



UK Health  
Security  
Agency

# **SARS-CoV-2 variants of concern and variants under investigation in England**

## **Technical briefing: Update on hospitalisation and vaccine effectiveness for Omicron VOC-21NOV-01 (B.1.1.529)**

31 December 2021

This briefing provides an update on previous [briefings](#) up to 23 December 2021

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## Summary

This report has been published to share the detailed variant surveillance analyses which contribute to the Omicron risk assessment. This specialist technical briefing contains early data and analysis on emerging variants and findings have a high level of uncertainty.

A [separate report is published](#) covering surveillance data on all other variants of concern (VOCs) and variants under investigation (VUIs).

## Omicron cases, hospitalisation and deaths

The data cut off for analyses in this report is 29 December 2021. At this time, there were 198,348 confirmed cases of Omicron VOC-21NOV-01 (B.1.1.529) (hereafter referred to as Omicron), identified through sequencing or genotyping in England, and 451,194 probable cases, identified through S-gene target failure (SGTF). This does not represent the total number of Omicron infections or cases (approximately 30% of community PCR tests are performed using an assay that can detect SGTF); SGTF accounts for 93% of cases with an S-gene test on 29 December, this is the number of cases which can be classified as Omicron for comparative analyses. As of 29 December, a total of 815 individuals with laboratory-confirmed (sequencing, genotyping or SGTF) Omicron have been admitted or transferred from emergency departments in England.

## Studies of hospitalisation and vaccine effectiveness (VE)

Two studies have been undertaken which examine the association between both variant and vaccination status and risk of hospitalisation. Study 1 is based on a larger dataset, approximately half a million Omicron cases, because it includes all cases diagnosed in the community and in the first day of hospital admission, and all age groups. Study 2 uses a smaller dataset because it is restricted to symptomatic cases diagnosed in the community, followed by a hospital admission, in part to reduce the impact of cases where coronavirus (COVID-19) is incidental to the admission but detected on routine hospital admission screening. It is restricted to ages 18 and over.

The previous finding of reduced overall risk of hospitalisation for Omicron compared to Delta is confirmed by the updated Study 1. In addition, both studies find a substantial reduction in risk of hospitalisation for Omicron cases after 3 doses of vaccine compared to those who are unvaccinated, with overlapping estimate ranges. Both studies have been run on relatively small numbers of hospitalised cases and will require iteration. Despite the estimated reduction in hospitalisation risk and preserved vaccine effectiveness against hospitalisation, the very high

number of Omicron cases means that there may still be large numbers of admissions to hospital.

## Study 1: Risk of hospitalisation (UKHSA/MRC Biostatistics Unit, University of Cambridge)

An update on the analysis published last week finds the **risk of presentation to emergency care or hospital admission with Omicron was approximately half of that for Delta (Hazard Ratio 0.53, 95% CI: 0.50 to 0.57)**. The risk of hospital admission from emergency departments with Omicron was approximately one-third of that for Delta (Hazard Ratio 0.33, 95% CI: 0.30 to 0.37). These analyses were stratified on date of specimen and area of residence and further adjusted for age, sex, ethnicity, local area deprivation, international travel, vaccination status. They are also adjusted for whether the current infection is a known reinfection, although as reinfections are substantially under-ascertained, the adjustment may not have fully accounted for the effect of reinfections.

In this analysis, the risk of hospitalisation is lower for Omicron cases after 2 and 3 doses of vaccine, with an **81% (77 to 85%) reduction in the risk of hospitalisation after 3 doses compared to unvaccinated Omicron cases.**

## Study 2. Vaccine effectiveness against symptomatic infection and hospitalisation (UKHSA)

**Vaccine effectiveness (VE) against symptomatic disease continues to be lower for Omicron than for Delta with waning by 10 weeks after dose 3**, confirming findings published last week.

Symptomatic cases were then linked to hospitalisation data. After 3 doses of vaccine, the risk of **hospitalisation for a symptomatic case** identified with Omicron through community testing was estimated to be **reduced by 68% (42 to 82%)** when compared to similar individuals with Omicron who were not vaccinated (after adjusting for age, gender, previous positive test, region, ethnicity, clinically extremely vulnerable status, risk group status and period). Combined with the protection against becoming a symptomatic case, this gives a vaccine effectiveness against hospitalisation of 88% (78 to 93%) for Omicron after 3 doses of vaccine. Although waning is seen in the effectiveness against symptomatic disease, there is insufficient data to assess the duration of protection against hospitalisation, which is expected to last longer.

## Risk assessment

The Omicron risk assessment will next be updated on 7 January 2022.

# Omicron VOC-21NOV-01 (B.1.1.529)

A new variant with a novel combination of mutations was detected on GISAID on 23 November 2021 and designated B.1.1.529 on 24 November 2021. This variant was designated VUI-21NOV-01 by the UK Health Security Agency (UKHSA) Variant Technical Group and on review re-designated as VOC-21NOV-01 on 27 November 2021.

## 1. Cases

As of data produced on 29 December 2021, there are 198,348 confirmed cases of Omicron, identified through sequencing or genotyping (see Table 1). Of the cases tested for the presence of the S-gene, 95.64% had SGTF.

**Table 1: Number of confirmed, provisional and possible Omicron VOC-21NOV-01 (B.1.1.529) cases, by region of residence as of 29 December 2021**

UKHSA region	Confirmed*	Probable**	Possible***	Total
East Midlands	15,504	38,517	40	54,061
East of England	12,674	47,553	30	60,257
London	48,320	104,543	63	152,926
North East	8,421	16,041	7	24,469
North West	24,082	94,496	23	118,601
South East	44,759	41,950	76	86,785
South West	20,772	15,799	1	36,572
West Midlands	12,379	39,149	24	51,552
Yorkshire and Humber	10,822	52,715	28	63,565
Unknown	615	431	0	1,046
Total	198,348	451,194	292	649,834

\* Confirmed case: Omicron (B.1.1.529) by sequencing or genotyping (i) 417N and 681R failure; ii) 69-70 deletion plus 417N; iii) 69-70 deletion plus 501Y; iv) Q493R, vi) other relevant genotyping results)

\*\*Probable case: COVID-19 polymerase chain reaction (PCR) positive and i) SGTF<sup>^</sup> or ii) 69-70 deletion with specimen dates from 1 December 2021

\*\*\*Possible case: COVID-19 PCR positive and SGTF<sup>^</sup> with specimen dates from 1 November up to and including 30 November 2021<sup>^^</sup>

<sup>^</sup>S-gene target failure (SGTF): A positive SARS-CoV-2 PCR test carried out on the TaqPath assay with undetectable S-gene and CT values  $\leq 30$  for both N and Orf1ab gene targets. Currently reported into SGSS by Milton Keynes, Alderley Park, Glasgow, and Newcastle lighthouse laboratories.

<sup>^^</sup>Excludes those confirmed as non-Omicron variant.

## 2. Hospitalisation

### Descriptive epidemiology of severe outcomes of Omicron in England

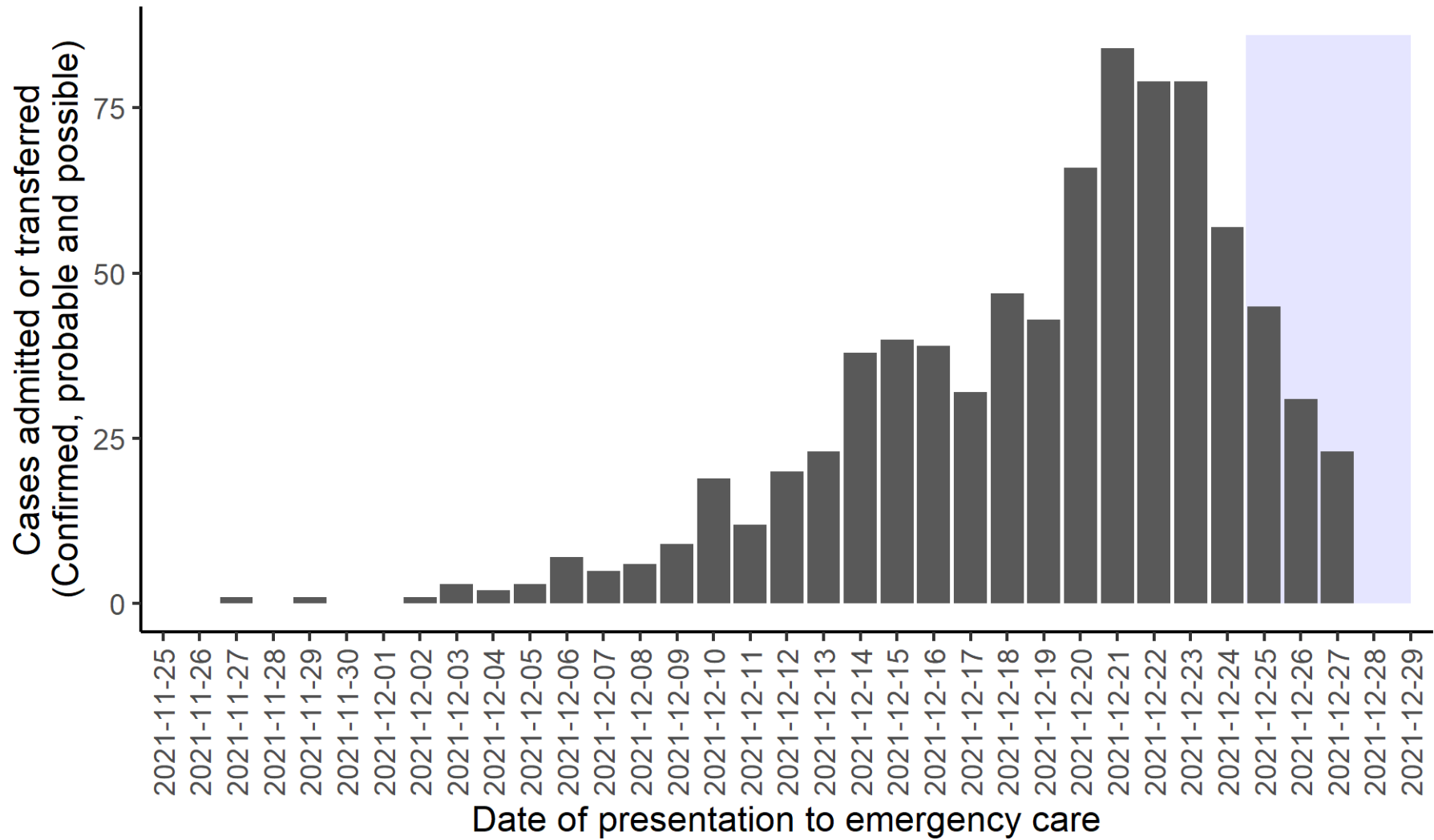
To monitor the severe outcomes of Omicron infections, Omicron cases are linked to NHS data on presentation to emergency care and to UKHSA data on deaths following confirmed COVID-19 test results. Hospitalisation was defined as attendance to emergency care which resulted in admission or transfer or died in emergency care, and the Omicron specimen date was between 14 days prior to attendance and one day after attendance.

Using data up until 29 December 2021, a total of 815 individuals with laboratory-confirmed (sequencing, genotyping or SGTF) Omicron have been admitted or transferred from emergency departments (Figure 1). Of these, 260 (31.9%) admissions were in London.

The age range of admitted individuals was 0 to 100 years (median: 45.5 years); 496 (60.9%) were aged 40 years or more; 30.8% were aged 70 years or more. 50% of Omicron hospitalisations occurred in people whose self-reported ethnicity was White (British) and 22% among people for whom the self-reported ethnicity is unknown or missing (Table 2).

A total of 57 people has been reported to have died within 28 days of an Omicron COVID-19 diagnosis up to 29 December 2021. The median time from Omicron specimen date to death was 5 days (range 0 to 14). The age of those dying ranged from 41 to 99 years.

**Figure 1. Omicron cases in England being admitted or transferred to hospital at the end of presentation to emergency care, as of 29 December 2021**



Shaded area indicates dates most likely to be affected by data lags.

**Table 2. Number of Omicron cases admitted or transferred to hospital at the end of presentation to emergency care by self-reported ethnicity, England. Data to 29 December 2021**

<b>Ethnicity</b>	<b>Count of cases</b>	<b>Percent (%)</b>
Asian Bangladeshi	4	0.5
Asian Indian	19	2.3
Asian other	15	1.8
Asian Pakistani	10	1.2
Black African	50	6.1
Black Caribbean	34	4.2
Black other	18	2.2
Mixed ethnicity	20	2.5
White British	409	50.2
White other	45	5.5
Other	7	0.9
Unknown	184	22.6

**Table 3. Number of Omicron cases admitted or transferred to hospital at the end of presentation to emergency care by vaccination status, England. Data to 29 December 2021**

<b>Vaccination status</b>	<b>Count (n)</b>	<b>Percentage (%)</b>
Unlinked*	18	2.2
Not vaccinated	206	25.3
Received one dose (1 to 20 days before specimen date)	1	0.1
Received one dose, $\geq 21$ days before specimen date	49	6.0
Second dose $\geq 14$ days before specimen date	352	43.2
Third dose or Booster $\geq 14$ days before specimen date	189	23.2

\* Individuals whose NHS numbers were unavailable to link to the National Immunisation Management System.

When interpreting Table 3 it should be understood that in a population with high vaccine coverage, the majority of cases will occur in vaccinated individuals. In comparison to the vaccination uptake in England there are higher proportions of cases in unvaccinated individuals and lower proportions who have received their third dose or booster. Vaccine effectiveness cannot be inferred from this table and vaccine effectiveness is described in section 3 below.

## Risk of hospitalisation in England

Assessment of the risk of hospital admission and emergency care attendance was undertaken by the University of Cambridge MRC Biostatistics Unit in collaboration with UKHSA. This assessment was based on a record linkage of sequenced or genotyped, probable and possible Omicron cases and Delta cases (COVID-19 cases with sequenced or genotyped variant or based on S-gene negativity/positivity) and used 528,176 Omicron cases and 573,012 Delta cases occurring between 22 November and 26 December 2021. A total of 3,019 Omicron cases



and 13,579 Delta cases were admitted or presented to emergency care within 14 days of specimen date.

Stratified Cox proportional hazard regression was used to assess that the risk of presentation to emergency care or hospital admission with Omicron was approximately half of that for Delta (Hazard Ratio 0.53, 95% Confidence Interval (CI): 0.50 to 0.57). The risk of hospital admission alone with Omicron was approximately one-third of that for Delta (Hazard Ratio 0.33, 95% CI: 0.30 to 0.37). These analyses stratified on date of specimen and area of residence and further adjusted for age, sex, ethnicity, local area deprivation, international travel, vaccination status and whether the current infection was an identified re-infection (that is the individual had a previous PCR positive test).

The risk of being admitted to hospital for Omicron cases was lower for those who had received 2 doses of a vaccine (65% lower) compared to those who had not received any vaccination (Table 4). The risk of being admitted to hospital for Omicron cases was lower still among those who had received 3 doses of vaccine (81% lower).

**Table 4: Adjusted hazard ratios (HR) for hospital admission within 14 days of positive test for a given variant (CI=Confidence interval)**

Vaccination status	Omicron HR (95% CI)	Delta HR (95% CI)
Unvaccinated/<28 days since first vaccine dose	1.00 (ref)	1.00 (ref)
≥28 days since first vaccine dose	1.02 (0.72-1.44)	0.42 (0.36-0.48)
≥14 days since second vaccine dose	0.35 (0.29-0.43)	0.18 (0.17-0.19)
≥14 days since third vaccine dose	0.19 (0.15-0.23)	0.15 (0.13-0.16)

These analyses were not adjusted for co-morbidities of the cases and, furthermore, they do not represent in hospital severity, which will take further time to assess. Despite adjusting for calendar date, there may still be reporting delays affecting the completeness of hospital events.

Preliminary sub-analyses estimated a lower risk of hospitalisation among Omicron cases in school-aged children (5 to 17 year olds) compared to Delta cases in the same age group (HR 0.42, 95% CI 0.28-0.63).

It is important to highlight that these lower risks do not necessarily imply reduced hospital burden over the current epidemic wave, given the higher growth rate and immune evasion observed with Omicron.

### 3. Vaccine effectiveness

A test negative case control design was used to estimate vaccine effectiveness (VE) against symptomatic COVID-19 with the Omicron variant compared to the Delta variant. Here vaccination rates in PCR positive cases are compared to vaccination rates in those who test negative. Individuals who reported symptoms and tested in pillar 2 (community testing) between 27 November and 24 December 2021 were included in the analysis. Those who reported recent foreign travel were excluded due to differences in exposure risk and possible misclassification of vaccination status in this group.

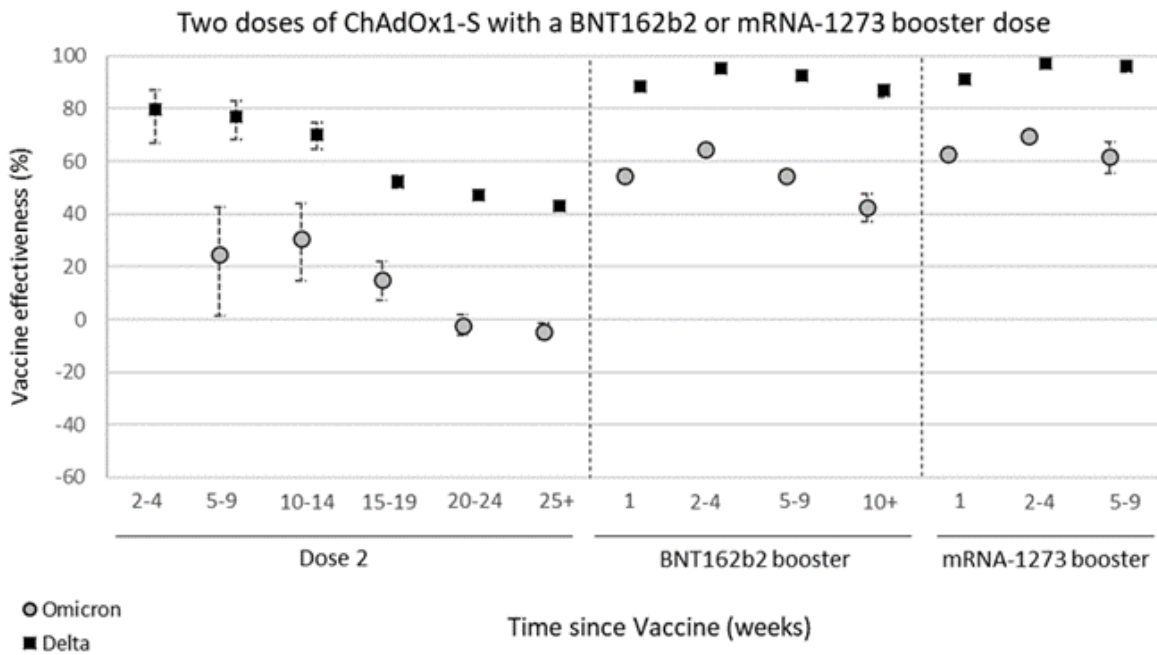
Cases were defined as the Omicron variant or Delta variant based on whole genome sequencing, genotyping, or S-gene target status on PCR testing. The Omicron variant has been associated with a negative S-gene target result on PCR testing with the Taqpath assay whereas with the Delta variant the S-gene target is almost always positive. Vaccine effectiveness was estimated by period after dose 2 and dose 3. Results are presented for 18+ year olds.

Pillar 2 symptomatic confirmed cases were then linked to the Emergency Care Dataset (ECDS) to identify admissions via emergency care 0 to 14 days after the positive test (excluding admissions due to injuries). Cox survival analysis was then used to estimate the risk of hospital admission by vaccination status. **Due to small numbers all vaccine brands are considered together.** Adjustments were made for age, gender, previous positive test, region, ethnicity, clinically extremely vulnerable status, risk group status and period. To estimate vaccine effectiveness against hospitalisation the odds ratios (OR) for symptomatic disease were multiplied by the hazard ratios (HR) for hospitalisation among symptomatic cases:  $VE_{\text{hospitalisation}} = 1 - (\text{OR}_{\text{symptomatic disease}} \times \text{HR}_{\text{hospitalisation}})$ .

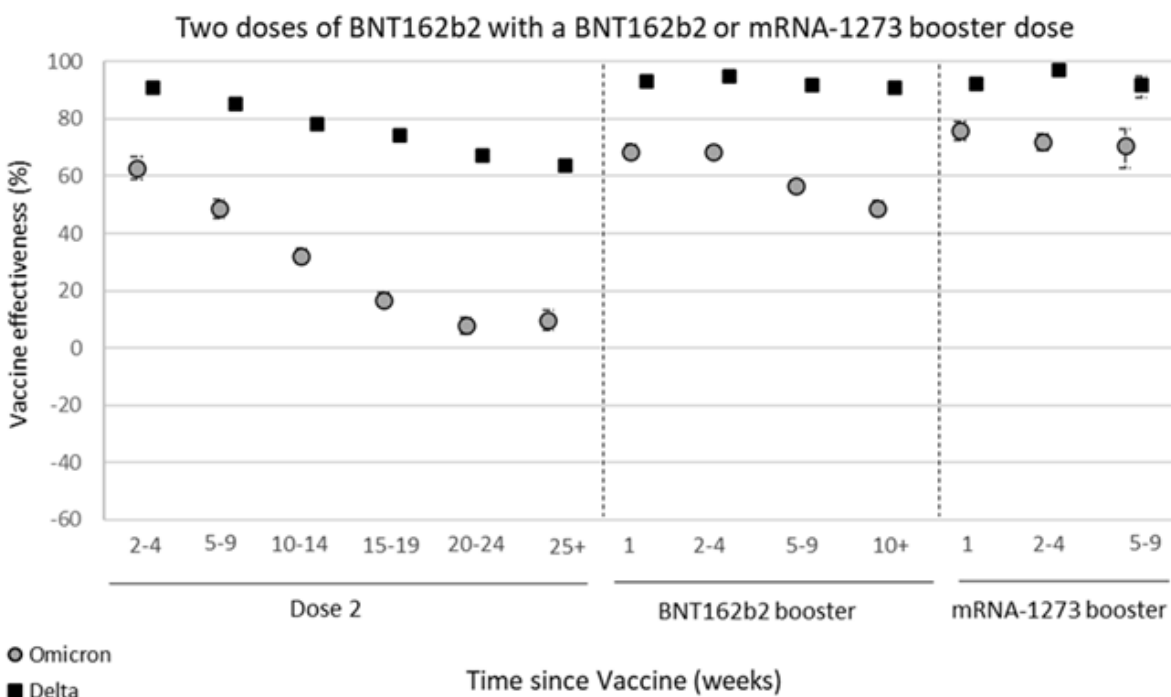
The symptomatic disease test negative case control analysis included 169,888 Delta cases and 204,036 Omicron cases. Vaccine effectiveness **against symptomatic disease by period after dose 2 and dose 3 is shown in Figure 2** for those who received a primary course of the AstraZeneca vaccine (Figure 2a), Pfizer (Figure 2b) or Moderna (Figure 2c). Effectiveness of booster doses of Pfizer and Moderna are shown for AstraZeneca and Pfizer primary courses. In all periods, effectiveness was lower for Omicron compared to Delta. Among those who had received **2 doses of AstraZeneca, there was no effect against Omicron from 20 weeks after the second dose.** Among those who had received **2 doses of Pfizer or Moderna effectiveness dropped from around 65 to 70% down to around 10% by 20 weeks after the second dose.** 2 to 4 weeks after a booster dose vaccine effectiveness ranged from around **65 to 75%, dropping to 55 to 70% at 5 to 9 weeks and 40 to 50% from 10+ weeks after the booster.**

**Figure 2: Vaccine effectiveness against symptomatic diseases by period after dose 1 and dose 2 for Delta (black squares) and Omicron (grey circles) for (A) recipients of 2 doses of AstraZeneca(ChAdOx1-S) vaccine as the primary course and Pfizer (BNT162b2) or Moderna (mRNA-1273) as a booster; (B) recipients of 2 doses of Pfizer vaccine as the primary course and Pfizer or Moderna as a booster, and (C) 2 doses of Moderna as a primary course (insufficient data for boosters after a Moderna primary course)**  
 Supplementary data is not available for this figure.

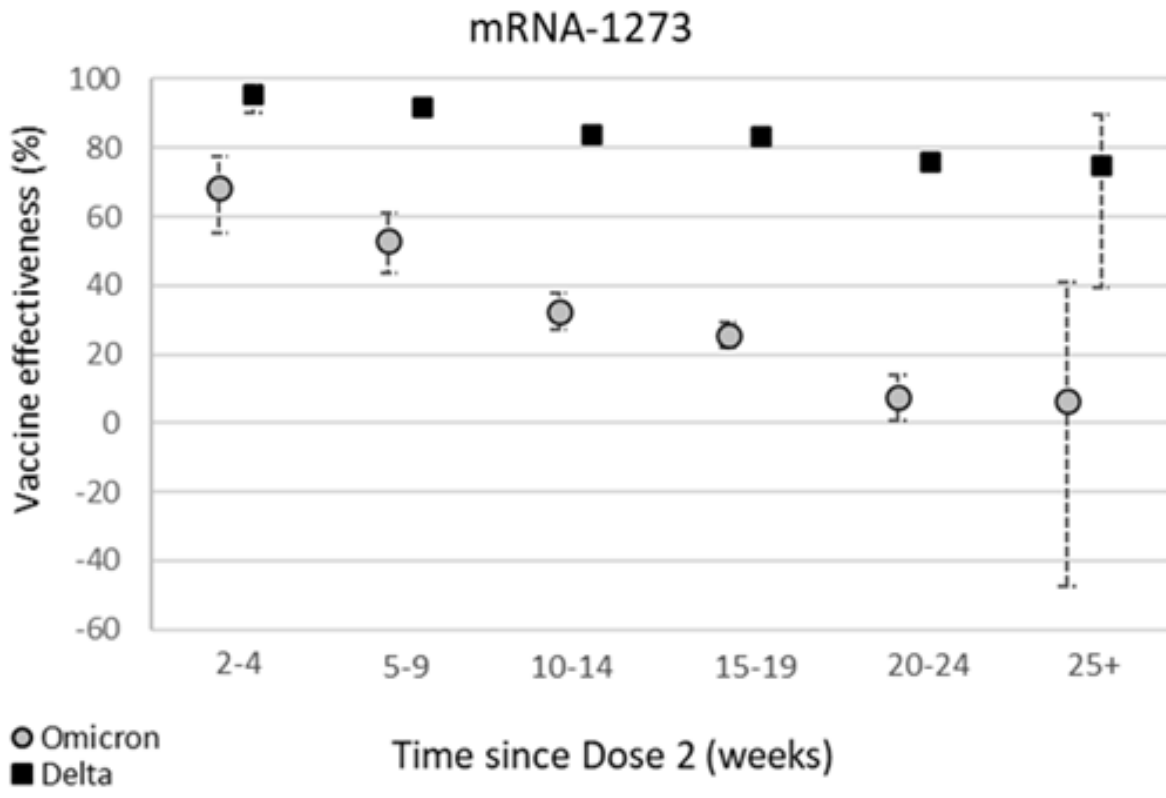
(A)



(B)



(C)



Results for hospitalisations are shown in Table 5 and Table 6. One dose of vaccine was associated with a 35% reduced risk of hospitalisation among symptomatic cases with the Omicron variant, 2 doses with a 67% reduction up to 24 weeks after the second dose and a 51% reduced risk 25 or more weeks after the second dose, and a third dose was associated with a 68% reduced risk of hospitalisation. When combined with vaccine effectiveness against symptomatic disease this was equivalent to vaccine effectiveness against hospitalisation of 52% after one dose, 72% 2 to 24 weeks after dose 2, 52% 25+ weeks after dose 2 and 88% 2+ weeks after a booster dose.

**Table 5: Hazard ratios (HR) against hospitalisation with Omicron and Delta (all brands combined) (CI=Confidence interval)**

Dose	Interval after dose	HR against hospitalisation (95% CI)	
		Omicron	Delta
1	4+ weeks	0.65 (0.30-1.42)	0.27 (0.2-0.37)
2	2-24 weeks	0.33 (0.21-0.55)	0.1 (0.09-0.13)
2	25+ weeks	0.49 (0.30-0.81)	0.15 (0.13-0.18)
3	2+ weeks	0.32 (0.18-0.58)	0.11 (0.09-0.14)

**Table 6: Vaccine effectiveness against hospitalisation for Omicron (all vaccine brands combined). OR = odds ratio, HR = hazard ratio, VE = vaccine effectiveness (CI=Confidence interval)**

<b>Dose</b>	<b>Interval after dose</b>	<b>OR against symptomatic disease (95% CI)</b>	<b>HR against hospitalisation (95% CI)</b>	<b>VE against hospitalisation (95% CI)</b>
1	4+ weeks	0.74 (0.70-0.77)	0.65 (0.30-1.42)	52% (-5-78)
2	2-24 weeks	0.82 (0.80-0.84)	0.33 (0.21-0.55)	72% (55-83)
2	25+ weeks	0.98 (0.95-1.00)	0.49 (0.30-0.81)	52% (21-71)
3	2+ weeks	0.37 (0.36-0.38)	0.32 (0.18-0.58)	88% (78-93)

These estimates suggest that vaccine effectiveness against symptomatic disease with the Omicron variant is significantly lower than compared to the Delta variant and wanes rapidly. Nevertheless, protection against hospitalisation is much greater than that against symptomatic disease, in particular after a booster dose, where vaccine effectiveness against hospitalisation is close to 90%. Further data is needed to estimate the duration of protection against hospitalisation. Experience with previous variants suggests that this will be sustained longer than protection against symptomatic disease.

# Sources and acknowledgments

## Data sources

Data used in this investigation is derived from the COG-UK and UKHSA genomic programme data set, the UKHSA Second Generation Surveillance System (SGSS), the Secondary Uses Service (SUS) data set, Emergency Care Data Set (ECDS), and the UKHSA Case and Incident Management System (CIMS).

## Repository of human and machine-readable genomic case definitions

Genomic definitions for all VOC and VUI are provided in order to facilitate standardised VOC and VUI calling across sequencing sites and bioinformatics pipelines and are the same definitions used internally at UKHSA. Definition files are provided in YAML format so are compatible with a range of computational platforms. The repository will be regularly updated. The genomic and biological profiles of VOC and VUI are also detailed on first description in prior technical briefings.

## Variant Technical Group

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- UKHSA Immunisations Team
- UKHSA Contact Tracing Data Team
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