of cases (835 patients).[21]

Many of the most common symptoms are shared with those of the common flu or cold. So it is also good to know which common symptoms of the common flu or the common cold are *not* symptoms of COVID-19. COVID-19 infection seems to **rarely cause a runny nose**.



How long is the incubation period of COVID-19?

The WHO writes “people with COVID-19 generally develop signs and symptoms, including mild respiratory symptoms and fever, on an average of 5-6 days after infection.”[22]

While the mean incubation period is 5 to 6 days, the WHO adds that the incubation period can vary in a wide range of between 1 to 14 days.[23]

This is based on the 55,924 confirmed cases in China. There are reports of cases with longer incubation periods in the media (a case of 27 days is reported here).

How long does COVID-19 last?

On average the disease lasts two weeks. The WHO reports that “the median time from onset to clinical recovery for mild cases is approximately 2 weeks.”[24]

Again this is based on the 55,924 confirmed cases in China

For severe and critical cases it is 3 to 6 weeks according to the same study.

And for those who eventually died, the time from symptom onset to death ranged from 2 to 8 weeks. This is important when interpreting the case fatality rate (see below). Measures of the CFR of an ongoing outbreak do (obviously)

not include deaths of patients who will eventually die, but have not died yet at the time of measurement. This means that the current CFR would be lower than the eventual CFR.

How does COVID-19 progress?

The symptoms of the disease develop and change over time.

It seems to be common that symptoms start with a fever, followed by a dry cough.[25]

After several days some patients experience shortness of breath.

Symptoms can increase in severity as emphasised in the following section. In severe and critical cases it can lead to severe pneumonia, respiratory failure, septic shock, and multiple organ dysfunction or failure.

As we discuss in detail below, for some cases COVID-19 leads to death.

The severity of the symptoms of COVID-19

This visualization shows the severity of symptoms suffered by 44,415 Chinese patients confirmed to have coronavirus in the early period up to February 11.[26]

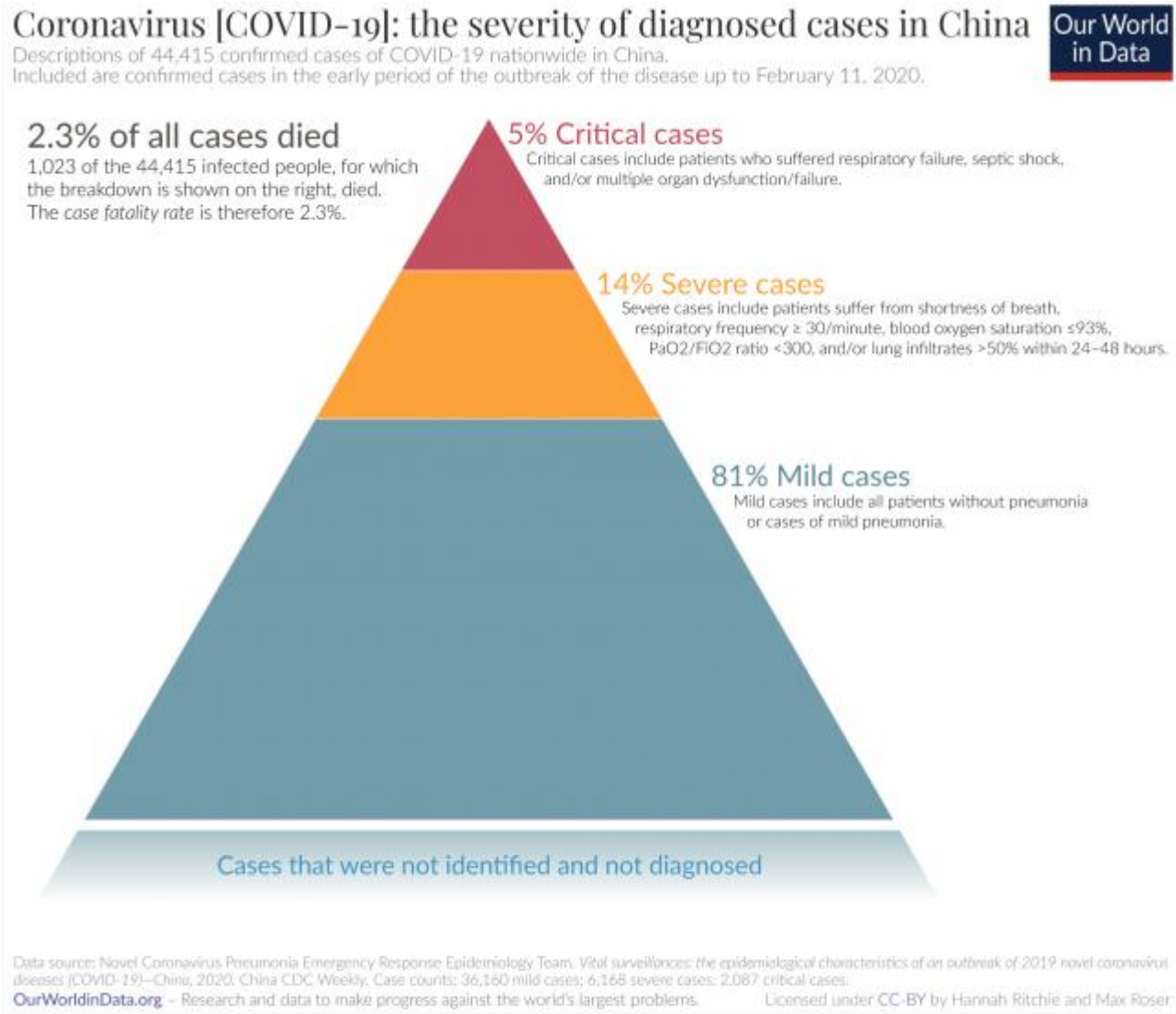
It is likely that many more cases were so mild that they were not identified as COVID-19. Estimates published by Read et al. (2020) suggest that only around 5% of cases in China have been diagnosed and recorded.[27]

Symptoms were categorized as mild, severe, or critical and the research article describes these as follows:

Critical cases: Critical cases include patients who suffered respiratory failure, septic shock, and/or multiple organ dysfunction or failure.

Severe cases: This includes patients who suffered from shortness of breath, respiratory frequency ≥ 30/minute, blood oxygen saturation ≤93%, PaO2/FiO2 ratio <300,[28] and/or lung infiltrates >50% within 24–48 hours.

Mild cases: The majority (81%) of these coronavirus disease cases were mild cases. Mild cases include all patients without pneumonia or cases of mild pneumonia.



What do we know about the risk of dying from COVID-19?

What we want to know is the risk of dying once you are infected with COVID-19.

As of early March 2020, this is not known to researchers, and we therefore have to rely on a number of metrics that allow us to get a perspective on the risk of mortality. However, to make sense of these metrics we need to understand their definitions and the challenges in measuring them. This is the focus of the section below.

We provide an overview of what we know and what these measures mean, to allow an interpretation of the current knowledge.

The definition of the case fatality rate (CFR)

Most current discussions of the mortality risk of COVID-19 refer to the **case fatality rate (CFR)**. This is the metric we will focus on, but it is crucial to understand the caveats to this data, and how it differs from alternative measures.[29]

The case fatality rate is the share who died from the disease among individuals diagnosed with the disease. The CFR is calculated by dividing the total number of *deaths* from a disease by the number of *confirmed cases*. It is expressed as a percentage and used as a measure of disease severity.

In the following section we look at the challenges of estimating the CFR. One of the key challenges is that the number of confirmed cases is often smaller than the number of total cases. The trouble is that often **many cases of a disease are never diagnosed**. This could be because cases with mild symptoms are often not tested or because not everyone who is sick goes to a hospital where such cases could be diagnosed, or because testing facilities are limited.

The case fatality rate is sometimes called case fatality risk or case fatality ratio.

The case fatality rate should not be confused with the **crude mortality rate** from the disease.

The *crude* mortality rate measures the probability that any individual in the population will die from the disease – not just those who are confirmed cases. It is a very different measure. It's calculated by dividing the number of deaths from the disease by the *total population*. This crude mortality rate is sometimes also referred to as the crude *death* rate.

This is important to differentiate, because unfortunately people sometimes confuse case fatality rates with crude death rates. A common example is the Spanish flu pandemic in 1918. The often cited estimate by Johnson and Mueller (2002) is that 50 million people died globally from this pandemic and this implies that 2.7% of the world population at the time died. This means the *crude* mortality rate was 2.7%. But 2.7% is often misreported as the *case* fatality rate.[30] If it was in fact the case that the crude mortality rate was 2.7% then the case fatality rate was much higher, since not everyone in the world was infected with the Spanish flu. *[We look at the global death count of this pandemic and others **here**.]*

Measuring and interpreting the case fatality rate

It is important to understand the measurement challenges to understand what the case fatality rate can and cannot tell us about a disease outbreak.

There is no single case fatality rate for a disease – it is context-specific, changing with time and location

Unfortunately, it is common to report the CFR as a single value. But the CFR is not a biological constant. The CFR is not a value which is tied to the given disease, but is instead reflective of the severity of the disease *in a particular context, at a particular time, in a particular population.*

The probability that someone dies from a disease is not only dependent on the disease itself, but also the social and individual response to it: the level and timing of treatment they receive, and the ability of the given individual to recover from it.

This means that the CFR can decrease or increase over time, and that it can vary by location and by the characteristics of the infected population (age, sex, pre-existing conditions).

The CFR of COVID-19 differs by location and has changed during the early period of the outbreak

In the chart here we see that the case fatality rate of COVID-19 is not constant. This chart was published in the *Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)*, in February 2020.[31]

The plotted values of the COVID-19 CFR here refer to several locations in China during the early stages of the outbreak, from the beginning of January 2020 to 20th February 2020.

We see that in the earliest stages of the outbreak the CFR was much higher: 17.3% across China as a whole (in yellow) and greater than 20% in the centre of the outbreak, in Wuhan (in blue).

In the weeks that followed, the CFR declined. The WHO reports that “the standard of care has evolved over the course of the outbreak”. The CFR fell to 0.7% for patients with the onset of symptoms after February 1st.

We also see that the CFR was different in different locations. By 1st February the CFR in Wuhan was still 5.8% while it was 0.7% across the rest of China.

This makes clear that what we said about the CFR more generally is true for the CFR of COVID-19 specifically. The CFR is not only reflective of the disease itself, but specific to where and when people are diagnosed with the disease. It’s therefore incorrect to report it as a single point value for the disease, and instead requires us to also report the time and place.

Case fatality ratio for COVID-19 in China over time and by location, as of 20 February 2020 – Figure 4 in WHO (2020)[32]

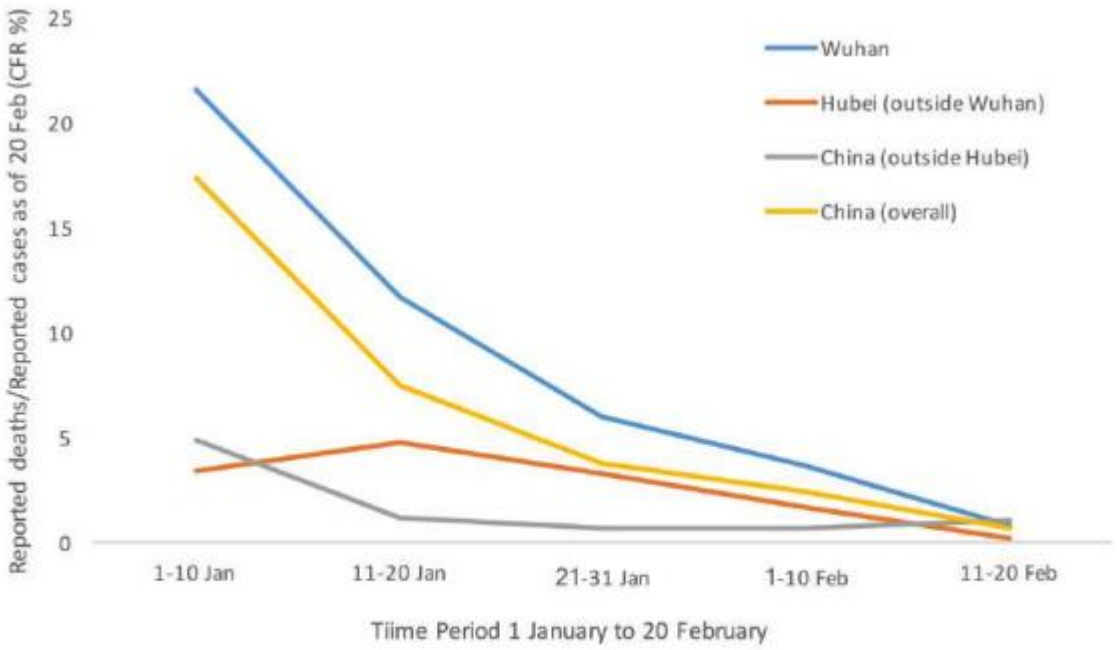


Figure 4 Case fatality ratio (reported deaths among total cases) for COVID-19 in China over time and by location, as of 20 February 2020

The true total number of cases is likely higher than the number of confirmed cases

To calculate the probability of dying from a disease, we would need to know two metrics: the number of deaths and the true total number of cases. However, the CFR is calculated from the number of *confirmed* cases only.

This means that if there are cases which are not diagnosed – for example because they are mild or asymptomatic – then the CFR does not provide a good measure of the probability of dying from the disease. If there are a large number of undiagnosed cases, we would overestimate the probability of dying from this disease. The CFR value would be too high.

The early data from China suggests that the majority of coronavirus disease cases are mild. 81% of the 44,415 studied Chinese cases during the early period of the outbreak had only mild symptoms (no pneumonia or only mild cases of pneumonia).[33] This makes it likely that some cases were so mild that they were never diagnosed as COVID-19. This would mean that the total number of people infected could be significantly higher than the number of diagnosed cases. If this is the case then the probability of dying from the disease is lower than the measured CFR.

Early research suggested that this was the case during the early period of the outbreak in Wuhan between 1 and 22 January: estimates published by Read et al. (2020) suggest that there and then 5% of cases had been diagnosed and recorded.[34]

We need to be careful in interpreting the case fatality rate of an ongoing outbreak

Once an epidemic or outbreak is over, we can rely on aggregate statistics of cases and deaths to calculate the case fatality rate.

But we need to be careful with how to interpret the CFR during an outbreak because the outcome (recovery or death) of a large number of cases is still unknown.

If today we calculate the CFR of the coronavirus disease based on the number of people who have died from it, and the number of people diagnosed with having the virus, we will be aggregating people at different stages in the development of the disease. Some people may be in the early stages of the illness; others towards the end.

As explained above, in the case of COVID-19 the time from symptom onset to death ranged from 2 to 8 weeks.[35] This means that there are many who are sick and will die, but have not died yet.

Though they may be now be counted as *confirmed cases*, those that will go on to die will not yet be included in the current count of the number deaths. This means we would underestimate the eventual case fatality rate of the infected population.

Or in other words, the case fatality rate *during* an outbreak would be just as high as the *eventual* case fatality rate of this population if none of the current cases die. This would be wrong to assume.

This is what happened during the SARS-CoV outbreak in 2003: the CFR was initially reported to be 3-5% during the early stages of the outbreak, but had risen to around 10% by the end.[36,37]

While this was due to the described problem it had two bad consequences for the responses to the outbreak: The low numbers that were published initially resulted in an underestimate of the severity of the outbreak. And the rise of the CFR over time gave the wrong impression that SARS was becoming more deadly over time.

Global case fatality rate of COVID-19

Based on the discussion of the definition of the case fatality rate (CFR), we should stress again that there is no single figure of CFR for any particular disease. The CFR varies by location, and is typically changing over time.

However, with a good understanding of the measure and its limitations, CFR is helpful for understanding what we currently know about the severity of the disease and for responding accordingly.

In the period up to and including 9th March 2020, the global Case Fatality Rate for COVID-19 are as follows.

Case fatality rate globally = 3.48%
[based on 109,578 confirmed cases and 3809 deaths]

Case fatality rate in China: 3.86%
[based on 80,904 confirmed cases and 3123 deaths]

Case fatality rate for the rest of the world: 2.39%
[based on 28,674 confirmed and 686 deaths]

As explained above, this number has changed and it will continue to change. It's currently higher than the estimates of a CFR of around 2% that were published until early February.

As we've discussed above, this does not necessarily represent a worsening of the situation: as we saw during the SARS outbreak, the CFR can rise during an outbreak because the outcome of more cases becomes known.

As we also explained above, it would be wrong to assume that this CFR would be true everywhere, because it is a global average of confirmed deaths and cases. The early CFR in Wuhan was very high as we see here; the large number of deaths there in the early period impacts the average.

Other studies for the Zhejiang province suggest that the CFR in China outside of Wuhan was likely lower.[38]

Case fatality rate of COVID-19 by age

Early data from China suggests that the elderly are most at risk

The total population-level estimate of the case fatality rate (CFR) above is useful for understanding the average severity of an outbreak, but does not tell us who within a population is most at risk. But this understanding is crucial in an outbreak. Understanding the relative risk to different sections of a population allows us to focus on the most vulnerable, and improve the allocation of health resources to those who need them most.

The *Chinese Center for Disease Control and Prevention* has published an analysis of recorded cases and deaths in China for the period until February 11th 2020 which provides a breakdown of all known cases, deaths and the CFR by specific demographics (age, sex, preexisting condition etc.).[39]

A breakdown of the CFR by age group is shown in the visualization. It shows very large differences of the CFR by age.

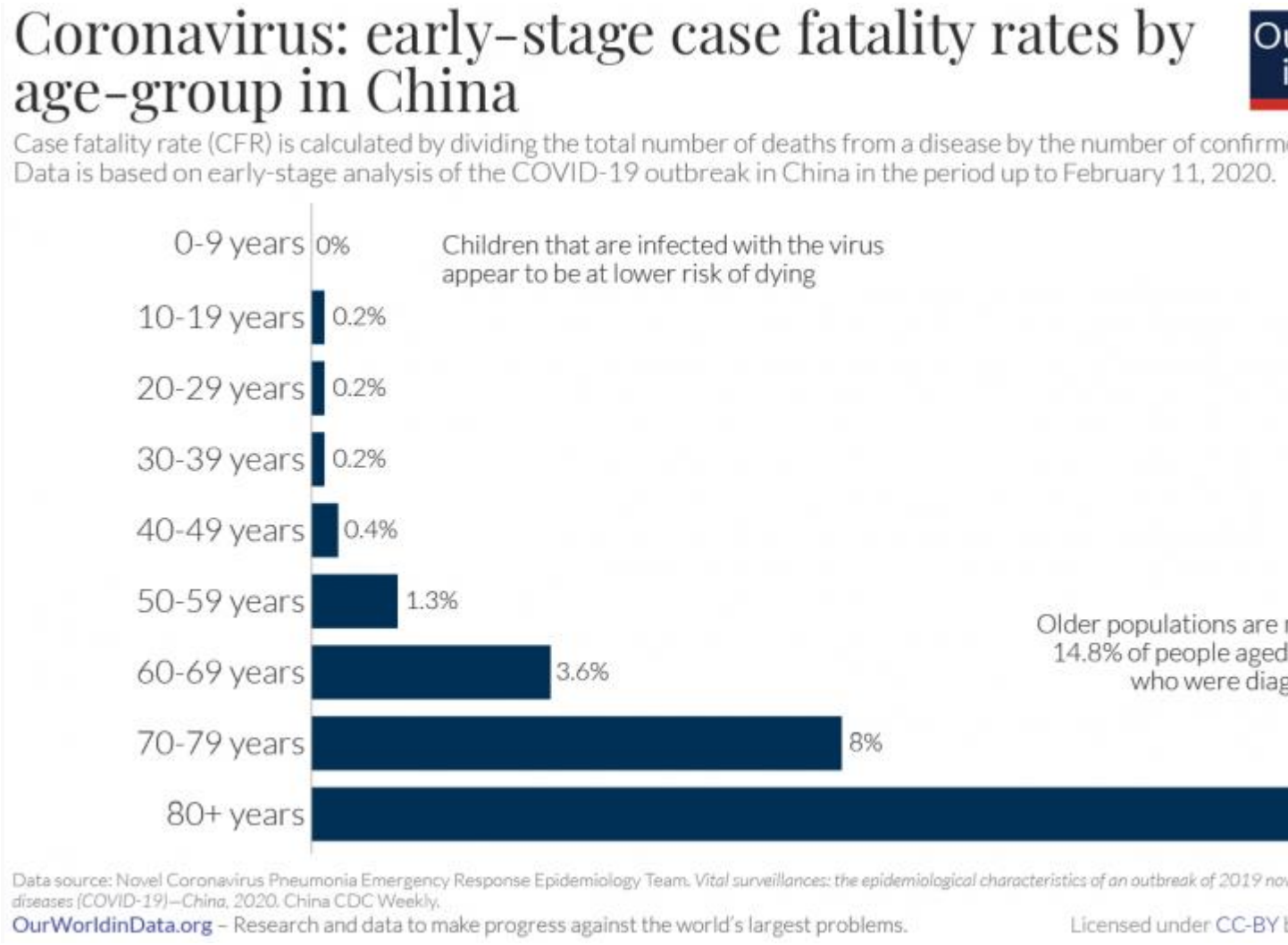
For many infectious diseases young children are most at risk. We see this for malaria: the majority of deaths (57% globally) are in children under five years of age. The same was true for the largest pandemic in recorded history: During the 'Spanish flu' in 1918 it was primarily children and young adults who died from the pandemic (we write more about this in the article here).

For the COVID-19 cases in China the opposite seems to be true, at least based on the information available at the time of writing. The elderly are at the greatest risk of dying if infected with this virus.

Based on the data from China – shown in the visualization – 14.8% of those who are 80 years and older who were infected by COVID-19 died as a result. As explained above, these figures represent the share of people *diagnosed as having the disease* who die from it. This does not represent the share of people in the entire population who die from it.

The case fatality rate for children is much lower. There were no reported deaths in children under 10 years old; 0.2% of those aged 10 to 19 years who were diagnosed with COVID-19 died from it according to the early Chinese data.

As we show in the following section, the CFR for people with underlying health conditions is higher than for those without. One possible reason why the elderly might be most at risk is that they are also those who are most likely to have underlying health conditions such as cardiovascular diseases, respiratory diseases or diabetes.



Case fatality rate of COVID-19 by preexisting health conditions

Early data from China suggests that those with underlying health conditions are at a higher risk

The visualization here shows the case fatality rate for populations within China based on their health status or underlying health condition.

This is based on the same data from the Center for Disease Control and Prevention's initial breakdown of cases, deaths and CFR among specific demographics in the population.[40] This analysis was based on recorded deaths and cases in China in the period up to February 11th 2020.

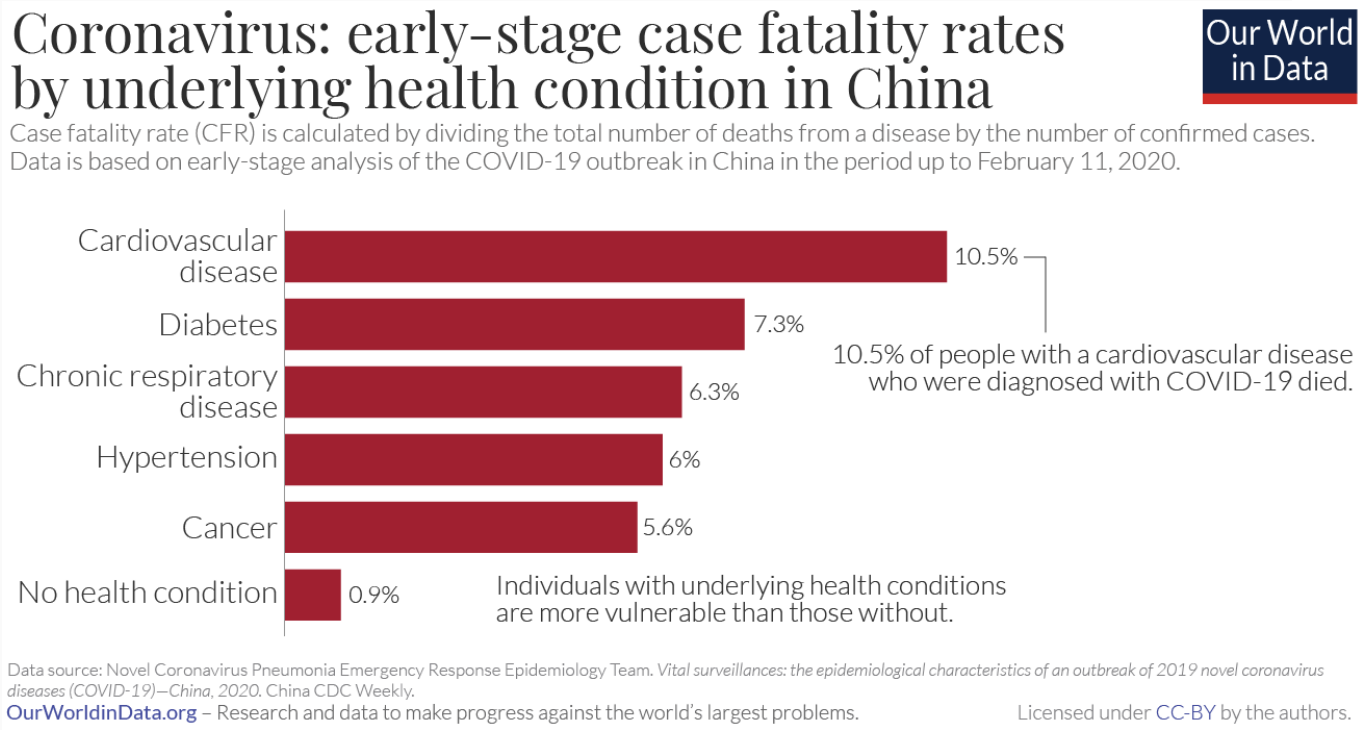
The researchers found that the CFR for those with an underlying health condition is much higher than for those without.

More than 10% of those diagnosed with COVID-19 who already had a cardiovascular disease, died as a result of the virus. Diabetes, chronic

respiratory diseases, hypertension, and cancer were all risk factors as well, as we see in the chart.

The CFR was 0.9% for those without a preexisting health condition.

Above we saw that the elderly are most at risk of dying from COVID-19. This might be partly explained by the fact that they are also most likely to have underlying health conditions such as cardiovascular disease, respiratory disease and diabetes; these health conditions make it more difficult to recover from the COVID-19 infection.



Case fatality rate of COVID-19 compared to other diseases

How does the case fatality rate (CFR) of COVID-19 compare to other virus outbreaks and diseases?

Once again, we should stress what we discussed above. One has to understand the measurement challenges and the definitions to interpret estimates of the CFR for COVID-19, particularly those relating to an ongoing outbreak.

As comparisons, the table shows the case fatality rates for other disease outbreaks. The CFR of SARS-CoV and MERS-CoV were high: 10% and 34%, respectively.[41]

The US seasonal flu has a case fatality rate of approximately 0.1% – much lower than the current CFR for COVID-19.

Sources of data shown in the table:
SARS-CoV: Venkatesh, S. & Memish, Z.A. (2004). SARS: the new challenge to international health and travel medicine. *EMHJ – Eastern Mediterranean Health Journal, 10 (4-5), 655-662, 2004.*
SARS-CoV and MERS-CoV: Munster, V. J., Koopmans, M., van Doremalen, N., van Riel, D., & de Wit, E. (2020). A novel coronavirus emerging in China—key questions for impact assessment. *New England Journal of Medicine*, *382*(8), 692-694.
Seasonal flu: US Centers for Disease Control and Prevention (CDC). Influenza Burden, 2018-19.
Ebola: Shultz, J. M., Espinel, Z., Espinola, M., & Rechkemmer, A. (2016). Distinguishing epidemiological features of the 2013–2016 West Africa Ebola virus disease outbreak. *Disaster Health*, *3*(3), 78-88.
Ebola: World Health Organization (2020). Ebola virus disease: Factsheet.

Disease	Estimated case fatality rate (CFR)
SARS-CoV	10% Venkatesh and Memish (2004) Munster et al. (2020)
MERS-CoV	34% Munster et al. (2020)
Seasonal flu (US)	0.1% US CDC
Ebola	50% 40% in the 2013-16 outbreak WHO (2020) Shultz et al. (2016)

How do case fatality rates from COVID-19 compare to those of the seasonal flu?

This question is answered in the visualization here. We compare the CFR during the outbreak of COVID-19 in China with the CFR of the US seasonal flu in 2018-19.

The case fatality rate of the seasonal flu in the US is around 0.1% to 0.2%, while the case fatality rate for COVID-19, measured in the cited study, was 2.3%.

The US data is sourced from the US CDC. Here we present an upper and lower estimate for the 2018-19 flu season. These two figures reflect whether we look at the percentage of deaths out of the number of symptomatic illnesses (giving us 0.1%), or the number of medical visits (giving us 0.2%). In the traditional calculation of CFR, we would tend to focus on the number of *symptomatic illnesses*. This is analogous to the number of confirmed cases, on which the COVID-19 figures are based. However, the US CDC derives these figures based on disease outbreak modelling which attempts to account for underreporting – you can read more about how it derives its annual flu figures **here**.

This means that some of the biases which tend to underestimate the actual number of cases have been corrected for. This is not the case for the COVID-19 figures, so it may be an unfair comparison.

Looking at estimates based on the number of medical visits may discount from the US seasonal flu data many of the kind of mild cases that may have been missed in the COVID-19 confirmed cases. However, this is likely to skew the comparison slightly in the other direction: we know that not all of the confirmed

cases included in COVID-19 figures were of a severity such that they would have received a medical visit in the absence of the heightened surveillance of the outbreak.

So, here we present both figures of the US seasonal flu figures: the CFR based on symptomatic illnesses, and those based on medical visits (shown in square brackets). It's likely that the fairest comparison to COVID-19 lies somewhere between these two values.

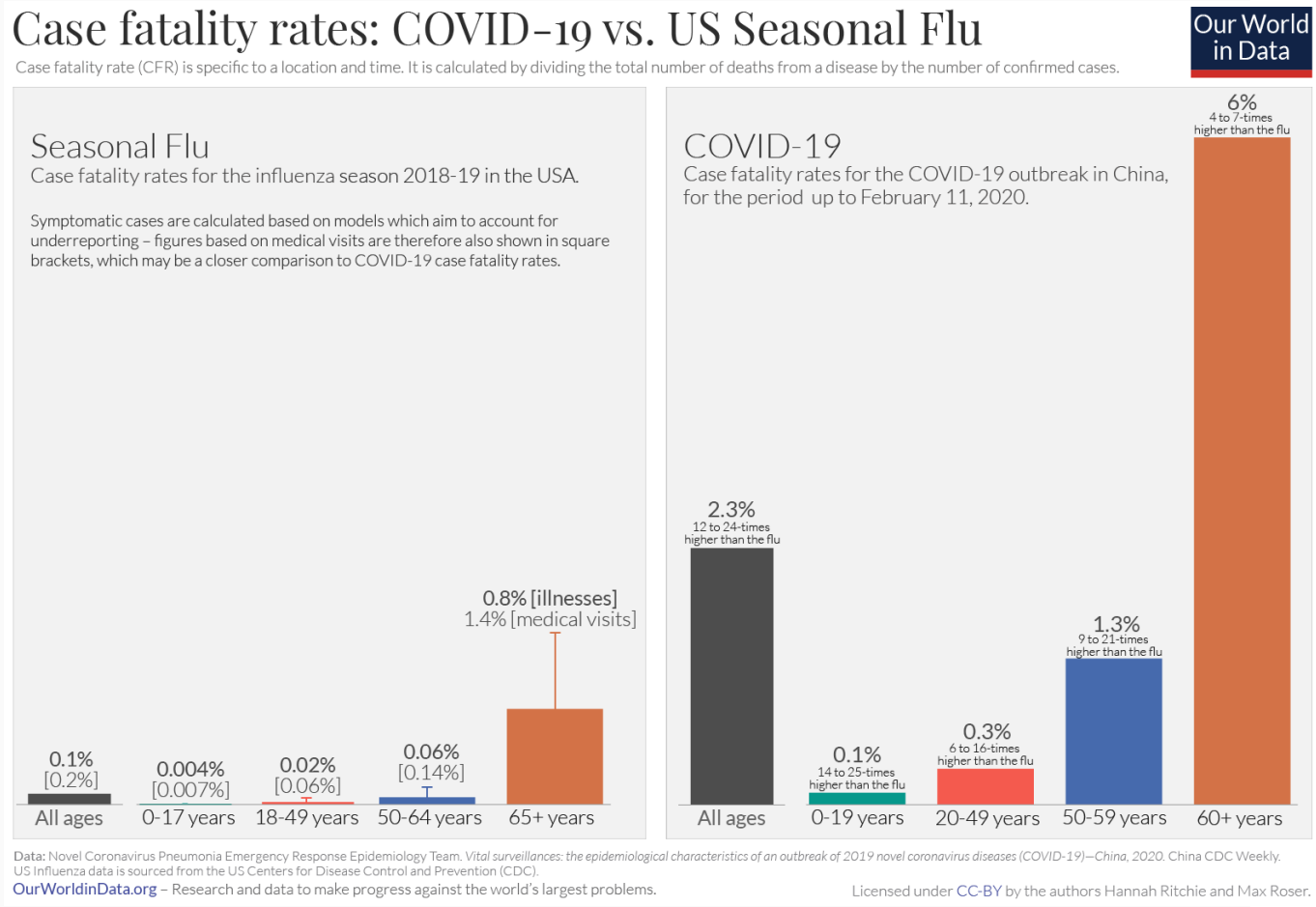
You can find the data for the reported cases, medical visits and deaths from the US Centers for Disease Control and Prevention (CDC) here. The CDC reports 35,520,883 symptomatic cases of influenza in the US and 34,157 deaths from the flu. To calculate the CFR based on symptomatic illnesses, we divide the number of deaths by the number of confirmed cases and find a case fatality rate of 0.1%.[42]

The CFRs for COVID-19 are again based on the numbers reported by the *Chinese Center for Disease Control and Prevention*.[43] As before, the Chinese data refers to recorded deaths and confirmed cases in China as of February 11th 2020.

As calculated above, the global CFR for COVID-19 continues to change over time, and the global average CFR based on the WHO data is 3.4% (as of 9th March 2020).

While the CFR for COVID-19 is much higher than the CFR of the seasonal flu the two diseases are similar in the profile of the fatality rate by age: elderly populations have higher case fatality rates.

However, the CFR of COVID-19 is much higher for all age groups, including young people. On top of each bar we have indicated how much higher the CFR for COVID-19 is for each age group.



Data and dashboards from other sources

The World Health Organization (WHO), researchers from Johns Hopkins University, and other institutions all maintain datasets on the number of cases, deaths, and recoveries from the disease.

These are presented in a number of useful dashboards and websites listed below.

Johns Hopkins data on COVID-19

A dashboard is published and hosted by researchers at the Center for Systems Science and Engineering, Johns Hopkins University. It shows the number and location of confirmed COVID-19 cases, deaths, and recoveries in all affected countries.

The researchers have the intention to "continue hosting and managing the tool throughout the entirety of the COVID-19 outbreak".

Scientific Paper: The background paper for the Johns Hopkins' dashboard was published by Dong, Du, and Gardner (2020) in *The Lancet Infectious Disease*.[44] This paper also includes a comparison of this data with the data reported by the WHO and the Chinese CDC.

Data: All collected data in this effort from the Johns Hopkins University is made freely available by the researchers through this GitHub repository. You can download all the data shown in the dashboard. Information on the sources of their data can also be found directly there.

Link: **Here** is the Johns Hopkins dashboard. A mobile friendly version of the embedded dashboard is here.

WHO data on COVID-19

The World Health Organization (WHO) publishes a dashboard similar to that of Johns Hopkins above.

The **WHO dashboard** on global cases and deaths is embedded here. In this dashboard it is possible to see up-to-date country specific data by selecting the country in the top right.

In addition to this dashboard, the WHO publishes **daily Situation Reports** which can be found here. It is the daily Situation reports that we rely on in our own published datasets on case and death numbers. Unlike the daily Situation Reports, the WHO dashboard is updated three times per day: any inconsistencies between the WHO dashboard and the data we present will be explained by this fact.

As we explained above, the Our World in Data team found several minor errors in the WHO data – we documented these errors, corrected them, reported them to the WHO, and are in close contact with colleagues at the WHO. Here is the documentation of our adjustments to the WHO data and an option to download all data.

nCoV-2019 Data Working Group data

The nCoV-2019 Data Working Group, which includes colleagues from the University of Oxford, publishes epidemiological data from the outbreak via this global dashboard. From this dashboard it is possible to obtain the underlying data which includes demographic and epidemiological descriptions of a long list of individual cases.

Their data on the list of cases includes individual travel history and key dates for each patient – date of onset of symptoms, date of hospitalisation and date of laboratory confirmation of whether the person was infected with the COVID-19 virus or not.

This data is intended to be helpful in the estimation of key statistics for the disease: Incubation period, basic reproduction number (R0), age-stratified risk, risk of importation.

In previous disease outbreaks such global individual data was not openly available.

Data from the Chinese Center for Disease Control and Prevention

The Chinese Center for Disease Control and Prevention publishes data via their dedicated site *Tracking the epidemic*.

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   The WHO also speaks of ‘suspected cases’ and ‘probable cases’, but the WHO Situation Reports do not provide figures on ‘probable cases’, and only report ‘suspected cases’ for Chinese provinces (‘suspected cases’ by country is not available).

   In Situation Report 50 they define these as follows:

   Suspect case
   A. A patient with acute respiratory illness (fever and at least one sign/symptom of respiratory disease (e.g., cough, shortness of breath), AND with no other etiology that fully explains the clinical presentation AND a history of travel to or residence in a country/area or territory reporting local transmission (See situation report) of COVID-19 disease during the 14 days prior to symptom onset.
   OR
   B. A patient with any acute respiratory illness AND having been in contact with a confirmed or probable COVID19 case (see definition of contact) in the last 14 days prior to onset of symptoms;
   OR
   C. A patient with severe acute respiratory infection (fever and at least one sign/symptom of respiratory disease (e.g., cough, shortness breath) AND requiring hospitalization AND with no other etiology that fully explains the clinical presentation.
   Probable case
   A suspect case for whom testing for COVID-19 is inconclusive.
   • Inconclusive being the result of the test reported by the laboratory

2. Note that this metric is distinct from another way in which a doubling time can be calculated. It is also possible to calculate the doubling time implied by the current daily rate of change. But the reporting of confirmed cases and deaths is very ‘noisy’ – one day the statistical agency does not report new confirmed cases, but the next day it is reporting all the new cases within the last two days for example. Doubling time based on the most recent *daily* growth rate

may therefore be more susceptible to this type of noise from day-to-day variability.

3. One way to see that this is true is to ask when the number of cases would be larger than the total world population. To give a concrete example: starting from 140,000 cases it would only take 18 doublings for the number of cases to be larger than the world population.
4. 500, 1000, 2000, 4000, 8000, 16,000, 32,000, 64,000, 128,000, 256,000, 512,000, 1,024,000
5. See for example Stango, Victor, and Jonathan Zinman (2009) – "Exponential growth bias and household finance." The Journal of Finance 64.6 (2009): 2807-2849.
6. This is quoted from Wagenaar and Sagaria (1975). Wagenaar, W.A., Sagaria, S.D. Misperception of exponential growth. Perception & Psychophysics 18, 416–422 (1975). https://doi.org/10.3758/BF03204114
7. In its Situation Report 27 (17th February 2020) the WHO notes: "*From today, WHO will be reporting all confirmed cases, including both laboratory-confirmed as previously reported, and those reported as clinically diagnosed (currently only applicable to Hubei province, China). From 13 February through 16 February, we reported only laboratory confirmed cases for Hubei province as mentioned in the situation report published on 13 February. The change in reporting is now shown in the figures. This accounts for the apparent large increase in cases compared to prior situation reports.*"
8. World Health Organization (2020). Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). Available online at: https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf
9. For example, the report of the WHO-China Joint Mission on Coronavirus Disease, 16-24 February 2020, online here, explains on page 34: "Development of rapid and accurate point-of-care tests which perform well in field settings are especially useful if the test can be incorporated into presently commercially available multiplex respiratory virus panels. This would markedly improve early detection and isolation of infected patients and, by extension, identification of contacts."
10. The report of the WHO-China Joint Mission on Coronavirus Disease, 16-24 February 2020, online here, explains that in addition to PCR tests, there are other diagnostic methods that remain less common, including serological diagnostic tests that rely on antibody assays using a blood sample. According to the WHO-China Joint Mission, the timeline for the development of the PCR tests was as follows: (i) On 29 December 2019 Chinese authorities identified a cluster of similar cases of pneumonia in the city of Wuhan in China; (ii) on 7 January, the virus found to cause COVID-19 was initially isolated from a clinical sample; (iii) on 16 January, the first PCR assays for COVID-19 were distributed to Hubei, China. You can find more information on the WHO protocols for COVID-19 laboratory testing in humans

here: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-guidance

11. The Wikipedia page on COVID-19 Testing also compiles available estimates. These often cover more countries, but they are sometimes inaccurate or out of date – as is clear from the sources we documented.

The estimates reported in the Wikipedia page were incorrect, or traced back to unreliable sources, such as comments from local officials or experts via social media or newspaper articles. For this reason we followed up all published national data ourselves and do not rely on Wikipedia as a source.

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(13.9%), headache (13.6%), myalgia or arthralgia (14.8%), chills (11.4%), nausea or vomiting (5.0%), nasal congestion (4.8%), diarrhea (3.7%), and hemoptysis (0.9%), and conjunctival congestion (0.8%). World Health Organization (2020). Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). Available online at: https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf

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