Office for National Statistics

Statistical bulletin

Coronavirus (COVID-19) testing behaviours and outcomes, England: September 2020 to November 2021

Analysis of delays between the onset of symptoms and booking a test in the Test and Trace system and the impact these delays had on COVID-19 hospitalisation and death involving COVID-19.

Contact:
Tim Larsen, Ted Dolby, Camille Harrison, Tom Tarling
health.data@ons.gov.uk
+44 1633 455046

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1 . Main points

- Of the 3,584,726 positive and symptomatic tests analysed between 1 September 2020 and 21 November 2021, 52.4% had been booked on the same or following day as symptoms began, 31.9% were booked between two to three days after and 15.7% were booked after four days or more.

- The rates of coronavirus (COVID-19) hospitalisation and death involving COVID-19 were higher following tests with longer delays between the onset of symptoms and booking than following tests with shorter delays.

- The age-standardised rate of death involving COVID-19 following tests with longer delays between the onset of symptoms and the booking of a test was lower than the rate following tests with shorter delays, and the age-standardised rates of COVID-19 hospitalisation were similar following tests across all delay durations.

- After adjusting for factors associated with adverse COVID-19 outcomes, there was little evidence that people whose tests involved longer delays between the onset of symptoms and the booking of a test were at greater risk of COVID-19 hospital admission or death involving COVID-19 than people whose test involved shorter delays.

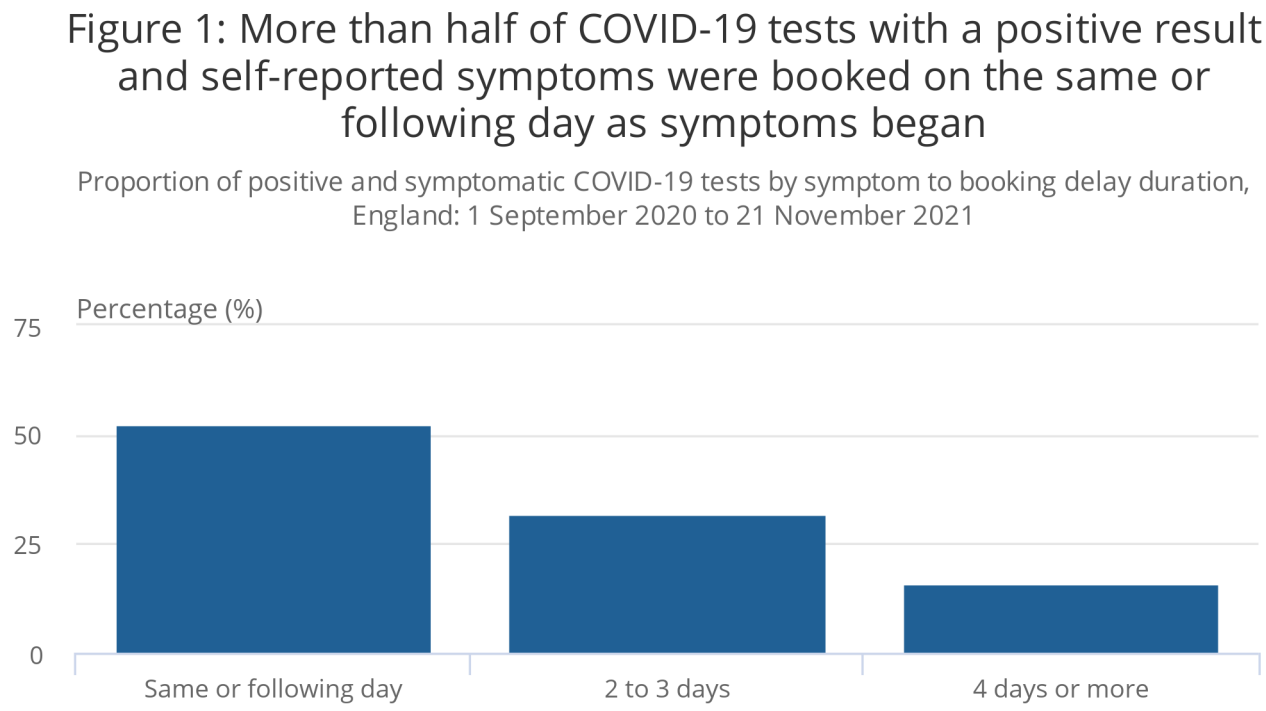
A limitation in this analysis was that we could not adjust for the severity of a person's symptoms, as these data were not available; it is possible that those with more severe symptoms were less likely to delay in getting a test and were also potentially more susceptible to adverse COVID-19 outcomes. This analysis focused only on adverse COVID-19 outcomes (hospitalisation and death) that directly affected the person who had recorded a positive and symptomatic test; this did not cover other aspects of the Test and Trace programme that helped to advise people testing positive, and their close contacts, to self-isolate to stop the onward spread of the virus.

2 . COVID-19 testing behaviours and outcomes

This analysis uses information on COVID-19 tests from NHS Test and Trace Pillar 2 test data. This was used to measure the delay between the onset of a person's symptoms and when they booked a test. This is referred to as "symptom to booking delay". Of the 3,584,726 positive and symptomatic tests analysed between 1 September 2020 and 21 November 2021, 52.4% had a test booked on the same day as symptoms began, or the following day, 31.9% were booked between two to three days after symptoms began and 15.7% were booked four days after symptom began or longer.

Figure 1: More than half of COVID-19 tests with a positive result and self-reported symptoms were booked on the same or following day as symptoms began

Proportion of positive and symptomatic COVID-19 tests by symptom to booking delay duration, England: 1 September 2020 to 21 November 2021



Source: Office for National Statistics Public Health Data Asset – NHS Test and Trace Pillar 2 data

Notes:

1. These data included tests that were recorded by the NHS Test and Trace programme Pillar 2 testing and involved people who were counted at the 2011 Census, resident in England, present in the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR), alive and aged 10 years or over on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date.

2. Symptom to booking delay was the delay taken by people between the onset of symptoms and booking a test and was categorised as tests booked: the same or following day (as the onset of symptoms); two to three days (following the onset of symptoms); four days or more (following the onset of symptoms).

Using information on hospital admissions and deaths, we looked at whether the person who had taken the test had been admitted to hospital for COVID-19 or had a death involving COVID-19 within 28 days of the test being booked. We analysed the relationship between these COVID-19 outcomes and symptom to booking delays.

For both males and females, the crude rates of hospitalisation for COVID-19 following a testing delay of four days or more were higher than rates following tests booked on the same or following day and following tests booked two to three days after the onset of symptoms.

For males, the crude rate of hospitalisation for COVID-19 following tests with symptom to booking delays of four days or more was 2,783.3 per 100,000 tests, while the rate following tests booked on the same or following day was 1,585.1 per 100,000 tests. However, adjusting for age greatly reduced the difference in rates between the groups. The age-standardised rate of COVID-19 hospitalisation following tests with delays of four days or more was 3870.6 per 100,000 tests. The age-standardised rate following tests booked on the same or following day was 3633.1 per 100,000 tests.

Similarly, for females, the crude rate of COVID-19 hospitalisation following tests with symptom to booking delays of four days or more was 1,728.1 per 100,000 tests, while the rate following tests booked on the same or following day was 1,143.3 per 100,000 tests. However, after accounting for differing age distributions of the groups, the age-standardised rate of COVID-19 hospitalisation was no greater following tests with longer delays than those with shorter delays.

Figure 2: While crude rates of COVID-19 hospitalisation were greater following tests with longer delays between symptom onset and booking, the age-standardised rates were similar following tests across all delay durations

Rates of COVID-19 hospitalisation within 28 days of a positive, symptomatic test per 100,000 tests by symptom to booking delay duration and sex, England: 1 September 2020 to 21 November 2021

Notes:

1. These data included tests that were recorded by the NHS Test and Trace programme Pillar 2 testing and involved people who were counted at the 2011 Census, resident in England, present in the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR), alive and aged 10 years or over on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date.

2. Symptom to booking delay was the delay taken by people between the onset of symptoms and booking a test and was categorised as tests booked: the same or following day (as the onset of symptoms); two to three days (following the onset of symptoms); four days or more (following the onset of symptoms).

Download the data

.xlsx

For both males and females, the crude rates of death involving COVID-19 following tests with symptom to booking delays of four days or more were higher than the rates following tests booked with shorter delays. For males, the crude rate of death involving COVID-19 was 446.3 per 100,000 tests following tests with delays of four days or more and 226.4 per 100,000 tests following tests booked on the same or following day. For females, the equivalent rates were 226.4 per 100,000 tests and 151.0 per 100,000 tests, respectively.

However, after adjusting for age, the age-standardised rates of death involving COVID-19 following tests with longer symptom to booking delays were lower than those following tests with shorter delays. For males, the age-standardised rate following tests with symptom to booking delays of four days or more was 904.4 per 100,000 tests, rising to 1207.9 per 100,000 tests following tests booked on the same or following day as symptom onset. For females, the equivalent age-standardised rates of death involving COVID-19 were 537.7 per 100,000 tests and 766.1 per 100,000 tests, respectively.

Figure 3: While crude rates of death involving COVID-19 were greater following tests with longer delays between symptom onset and booking, the age-standardised rates were lower following tests with longer delays

Rates of death involving COVID-19 within 28 days of a positive, symptomatic test per 100,000 tests by symptom to booking delay duration and sex, England: 1 September 2020 to 21 November 2021

Notes:

1. These data included tests that were recorded by the NHS Test and Trace programme Pillar 2 testing and involved people who were counted at the 2011 Census, resident in England, present in the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR), alive and aged 10 years or over on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date.

2. Symptom to booking delay was the delay taken by people between the onset of symptoms and booking a test and was categorised as tests booked: the same or following day (as the onset of symptoms); two to three days (following the onset of symptoms); four days or more (following the onset of symptoms).

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We used Cox proportional hazards models to assess how the rates of COVID-19 hospitalisation and death involving COVID-19 varied by delay from symptom onset to booking, while controlling for factors known to be associated with adverse COVID-19 outcomes.

We estimated hazard ratios of COVID-19 hospitalisation and death involving COVID-19 following tests with symptom to booking delays of two to three days and four days or more, relative to tests booked on the same or following day, and adjusted sequentially for groups of factors associated with adverse COVID-19 outcomes.

In our baseline model, we adjusted for age, sex and the month when the test was booked. We then adjusted sequentially for additional factors including:

- ethnicity
- geography (region, rural urban classification, deprivation of area)
- Pre-existing health conditions and disability status
- highest level of qualification and religion
- vaccination status

The final model presented included all of these factors.

When adjusting for age, sex and month, the hazard ratios of COVID-19 hospitalisation following tests with symptom to booking delays of two to three days and four days or more were 1.09 and 1.09, respectively, when compared with tests booked on the same or following day as symptom onset. When controlling for factors known to affect COVID-19 hospitalisation, these hazard ratios were reduced to 1.05 and 1.00 for symptom to booking delays of two to three days and four days or more, respectively. The largest reductions in the hazard ratios were observed when controlling for ethnicity, pre-existing health conditions and disability status, and vaccination status. This suggests that the risk of COVID-19 hospital admission for people whose tests involved longer delays (two to three days and four days or more) between the onset of symptoms and the booking of a test was similar to those people who had booked tests on the same or following day as symptom onset.

Figure 4: After adjusting for factors associated with adverse COVID-19 outcomes, people whose tests had longer symptom to booking delays had a similar hazard of COVID-19 hospitalisation to those whose tests had shorter delays

Hazard ratios of COVID-19 hospitalisation within 28 days of a positive, symptomatic test by symptom to booking delay duration, England: 1 September 2020 to 21 November 2021

Notes:

1. These data included tests that were recorded by the NHS Test and Trace programme Pillar 2 testing and involved people who were counted at the 2011 Census, resident in England, present in the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR), alive and aged 10 years or over on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date.

2. Symptom to booking delay was the delay taken by people between the onset of symptoms and booking a test and was categorised as tests booked: the same or following day (as the onset of symptoms); two to three days (following the onset of symptoms); four days or more (following the onset of symptoms).

3. In the baseline model, age, sex and the month when the test was booked were adjusted for. Additional factors were then sequentially adjusted for – ethnicity; geography (region, rural urban classification, area-based deprivation); pre-existing health conditions and disability status; highest level of qualification and religion; COVID-19 vaccination status so that the final model presented included all of these factors.

4. The hazard ratios of COVID-19 hospital admission and death involving COVID-19 following tests with symptom to booking delays of two to three days and four days or more are relative to tests booked on the same or following day.

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When adjusting for the factors associated with adverse COVID-19 outcomes, the hazard ratios of death involving COVID-19 following tests with symptom to booking delays of two to three days and four days or more were 0.96 and 0.86, respectively, compared with tests on the same or following day as symptom onset. This suggests people whose tests involved longer delays (two to three days and four days or more) between the onset of symptoms and the booking of a test experienced no additional risk of death involving COVID-19 than those people who had booked tests on the same or following day as symptom onset.

Figure 5: After adjusting for factors associated with adverse COVID-19 outcomes, people whose tests had longer symptom to booking delays had a lower hazard of death involving COVID-19 than those whose tests had shorter delays

Hazard ratios of death involving COVID-19 within 28 days of a positive, symptomatic test by symptom to booking delay duration, England: 1 September 2020 to 21 November 2021

Notes:

1. These data included tests that were recorded by the NHS Test and Trace programme Pillar 2 testing and involved people who were counted at the 2011 Census, resident in England, present in the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR), alive and aged 10 years or over on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date.

2. Symptom to booking delay was the delay taken by people between the onset of symptoms and booking a test and was categorised as tests booked: the same or following day (as the onset of symptoms); two to three days (following the onset of symptoms); four days or more (following the onset of symptoms).

3. In the baseline model, age, sex and the month when the test was booked were adjusted for. Additional factors were then sequentially adjusted for – ethnicity; geography (region, rural urban classification, area-based deprivation); pre-existing health conditions and disability status; highest level of qualification and religion; COVID-19 vaccination status so that the final model presented included all of these factors.

4. The hazard ratios of COVID-19 hospital admission and death involving COVID-19 following tests with symptom to booking delays of two to three days and four days or more are relative to tests booked on the same or following day.

Download the data

.xlsx

3 . Coronavirus (COVID-19) testing behaviours and outcomes data

Coronavirus (COVID-19) testing behaviours and outcomes, England: September 2020 to November 2021
Dataset | Released 9 November 2022
Analysis of delays across the Test and Trace system and the impact these delays have on hospitalisation and mortality.

4 . Glossary

Age-standardised rates

Age-standardised rates were calculated as the number of outcomes per 100,000 tests. Age-standardised rates allow comparisons between populations that may contain proportions of different ages. The age distribution within each group was standardised to the 2013 European Standard Population.

Confidence interval

A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. The 95% confidence intervals are calculated so that if we repeated the study many times, 95% of the time the true unknown value would lie between the lower and upper confidence limits. A wider interval indicates more uncertainty in the estimate. Overlapping confidence intervals indicate that there may not be a true difference between two estimates.

For more information, see our methodology page on statistical uncertainty.

Cox proportional hazards regression model

The Cox proportional hazards regression model is a multiple regression procedure that measures the association between a time-to-event outcome and a characteristic of interest, while adjusting for other characteristics expected to also be associated with the outcome.

Hazard ratio

A hazard ratio is a measure of the relative differences in the instantaneous rate of an outcome between groups. A hazard ratio greater than 1 indicates the rate of the outcome is higher, and likewise less than 1 is lower, in the population group under study compared with a reference group.

5 . Measuring the data

We linked the Office for National Statistics (ONS) Public Health Data Asset (PHDA) to NHS Test and Trace Pillar 2 test data (swab testing in the wider population) using NHS numbers. Of the 268,331,447 unique Pillar 2 tests, 78.7% could be linked to individuals present in the Public Health Data Asset.

The PHDA combines Census 2011 records, death registrations, Hospital Episode Statistics (HES) and primary care records retrieved from the General Practice Extraction Service (GPES) Data for Pandemic Planning and Research (GDPPR).

Individuals' socio-demographic characteristics (age, sex, ethnicity, highest level of qualification and religion) were derived from the 2011 Census; age was measured at the time the test was booked. Place of residence (region and rural-urban classification) and area-based deprivation were derived from the GPES data for pandemic planning and research where available, and from the 2011 Census where not available. Area-based deprivation was measured as the area's Index of Multiple Deprivation quintile, according to the English Index of Multiple Deprivation 2019. The pre-existing health conditions included in the modelling were based on the coronavirus (COVID-19) risk prediction model known as QCovid2 and disability status was derived from the 2011 Census.

We linked vaccination data from the National Immunisation Management Service (NIMS) to the PHDA, based on NHS number. We used NIMS data for the period 8 December 2020 (the day of the first vaccination in England) to 21 November 2021. Vaccination status was measured at the time the test was booked and measured whether a person had received no vaccination or had received at least one vaccination. We considered a vaccination to be protective from 14 days after the date of immunisation.

The information on COVID-19 tests was obtained from NHS Test and Trace Pillar 2 test data and includes all tests, including both polymerase chain reaction (PCR) and lateral flow device (LFD) tests, recorded in the wider population between 1September 2020 and 21 November 2021. For this analysis, only tests that had evidence of a confirmed positive test result and self-reported symptoms at the time of booking were included. As the test data were recorded for each individual test, these data were reduced to only include one test per COVID-19 infection, by removing instances where a person had recorded multiple tests during the same infection. If an individual had two positive tests in short succession, for instance a confirmatory PCR test following a LFD test, we used the date associated with the PCR test as the start of the follow-up period, if the PCR test occurred less than seven days after the LFD. In cases when the PCR test occurred seven days or more after a LFD test, the PCR test was ignored and the LFD test record used instead. As per the UK Health Security Agency (UKHSA) guidance, we recorded any positive LFD test followed by a negative PCR test within three days as negative. We defined a new COVID-19 infection (or reinfection) for a given person only if a new positive test result occurred more than 120 days since the previous one.

The delay between the onset of symptoms and booking a test was derived as the time between the self-reported date of symptom onset and the date at which the person registered for a test on the NHS Test and Trace platform. The length of delay was categorised as tests booked:

- the same or following day (as the onset of symptoms)
- two to three days (following the onset of symptoms)
- four days or more (following the onset of symptoms)

The adverse COVID-19 outcomes used in this analysis were COVID-19 hospital admissions and deaths involving COVID-19. COVID-19 hospital admissions were derived from HES and included any hospital episode, as an inpatient, with the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes U07.1 (COVID-19, virus identified) or U07.2 (COVID-19, virus not identified) recorded as primary diagnostic.

Deaths involving COVID-19 were derived from death registrations and included any death with an underlying cause or any mention of ICD-10 codes U07.1, U07.2, U09.9 (Post COVID-19 condition) or U10.9 (Multisystem inflammatory syndrome associated with COVID-19). For both outcomes, an individual was considered to have experienced the outcome if it occurred within 28 days of booking the test to ensure that the test -- and associated symptom to booking delay -- and the outcome were relevant to the same COVID-19 infection.

The study population includes individuals who were enumerated at the 2011 Census, resident in England, and present in the GDPPR. We further restricted our population to tests from people alive and aged at least 10 years on 1 September 2020, and with no recorded date of death between the test booking date and the actual test date. Our final data consisted of 3,584,726 Pillar 2 tests from 1 September 2020 to 21 November 2021.

While this study was based on a large and nationally representative population, it did not cover children aged below 10 years and those who have immigrated to England since the 2011 Census; it also excluded those who were not present in the GDPPR. It was also limited to individuals who engaged with the NHS Test and Trace programme, specifically Pillar 2 testing: swab testing in the wider population. Therefore, it did not cover people who did not test, people who did not record their test results with the programme or people whose tests were recorded in other testing pillars. For example, Pillar 1 covers swab testing in UKHSA labs and NHS hospitals for those with a clinical need, and health and care workers.

A limitation in this analysis was that we do not control for the severity of a person's symptoms, as these data were not available. It is possible that those with more severe symptoms were less likely to delay in getting a test; simultaneously those with more severe symptoms may be more susceptible to adverse COVID-19 outcomes.

This analysis focused only on adverse COVID-19 outcomes (hospitalisation and death) that directly affected the person who had recorded a positive and symptomatic test; this analysis did not cover other aspects of the Test and Trace programme that helped to advise people testing positive, and their close contacts, to self-isolate to stop the onward spread of the virus.

6 . Related links

Coronavirus (COVID-19) latest insights
Interactive tool | Updated regularly
A live roundup of the latest data and trends about the coronavirus (COVID-19) pandemic from the Office for National Statistics (ONS) and other sources.

Coronavirus (COVID-19) Infection Survey, UK
Bulletin | Released 4 November 2022
Percentage of people testing positive for coronavirus (COVID-19) in private residential households in England, Wales, Northern Ireland and Scotland, including regional and age breakdowns.

7 . Cite this bulletin

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