Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Estimated COVID-19 Burden

Updated July 27, 2021
Languages
Print

- •Estimated COVID-19 Infections, Symptomatic Illnesses, Hospitalizations, and Deaths in the United States

- •What Can Be Learned from Estimates of COVID-19 Infections, Illnesses, Hospitalizations, and Deaths in the United States

- •Why CDC Estimates COVID-19 Infections, Illnesses, Hospitalizations, and Deaths

- •How CDC Estimates COVID-19 Infections, Symptomatic Illnesses, and Hospitalizations

- •How CDC Estimates COVID-19 Deaths

- •Limitations

To better reflect the full burden of COVID-19, CDC provides estimates of COVID-19 infections, symptomatic illnesses, hospitalizations, and deaths using statistical models to adjust for cases that national surveillance networks do not capture for a number of reasons. These estimates and the methodologies used to calculate them are published in *Clinical Infectious Diseases*external icon and *The Lancet Regional Health – Americas*external icon. These estimates will be updated periodically.

Estimated COVID–19 Infections, Symptomatic Illnesses, Hospitalizations, and Deaths in the United States

CDC estimates that from February 2020–May 2021:

1 in 4.2 (95% UI* 3.6 – 4.9) COVID–19 infections were reported.

1 in 3.8 (95% UI* 3.4 – 4.3) COVID–19 symptomatic illnesses were reported.

1 in 1.8 (95% UI* 1.6 – 2.0) COVID–19 hospitalizations were reported.

1 in 1.3 (95% UI* 1.30 – 1.34) COVID-19 deaths were reported.

These estimates suggest that during this period, there were approximately:

120.2 Million

Estimated Total Infections

101.8 Million

Estimated Symptomatic Illnesses

6.2 Million

Estimated Hospitalizations

767,000
Estimated Total Deaths

Last Updated: May 29, 2021

Table 1: Preliminary estimated COVID-19 cumulative incidence, by age group — United States, February 2020–May 2021[†]

Age group	Infections		Symptomatic Illness		Hospitalizations		Deaths	
	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*
0-17 years	26,838,244	21,966,492 – 33,109,862	22,895,857	19,681,278 – 27,181,718	209,264	169,035 – 256,472	332	310-449
18-49 years	60,461,355	50,372,115 – 73,172,038	51,581,445	45,181,664 – 59,344,624	1,533,679	1,313,618 – 1,796,098	34,171	31,355 – 37,360
50-64 years	20,375,641	17,043,764 – 24,561,779	17,377,602	15,329,878 – 19,854,568	1,604,612	1,411,704 – 1,831,326	116,284	112,590 – 120,005
65+ years	12,298,890	9,934,247 – 15,460,317	10,005,696	8,872,135 – 11,338,584	2,808,089	2,474,510 – 3,218,931	615,824	607,666 – 623,771

Table 1: Preliminary estimated COVID-19 cumulative incidence, by age group — United States, February 2020–May 2021[†]

Age group	Infections		Symptomatic Illness		Hospitalizations		Deaths	
	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*
All ages	120,259,370	103,321,791 – 140,873,869	101,886,269	90,959,297 – 115,248,191	6,156,065	5,502,505 – 6,954,083	766,611	754,944 – 778,170

* Adjusted estimates are presented in two parts: an uncertainty interval [UI] and a point estimate. The uncertainty interval provides a range in which the true number or rate of COVID-19 infections, symptomatic illnesses, hospitalizations, or deaths would be expected to fall if the same study was repeated many times, and it gives an idea of the precision of the point estimate. A 95% uncertainty interval means that if the study were repeated 100 times, then 95 out of 100 times the uncertainty interval would contain the true point estimate. Conversely, in only 5 times out of a 100 would the uncertainty interval not contain the true point estimate.

[†]These are preliminary estimates that may fluctuate up or down as more data become available and as we improve our understanding of the detection and reporting of COVID-19. CDC will continue to update these estimates periodically.

Table 2: Estimated rates of COVID-19 disease outcomes per 100,000, by age group — United States, February 2020–May 2021

Age group	Infection rate per 100,000		Symptomatic Illness rate per 100,000		Hospitalization rate per 100,000		Death rate per 100,000	
	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*	Estimate	95% UI*
0-17 years	36,746	30,075 – 45,332	31,348	26,947 – 37,216	287	231 – 351	0.5	0.4-0.6
18-49 years	44,116	36,754 – 53,391	37,637	32,967 – 43,301	1,119	958 – 1,311	25	23-27
50-64 years	32,391	27,094 – 39,045	27,625	24,369 – 31,562	2,551	2,244 – 2,911	85	179-191
65+ years	22,751	18,377 – 28,599	18,509	16,412 – 20,975	5,195	4,577 – 5,955	1139	1124-1154
All ages	36,771	31,592 – 43,074	31,153	27,812 – 35,238	1,882	1,682 – 2,126	234	230-327

* Adjusted rates are presented in two parts: an uncertainty interval [UI] and a point estimate. The uncertainty interval provides a range in which the true number or rate of COVID-19 infections, symptomatic illnesses, hospitalizations, or deaths would be

expected to fall if the same study was repeated many times, and it gives an idea of the precision of the point estimate. A 95% uncertainty interval means that if the study were repeated 100 times, then 95 out of 100 times the uncertainty interval would contain the true point estimate. Conversely, in only 5 times out of a 100 would the uncertainty interval not contain the true point estimate.

Percentage of COVID-19 infections, symptomatic illness, and hospitalizations, and deaths, by age group—United States, February 2020-May 2021

No Data AvailableInfectionsSymptomatic IllnessesHospitalizationsDeaths0%10%20%30%40%50%60%70%80%90%100%
0-17 years18-49 years50-64 years65 and older

Data Table

	Infections	Symptomatic Illnesses	Hospitalizations	Deaths
0-17 years	22%	22%	3%	4%
18-49 years	50%	51%	25%	5%
50-64 years	17%	17%	26%	15%
65 and older	10%	10%	46%	80%

What Can Be Learned fromEstimates of COVID-19 Infections, Illnesses, Hospitalizations, and Deaths in the United States▢

Estimating unreported cases, hospitalizations, and deaths helps to quantify the impact and severity of the COVID-19 pandemic on the healthcare system and society. Additionally, these estimates can inform how to direct and allocate healthcare resources; assist in planning for prevention and control measures, including vaccination; predict the future burden of COVID-19; and evaluate the potential impact of interventions.

Why CDC Estimates COVID-19 Infections, Illnesses, Hospitalizations, and Deaths

The cumulative burden of COVID-19 is an estimate of the number of people who may have been infected, sick, hospitalized, or died as a result of a COVID-19 infection in the United States. Confirmed COVID-19 cases and deaths are nationally reported, but these cases and deaths likely represent only a fraction of the true number that have occurred in the population. COVID-19 infections, symptomatic illnesses, hospitalizations, and deaths might be underdetected and go unreported for a variety of reasons. For example:

- Some people infected with SARS-CoV-2 never show symptoms (asymptomatic infection), so their infection will likely go undetected.

- Case reports sent to CDC are often missing patient information, like age or hospitalization status, or are delayed.

- Not everyone who is sick will seek medical care and/or be tested; and patients may not be tested for COVID-19 while hospitalized or if they die.

- Even if a sick outpatient or hospitalized patient is tested, an infection with COVID-19 may not be accurately captured if, for example:

    o   the test was not completed correctly or within the appropriate timeframe for capturing infection;

    o   the test result was falsely negative for a COVID-19 infection due to the sensitivity of the test;

    o   the test result was falsely negative for a COVID-19 infection due to the quality or quantity of the specimen collected; or

- o the confirmed COVID-19 case was never reported to the local and state public health agency and then to CDC.

- For patients with COVID-19, death can occur several days or weeks after being tested and reported, and the death might be incorrectly attributed to a cause other than COVID-19 because of the time between testing positive and death.

- COVID-19 may result in non-respiratory complications or it might increase the severity of chronic conditions, which can lead to death (e.g., sepsis, circulatory diseases, respiratory diseases, diabetes, or renal failure), and COVID-19 might be incorrectly omitted as a contributing cause of death on the death certificate.

Because current surveillance systems do not capture all cases or deaths of COVID-19 occurring in the United States, CDC provides these estimates to better reflect the larger burden of COVID-19. CDC uses these types of estimates to inform policy decisions and public messages.

How CDC Estimates COVID-19 Infections, Symptomatic Illnesses and Hospitalizations⯑

To estimate COVID-19 infections, symptomatic illnesses, and hospitalizations, CDC uses a statistical model applied to confirmed cases of COVID-19, adjusted for missing age and hospitalization status. Several data sources and surveillance systems are used to identify and characterize potential sources of underdetection, which include:

- **SARS-CoV-2 test sensitivity is lower**. People tested for SARS-CoV-2, the virus that causes COVID-19 disease, may not test positive even if infected with the virus due to the lower sensitivity of the test used. SARS-CoV-2 test sensitivity has been reported in the literature; a range of 79%-98% sensitivity for RT-PCR tests is used to account for false negative test results.

- **SARS-CoV-2 test is not ordered or not completed in a timely manner**. Not all outpatients who seek care for acute respiratory illness (ARI) or inpatients hospitalized with ARI are tested for COVID-19, and

not all ordered tests are correctly completed in a timely manner. CDC uses two data sources to approximate how many outpatients with ARI are not tested for COVID-19:

- o IBM Watson Explorys Electronic Health Record database, a data repository of electronic health records from more than 39 health partners, 400 acute care facilities, and 400,000 unique providers; and

- o [COVID Near Youexternal icon](#) (CNY), a website application launched by Harvard University in March 2020 where participants can submit information on self-reported symptoms, efforts to obtain health care, and COVID-19 testing.

- **Not all patients with symptoms seek care or testing services**. Not all sick patients seek care or are tested for COVID-19, and therefore they are not included in national case reports. To approximate the number of symptomatic people who never sought medical care, researchers use data from [COVID Near Youexternal icon](#) (CNY) and [Flu Near Youexternal icon](#) (FNY) sites on health care seeking behaviors. While COVID Near You launched in March 2020, FNY has been collecting self-reported influenza participatory data since 2011.

- **Patients do not have symptoms**. Some people infected with SARS-CoV-2 never show symptoms (they have asymptomatic infection). People with asymptomatic infection are very likely to go undetected. The percentage of asymptomatic infections is reported in the literature and varies by age group. In people 0-64 years old, a range of 5%-24% is used to estimate asymptomatic infections, and for people 65 years and older, a range of 5%-32% is used.

The statistical model used to adjust hospitalized and non-hospitalized case counts for the above sources of underdetection is based on methods that have been previously used to estimate the disease burden of influenza, detailed [elsewhere](#). These methods are peer-reviewed and published in *Clinical Infectious Diseases*.

How CDC Estimates COVID-19 Deaths

COVID-19 deaths are estimated using a statistical model to calculate the number of COVID-19 deaths that were unrecognized and those that were not recorded on death certificates and, as a result, were never reported as a death related to COVID-19.

To estimate these unrecognized COVID-19 deaths, all-cause deaths are obtained from the National Center of Health Statistics. Before applying the statistical model, reported COVID-19 deaths are subtracted by age, state, and week from all-cause deaths, so that these reported COVID-19 deaths are not included in the calculation of the expected deaths for the statistical model.

Then, to understand how many deaths may have not been recognized as being related to COVID-19, CDC uses a statistical model to estimate the number of expected deaths from all causes assuming that there was no circulation of COVID-19 (that is, those deaths expected in the absence of any COVID-19 illnesses). Researchers then use the model to predict the number of all-cause deaths that would have occurred taking into account information on COVID-19 circulation,. To obtain the number of unrecognized COVID-19 deaths, the number of expected all-cause deaths (without COVID-19 circulation) are subtracted from the number of predicted all-cause deaths (with COVID-19 circulation). The model is used to calculate estimates by state and age (for six age groups: 0-17, 18-49, 50-64, 65-74, 75-84, and ≥85 years).

Once investigators estimate unrecognized COVID-19 deaths, they add documented COVID-19 deaths to the unrecognized deaths to obtain an estimate of the total number of COVID-19-attributable deaths. These methods are peer-reviewed and published in *The Lancet Regional Health – Americas*external icon.
Limitations⬚
These estimates of COVID-19 infections, symptomatic illnesses, hospitalizations and deaths are subject to several limitations, either from the data inputs used or some statistical assumptions made in the methods. A detailed discussion of these limitations can be found in *Clinical Infectious Diseases*external icon and *The Lancet Regional Health – Americas*external icon. CDC continues to explore data sources and statistical methodologies for estimating COVID-19 disease burden and will refine estimates over time.