

Article

Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 2 July 2021

An analysis of deaths involving COVID-19 that occurred between 2 January and 2 July 2021 in England, by vaccination status. Includes weekly age-standardised mortality rates for deaths involving COVID-19 by vaccination status and a detailed analysis of deaths involving COVID-19 that occurred in fully vaccinated individuals.

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1 . Main points

- In England, between 2 January and 2 July 2021, there were 51,281 deaths involving coronavirus (COVID-19); 640 occurred in people who were fully vaccinated, which includes people who had been infected before they were vaccinated.
- The risk of death involving COVID-19 was consistently lower for people who had received two vaccinations compared to one or no vaccination, as shown by the weekly age-standardised mortality rates (ASMRs) for deaths involving COVID-19.
- "Breakthrough cases" are where infection has occurred in someone who is fully vaccinated, whereas we define a "breakthrough death" as a death involving COVID-19 that occurred in someone who had received both vaccine doses and had a first positive PCR test at least 14 days after the second vaccination dose; in total, there were 256 breakthrough deaths between 2 January and 2 July 2021.
- 61.1% of breakthrough deaths occurred in males, compared to 52.2% and 48.5% for other COVID-19 deaths and for non-COVID-19 deaths respectively; the median age of breakthrough deaths was 84, compared to 82 for other COVID-19 deaths and for non-COVID-19 deaths.
- 13.1% of breakthrough deaths occurred in people who were identified as likely to be immunocompromised from hospital episodes or causes of death, compared to 5.4% for other COVID-19 deaths.

2 . Deaths involving COVID-19 by vaccination status

The number of deaths involving COVID-19 by vaccination status is shown in Table 1 for deaths occurring between 2 January and 2 July 2021, corresponding to Week 1 (week ending 8 January 2021) to Week 26 (week ending 2 July 2021). This report does not cover deaths "due to" vaccination but is for all deaths by vaccination status. The number of deaths where an adverse reaction to the vaccine was mentioned on the death certificate can be found in Table 12 of our [Monthly Mortality Analysis](#) dataset. Vaccination status is assessed at date of death and includes those who:

- were unvaccinated
- received only the first dose and died within 21 days of vaccination
- received only the first dose and died 21 days or more after vaccination
- received the second dose and died within 21 days of the second vaccination
- received the second dose and died 21 days or more after the second vaccination

The risk of a new infection following vaccination is highest during the first 21 days after the first vaccination, as shown by analysis of the [COVID-19 Infections Survey](#).

Table 1: There were 640 deaths involving COVID-19 of people who had received both vaccination doses
Count of deaths involving COVID-19 and percentage of all deaths by vaccination status, England, deaths occurring between 2 January and 2 July 2021

Vaccination status	Deaths involving COVID-19	Non-COVID-19 deaths	Percent of all deaths
All deaths regardless of vaccination status	51,281	214,701	19.3
Unvaccinated	38,964	65,170	37.4
Deaths within 21 days of first dose	4,388	14,265	23.5
Deaths 21 days or more after first dose	7,289	66,533	9.9
Deaths within 21 days of second dose	182	11,470	1.6
Deaths 21 days or more after second dose	458	57,263	0.8

Source: Office for National Statistics – National Immunisation Management Service, NHS Test and Trace

Notes:

1. Office for National Statistics (ONS) figures based on death registrations up to 28 July 2021 for deaths that occurred between 2 January and 2 July 2021 (Week 1 - Week 26).
2. Date of infection is the first known positive test date, of the last COVID-19 infection that occurred prior to death.
3. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs. Please see Glossary for more information.
4. Deaths were linked to the National Immunisation Management Service and Test and Trace by NHS number.
5. Due to low numbers, ASMRs could not be calculated for those whose deaths was within 21 days of first dose from week 13 onward, and for doubly vaccinated people in weeks 1, 8, 9 and 11.

Some deaths are expected in vaccinated individuals as the number of people who are vaccinated is high and no vaccine is 100% effective. Between 2 January and 2 July 2021, there were 640 deaths involving COVID-19 in people who had received both vaccine doses, which is 1.2% of all deaths involving COVID-19 in that period (51,281 deaths). There were 458 deaths involving COVID-19 in people who received their second dose at least 21 days before the date of death. Deaths involving COVID-19 accounted for 0.8% of all deaths in this group, compared with 37.4% in unvaccinated individuals.

Vaccinations were being offered according to priority groups set out by the [JCVI](#), therefore the characteristics of the vaccinated and unvaccinated populations are changing over time, which limits the usefulness of comparing counts between the groups.

3 . Date infected relative to vaccination for COVID-19 deaths

The numbers of coronavirus (COVID-19) deaths occurring between 2 January and 2 July 2021 for vaccinated people by vaccination status, and the first positive PCR test date relative to vaccination, are summarised in Table 2. The first positive date is taken as the date of the first positive PCR test for the last COVID-19 infection that occurs before death (see [Measuring the data](#)). However, the actual start of infection and symptom onset may precede this. 85.7% of the deaths involving COVID-19 of vaccinated people (10,556 deaths) and 84.5% of those for unvaccinated people (32,910 deaths) have at least one positive PCR test result.

Table 2: There were 47.5% of fully vaccinated people with a record of infection, whose death involved COVID-19, first tested positive at least 14 days after the second vaccination

Deaths involving COVID-19 in vaccinated people, by vaccination status and first positive date relative to vaccination, England, deaths occurring between 2 January and 2 July 2021

First positive date relative to vaccination

Vaccination status	No infection data	Before vaccination	Less than 21	21 days or	Less than 14	14 days or
			days after first dose (before/no second dose)	more after first dose (before/no second dose)	days after second dose	more after second dose
Deaths after first dose only	1,660	961	6,430	2,626	-	-
Deaths after second dose	101	63	49	44	127	256

Source: Office for National Statistics, National Immunisation Management Service, NHS Test and Trace

Notes:

1. Office for National Statistics (ONS) figures based on deaths that occurred between 2 January and 2 July 2021 and were registered up to 28 July 2021.
2. Date of infection is the first known positive test date, of the last COVID-19 infection that occurred prior to death.
3. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs (see Glossary).
4. Deaths were linked to the National Immunisation Management Service and Test and Trace by NHS number.

Considering only deaths involving COVID-19 with a known infection date (10,556 deaths), of those who were vaccinated 9.7% had a first positive date preceding the first vaccination (1,024 deaths). Of those who had received only one vaccination dose, 64.2% had a first positive date within 21 days of vaccination (6,430 deaths). Of those who had received both vaccinations, 47.5% had a first positive date at least 14 days after the second vaccination (256 deaths).

4 . Age-standardised mortality rates for deaths involving COVID-19 by vaccination status over time

To account for differences in population size and age of the vaccination status groups over time, we calculated age-standardised mortality rates (ASMRs) for deaths involving coronavirus (COVID-19) (Figure 1) using the Public Health Data Asset (PHDA) dataset (see Methodology). This is a dataset containing people who reside in England who could be linked to the 2011 Census and the GP Patient Register 2019, which covers approximately 79% of people aged over 10 years living in England. ASMRs for non-COVID-19 deaths are also included in the reference tables.

Figure 1: Age-standardised mortality rates for deaths involving COVID-19 are consistently lower for people who have received two vaccinations

Weekly age-standardised mortality rates for deaths involving COVID-19 by vaccination status, England, deaths occurring between Week 1 (week ending 8 January 2021) and Week 26 (week ending 2 July 2021)

Notes:

1. Age-standardised mortality rates per 100,000 people per week, standardised to the 2013 European Standard Population using 5-year age groups from age 10 and over.
2. Office for National Statistics (ONS) figures based on death registrations up to 28 July 2021 for deaths that occurred between 2 January and 2 July 2021 (Week 1 - Week 26).
3. ASMRs are calculated using the Public Health Data Asset, a linked dataset of people resident in England, who could be linked to the 2011 Census and GP Patient Register.
4. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs (see Glossary).
5. Age and vaccination status are defined on the date of death where a death has occurred, and on the last day of the week if not.
6. 95% Confidence intervals are indicated by the shaded regions. Non-overlapping confidence intervals denote a statistically significant difference in ASMR.
7. Rates are not calculated where the total number of deaths is less than 10. Data for the two second dose categories are combined due to low counts.

[Download the data](#)

The weekly ASMRs for people who had received two vaccination doses are lower than those for people who have received one dose or are unvaccinated. The weekly ASMRs for people who had only one dose are lower than the ASMRs for people who were unvaccinated in earlier weeks (approximately Week 1 to Week 12). From week 15 onwards, the ASMRs for unvaccinated people and people vaccinated only once are similar, but the smaller population in these groups and lower COVID-19 mortality rates make comparisons less reliable than in earlier weeks.

While the ASMRs provide evidence that vaccinated individuals have a lower risk of dying of COVID-19 than unvaccinated individuals, they cannot be used to determine vaccine effectiveness, as the populations in each vaccine status group are likely to differ in ways other than population size and age because of the [selective roll out of the vaccination programme](#) and differences in [vaccine uptake](#). [Published studies](#) have calculated vaccine effectiveness using observational methods, taking into account known differences in characteristics of vaccinated and unvaccinated people, and confirming the [lack of bias because of remaining unobserved differences between the groups](#).

5 . Characteristics of breakthrough deaths

"Breakthrough cases" are where infection has occurred in someone who is fully vaccinated. We define a "breakthrough death" as a death involving coronavirus (COVID-19) that occurred in someone who had received both vaccine doses, and had a first positive PCR test at least 14 days after the second vaccination dose. In total, there were 256 breakthrough deaths between 2 January and 2 July 2021 (Table 2).

We used the Public Health Data Asset (PHDA) to investigate the characteristics of breakthrough cases, leveraging information from the General Practice Extraction Service (GPES) data for coronavirus (COVID-19) pandemic planning and research and Hospital Episode Statistics (HES). The linked data includes 252 breakthrough deaths and 43,956 total deaths involving COVID-19, 98.4% and 85.7% respectively of all breakthrough and total deaths involving COVID-19 that occurred between 2 January and 2 July 2021.

Table 3 shows some characteristics of these deaths.

Table 3: 61.1% of breakthrough deaths occurred in males, which is higher than for other deaths involving COVID-19 and non-COVID-19 deaths

Number and percentage of deaths occurring by various characteristics for breakthrough deaths, other deaths involving COVID-19 and non-COVID-19 deaths, England, deaths occurring between 2 January and 2 July 2021

	Breakthrough deaths	Other deaths involving COVID-19	Non COVID-19
Median age	84	82	82
Male	154 (61.1%)	22,819 (52.2%)	89,498 (48.5%)
Female	98 (38.9%)	20,885 (47.8%)	94,901 (51.5%)
Clinically extremely vulnerable	193 (76.6%)	32,567 (74.5%)	128,454 (69.7%)
Not clinically extremely vulnerable	59 (23.4%)	11,137 (25.5%)	55,945 (30.3%)
Limited a lot by long-term health problem or disability	80 (31.7%)	12,152 (27.8%)	44,642 (24.2%)
Limited a little by long-term health problem or disability	80 (31.7%)	12,604 (28.8%)	50,817 (27.6%)
Not limited by long-term health problem or disability	92 (36.5%)	18,948 (43.4%)	88,940 (48.2%)
Immunocompromised	33 (13.1%)	2,360 (5.4%)	18,049 (9.8%)
Not immunocompromised	219 (86.9%)	41,344 (94.6%)	166,350 (90.2%)

Source: Office for National Statistics – Public Health Data Asset, National Immunisation Management Service, NHS Test and Trace

Notes:

1. Office for National Statistics (ONS) figures based on death registrations up to 28 July 2021 for deaths that occurred between 2 January and 2 July 2021 (Week 1 - Week 26).
2. Statistics are calculated using the Public Health Data Asset, a linked dataset of people resident in England who could be linked to the 2011 Census and GP Patient Register.
3. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs (see Glossary).
4. Age is defined on the date of death.
5. See Glossary for definitions of health-related variables.

The median age for breakthrough deaths was 84 and 61.1% of the deaths occurred in males, despite there being more elderly women than men, and therefore initially more fully vaccinated women who could experience a breakthrough death. For all other deaths involving COVID-19 occurring between 2 January and 2 July 2021 in the PHDA dataset, the median age was 82 and 52.2% were male.

13.1% of the breakthrough deaths occurred in people who were immunocompromised, compared to 5.4% for other deaths involving COVID-19. Individuals were identified as immunocompromised if they had experienced a hospital episode since 1 January 2019 where the diagnosis or procedure code corresponded to an immunocompromised condition, or who had died and a condition corresponding to being immunocompromised was listed on the death certificate (see [Measuring the data](#)).

A greater proportion of breakthrough deaths occurred in those who were [clinically extremely vulnerable](#) (76.6%, 193 deaths), than other COVID-19 deaths (74.5%, 32,567 deaths) or non-COVID-19 deaths (69.7%, 128,454 deaths). A similar trend is observed for disability and long-term health problem status, with proportions of deaths among people self-reporting that they are "limited a lot" on the 2011 Census as 31.7%, 27.8% and 24.2% for breakthrough deaths, other deaths involving COVID-19 and non-COVID-19 deaths respectively. However, the characteristics of breakthrough deaths can reflect the characteristics of the population that is more likely to be double vaccinated as well as having an increased risk of a breakthrough death, and numbers are relatively low and should therefore be interpreted with caution.

6 . Glossary

Age standardised mortality rates

Age-standardised mortality rates (ASMRs) are used to allow comparisons between populations that may contain different proportions of people of different ages and sex. The 2013 European Standard Population is used to standardise rates. In this bulletin, the ASMRs are calculated for each week. For more information see [Section 7: Measuring the data](#).

Coronaviruses

The World Health Organization (WHO) defines coronaviruses as "a large family of viruses that are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS)". Between 2001 and 2018, there were 12 deaths in England and Wales due to a coronavirus infection, with a further 13 deaths mentioning the virus as a contributory factor on the death certificate.

Coronavirus (COVID-19)

COVID-19 refers to the "coronavirus disease 2019" and is a disease that can affect the lungs and airways. It is caused by a type of coronavirus. Further information is available from the [World Health Organization \(WHO\)](#).

Statistical significance

The term "significant" refers to statistically significant changes or differences. Significance has been determined using the 95% confidence intervals, where instances of non-overlapping confidence intervals between estimates indicate the difference is unlikely to have arisen from random fluctuation.

95% confidence intervals

A confidence interval is a measure of the uncertainty around a specific estimate. If a confidence interval is 95%, it is expected that the interval will contain the true value on 95 occasions if repeated 100 times. As intervals around estimates widen, the level of uncertainty about where the true value lies increases. The size of the interval around the estimate is strongly related to the number of deaths, prevalence of health states and the size of the underlying population. At a national level, the overall level of error will be small compared with the error associated with a local area or a specific age and sex breakdown. More information is available on our [uncertainty pages](#).

Deaths involving COVID-19

For this analysis we define a death as involving COVID-19 if either of the ICD-10 codes U07.1 (COVID-19, virus identified) or U07.2 (COVID-19, virus not identified) is mentioned on the death certificate. In contrast to the definition used in the weekly deaths release, deaths where the ICD-10 code U09.9 (post-COVID condition, where the acute COVID-19 had ended before the condition immediately causing death occurred) is mentioned on the death certificate and neither of the other two COVID-19 codes are mentioned are not included, as they are likely to be the result of an infection caught a long time previously, and therefore not linked to the vaccination status of the person at date of death. Deaths involving U10.9 (multisystem inflammatory syndrome associated with COVID-19) where U07.1 or U07.2 are mentioned are also excluded. This is a rare complication affecting children, and there are no such deaths in our dataset for the data released in Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 2 July 2021.

Limitation by a long-term health problem of disability

Limitation by a long-term health problem or disability is self-reported on the 2011 Census for the question, "Are your day-to-day activities limited because of a health problem or disability which has lasted, or is expected to last, at least 12 months?". Answers are one of, "Yes, limited a lot", "Yes, limited a little", or "No".

Clinical vulnerability

Clinical vulnerability is determined according to the QCOVID risk model for health conditions that result in a higher risk of COVID-19. Health conditions are determined using the General Practice Extraction Service (GPES) and Hospital Episode Statistics (HES) data.

Immunocompromised

A person was identified as immunocompromised if they had a hospital episode recorded in the [Hospital Episode Statistics dataset \(HES\) Admitted Patient Care dataset](#) that started on or after 1 January 2019, with a diagnosis code (ICD-10) or procedure code (OPCD) corresponding to a condition that is associated with either primary or secondary immunosuppression. A person was also flagged as immunocompromised if they died and at least one of these ICD-10 diagnosis codes was mentioned on the death certificate or if they had SNOMED codes recorded in the General Practice Extraction Service dataset corresponding to a prescription of immunosuppressants.

The ICD-10 diagnosis codes included are based on the [Immunocompromised State Diagnosis codes](#) from the US Agency for Healthcare Research and Quality. These are ICD-10-CM codes, therefore we used only those codes that were up to 4 digits long to correspond to ICD-10 codes.

The OPCS-4 procedure codes are based on the OPCS-4 codes listed in the [NHS shielding list](#) published by NHS Digital for the following disease groups: transplant, or cancer undergoing active chemo or radiotherapy.

Full lists of the ICD-10 codes and OPCS-4 codes used are given in the reference tables.

Date infected with COVID-19

The first positive test date of the most recent COVID-19 infection recorded in Test and Trace data is used to determine when a person who died from COVID-19 was infected relative to their vaccination data. The absence of a positive test can be either due to a linkage failure (the person was tested but we could not find them in the Test and Trace dataset) or to infection having occurred either not in England or before mass testing was available.

A COVID-19 infection can have multiple positive test results, and a person may be reinfected at a later period. The first positive test result was taken as the start of the first infection, and subsequent infections were determined as starting on the first positive test date that occurred >90 days after the start of the previous infection. The most recent infection is then defined as the start of the last recorded infection.

Note: this data is experimental and subject to further quality assurance tests.

7 . Measuring the data

Data sources

The data in Tables 1 and 2 in this bulletin are produced using a linked dataset of deaths, linked to vaccinations data from the National Immunisation Management System (NIMS) based on NHS number and linked to the Test and Trace data on PCR test results, also via NHS number. This covers all deaths, and all vaccinations and infections for these deaths that were recorded in NIMS or Test and Trace.

The data for the age-standardised mortality rates (ASMRs) in Figure 1 and Table 3, as well as the reference tables, are created using the Public Health Data Asset (PHDA), a linked dataset combining the 2011 Census, the General Practice Extraction Service (GPES) data for coronavirus (COVID-19) pandemic planning and research, and the Hospital Episode Statistics (HES). We linked vaccination data from the National Immunisation Management Service (NIMS) to the PHDA based on NHS number and linked data on COVID-19 positive Polymerase Chain Reaction (PCR) tests from Test and Trace to the PHDA also based on an NHS number.

The PHDA dataset contains a subset of the population and allows for analyses to be carried out that require a known living population with known characteristics (such as for ASMRs by vaccination status) and the use of variables such as health conditions and census characteristics.

8 . Strengths and limitations

Provisional data are used

Provisional death registrations and death occurrences data are used in this bulletin. This enables timely analysis to be completed to monitor mortality trends. However, as the data for 2021 are provisional, they are subject to change.

Use of death occurrences rather than registrations

This publication uses death occurrences registered up to 28 July 2021, rather than death registrations. Because of [registration delays](#), more deaths may be registered at later dates, leading to an increase in the death occurrences. This is especially true for more recent deaths.

Definition of immunocompromised

There is no standard way to identify someone who is immunocompromised using UK data. The method used here, detailed in the Glossary and Reference tables, draws on a definition of Immunocompromised State Diagnosis codes from the US Agency for Healthcare Research and Quality. As this is a US body, the codes are given as ICD-10-CM codes; therefore, we use the 3- and 4- digit codes in this list, which largely correspond to ICD-10 codes used in UK data. There may be differences between US and UK diagnostic practice that affect the results. Therefore, we may only imperfectly identify people who are immunosuppressed based on the ICD-10 codes. However, we also use information from procedures and prescription to improve our definition of the immunocompromised population.

Data coverage

The data are for England only, as vaccinations data for Wales is not yet available to be linked to the mortality dataset and the PHDA covers England only.

The dataset used for Tables 1 and 2 cover all deaths that occurred between 2 January and 2 July 2021 and were registered by 28 July for England, and includes all vaccinations and positive tests recorded from the NIMS and Test and Trace datasets.

The PHDA dataset was used in order to calculate the ASMRs by vaccination status and Table 3. One of the main strengths of the linked PHDA is that it combines a rich set of demographic and socio-economic factors from the 2011 Census and 2019 Patient Register with pre-existing conditions based on clinical records. This unique dataset was linked to NIMS and Test and Trace to allow us to analyse how ASMRs differ by vaccination status, when people were infected relative to vaccination, and examine the characteristics of people by vaccination status and infection date.

The PHDA contains data on approximately 79% of the population of England aged 10 years and over and includes 85.9% of all deaths of residents in England that occurred between 2 January 2021 and 2 July 2021 and were registered by 28 July 2021.

The NIMS data in our dataset cover the period up to 9 August 2021; however, there may be some additional lag in reporting the data. The Test and Trace data in our dataset cover the period up to 4 July 2021.

Acknowledgement

We would like to thank Professor Aziz Sheikh for his valued contribution to this bulletin.

9 . Related links

[Coronavirus \(COVID-19\) latest data and analysis](#)

Web page | Updated as and when new data become available

Brings together the latest data and analysis on the coronavirus (COVID-19) pandemic in the UK and its effect on the economy and society.

[Deaths registered weekly in England and Wales](#)

Bulletin | Released 24 August 2021

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

[Coronavirus and vaccination rates in people aged 70 years and over by socio-demographic characteristic, England: 8 December 2020 to 9 May 2021](#)

Bulletin | Released 7 June 2021

First and second dose COVID-19 vaccination rates among people aged 70 years and older who live in England, both in private households and communal establishments. Includes estimates by socio-demographic factor such as ethnic group, religious group, and those identified as disabled.

[Coronavirus \(COVID-19\) Infection Survey, UK](#)

Bulletin | Released 27 August 2021

Estimates for England, Wales, Northern Ireland and Scotland. This survey is being delivered in partnership with University of Oxford, University of Manchester, Public Health England and Wellcome Trust. This study is jointly led by the ONS and the Department for Health and Social Care (DHSC) working with the University of Oxford and UK Biocentre to collect and test samples.