UK Health Security Agency

COVID-19 vaccine surveillance report

Week 4

25 January 2024

Contents

Executive summary

Rigorous clinical trials have been undertaken to understand the immune response, safety profile, and efficacy of all COVID-19 vaccines approved for use in the UK as part of the regulatory process. Ongoing monitoring of the vaccines as they are rolled out in the population is important to continually ensure that clinical and public health guidance on the vaccination programme is built upon the best available evidence.

UK Health Security Agency (UKHSA), formerly Public Health England (PHE), works closely with the Medicines and Healthcare Regulatory Agency (MHRA), NHS England, and other government, devolved administration, and academic partners to monitor the COVID-19 vaccination programme. Details of the vaccine surveillance strategy are set on the page COVID-19: vaccine surveillance strategy (1). As with all vaccines, the safety of COVID-19 vaccines is continuously being monitored by the MHRA. They conclude that overall, the benefits of COVID-19 vaccines outweigh any potential risks (2).

This report contains updates on vaccine effectiveness, vaccination in pregnancy, and vaccine impact on the proportion of the population with antibodies to COVID-19.

Vaccine effectiveness

Vaccine effectiveness is estimated by comparing rates of disease (or positivity among those tested) in vaccinated individuals to rates in unvaccinated individuals. Below we outline the latest real-world evidence on vaccine effectiveness from studies in UK populations.

Effectiveness against symptomatic disease

Vaccine effectiveness against symptomatic COVID-19 has been assessed in England based on testing data linked to vaccination data from the National Immunisation Management System (NIMS) (3), cohort studies such as the COVID-19 Infection Survey, and GP electronic health record data .

Effectiveness against hospitalisation

Several studies have estimated vaccine effectiveness against hospitalisation, all of which indicate higher levels of protection against hospitalisation than symptomatic disease with all vaccines against the Alpha, Delta and Omicron variants (4 to 8). Given that Omicron generally causes milder disease than previous variants (9), in particular among younger individuals, an increasing proportion of individuals hospitalised with a positive COVID-19 test are likely to have COVID-19 as an incidental finding rather than the primary reason for admission (8).We therefore use strict definitions to define a COVID-19 hospitalisation – at least 2 days stay in the hospital and a respiratory code in the primary diagnostic field. There are likely still some incidental admissions in our data, in particular among younger adults.

Long term duration of protection of monovalent vaccines

All adults in the UK have been offered a primary course and a booster. The last booster offered to all adults was a dose of monovalent Moderna or Pfizer vaccine in autumn 2021. We estimated the duration of protection of the monovalent vaccines against hospitalisation in adults who have not received any further doses of bivalent boosters. We found protection is long-lasting, plateauing from around 6 months after the most recent dose with a modest level of protection observed even after 15 or more months. Amongst those aged 65 years and older, protection plateaued at around 50% after a year (10).

Effectiveness of Autumn 2022 bivalent boosters against XBB.1.5, CH.1.1 and BQ.1

Across all omicron variants the autumn 2022 bivalent booster vaccines gave an incremental effectiveness compared to at least 6 month waned protection of about 50% in the period 2-9 weeks post vaccination with some waning after this (10). Sub-lineages CH.1.1 and XBB.1.5 increased in prevalence in England in December 2022 and January 2023, respectively. To assess whether VE differed by these sub-lineages VE against hospitalisation for XBB.1.5, CH.1.1. and BQ.1 was estimated during a period of co-circulation between 5 December 2022 and 19 February 2023 (Table 1). During this period, BA.5 was not a prominent sub-lineage. Cases were classified based on sequencing information. Cases were classified as XBB.1.5 (V-23JAN-01), CH.1.1 (V-22DEC-01) or BQ.1 (V-22OCT-01) based on sequencing information. The effectiveness measured was the incremental effectiveness on top of at least 6 months of waned protection in those who had received at least 2 doses. VE of the bivalent BA.1 boosters given as part of the autumn 2022 booster programme was measured in addition to at least 6 months of waned protection. We did not find a significant difference in VE and these results provide reassuring evidence that the bivalent BA.1 booster vaccines provide similar protection against hospitalisation with BQ.1, CH.1.1 and XBB.1.5. (11).

Table 1. VE estimates against hospitalisation with XBB.1.5, CH.1.1 and BQ.1 for the bivalent boosters in those aged 50 years and older

Variant	Bivalent booster	Controls	Cases	VE (%)
XBB.1.5	None	48,099	338	Baseline
	2 to 4 weeks	3,374	6	Insufficient data
	5 to 9 weeks	20,700	20	52.7 (24.6 to 70.4)
	10 to 14 weeks	45,087	109	35.0 (18.1 to 48.4)
	15+ weeks	69,263	883	21.1 (9.6 to 31.1)
CH.1.1.	None	48,099	211	Baseline
	2 to 4 weeks	3,374	11	36.0 (-18.3 to 65.4)
	5 to 9 weeks	20,700	80	29.7 (7.5 to 46.6)
	10 to 14 weeks	45,087	214	28.3 (12.2 to 41.5)
	15+ weeks	69,263	348	24.5 (8.6 to 37.7)
BQ.1	None	48,099	509	Baseline
	2 to 4 weeks	3,374	22	66.7 (48.7 to 78.4)
	5 to 9 weeks	20,700	218	48.0 (38.5 to 56.0)
	10 to 14 weeks	45,087	495	41.1 (32.8 to 48.3)
	15+ weeks	69,263	394	30.5 (18.7 to 40.6)

Effectiveness of the spring 2023 booster

Booster vaccines with either the Sanofi/GSK AS03-adjuvanted monovalent beta variant (VidPrevtyn Beta) booster vaccine, the Pfizer-BioNTech mRNA (Comirnaty Original/Omicron BA.4-5) bivalent vaccine and the Moderna mRNA (Spikevax bivalent Original/Omicron BA.4-5) bivalent vaccine were offered to all adults aged 75 years and older, and immunosuppressed individuals as part of the spring booster vaccination programme in England. VE of the Sanofi/GSK and Pfizer BA.4-5 boosters was estimated against hospitalisation amongst those aged 75 years and older. The effectiveness measured was the incremental effectiveness on top of at least 3 months of waned protection. VE against hospitalisation for both manufacturers peaked at about 50% and there was no significant difference between manufacturers (12). The full analysis is available in earlier editions of the report.

Effectiveness of the autumn 2023 booster

An autumn booster programme was recommended by the JCVI for adults aged 65 years and older, as well as those in a clinical risk group, care home staff and residents, frontline health and social care workers, carers and household contacts of people with immunosuppression. Vaccinations began 11 September 2023, with the most at risk (adult care home residents and people who are immunosuppressed) prioritised for vaccination. The products offered were bivalent Original/Omicron BA.4-5 vaccine (Pfizer-BioNTech) and monovalent XBB vaccine (Pfizer-BioNTech and Moderna). The bivalent BA.4-5 boosters were rolled out first, followed by the XBB boosters.

Relative VE was estimated against hospitalisation amongst those aged 65 years and older against all Omicron sub-lineages in circulation between 4 September 2023 and 17 December 2023 (Table 2). Only individuals who had previously received at least 2 doses before their autumn booster and whose last dose was given at least 12 weeks prior were included. The effectiveness measured is therefore incremental effectiveness on top of at least 12 weeks of waned protection.

Incremental effectiveness against hospitalisation for both booster vaccines peaked at about 50%; 45.4% and 55.4% for the bivalent BA.4-5 boosters and monovalent XBB boosters, respectively (Table 2). Confidence intervals overlapped so the difference in the VE point estimates was not statistically significant. There was some evidence of waning with a reduction to about 34% at 10 weeks post vaccination for the bivalent BA.4-5 doses. We do not yet have sufficient data to estimate VE at this time point for the XBB doses.

Table 2. Vaccine effectiveness (VE) against hospitalisation amongst those aged 65 years and older in England, stratified by autumn booster manufacturer

Autumn booster [Note 1]	Interval	Controls	Cases	VE (95% C.I.)
No booster	-	7,536	3,469	Baseline
Pfizer BA.4-5	9 to 13 days	211	61	44.9 (25.7 to 59.2)
	2 to 4 weeks	974	227	45.4 (35.3 to 53.9)
	5 to 9 weeks	1,323	195	43.8 (32.5 to 53.1)
	10+ weeks	281	58	34.2 (8.1 to 52.8)
Pfizer XBB	9 to 13 days	220	51	42.3 (20.5 to 58.2)
	2 to 4 weeks	937	127	55.4 (45 to 63.8)
	5 to 9 weeks	752	103	50.9 (37.5 to 61.5)
	10+ weeks	23	1	Insufficient data

Note 1. All individuals had received a bivalent BA.1 booster vaccine as part of the autumn 2022 booster programme, and their last dose was at least 3 months prior to their test. Due to insufficient data, Moderna is not included.

Effectiveness against mortality (vaccines given prior to the autumn 2022 bivalent boosters)

Vaccine effectiveness against mortality with the Omicron variant (all sub-lineages using tests taken until 5 September 2022) has been estimated for those aged 65 years and older using a test-negative case control study design (all vaccines combined) (Table 3). At 40-plus weeks following the second dose, vaccine effectiveness was around 50%. At 2 or more weeks following the third and fourth dose vaccination, effectiveness was boosted to 85.0% and 80.9%, respectively. At 40 or more weeks after a third dose VE waned to 56.9% while at 20 or more weeks after a fourth dose (spring 2022 booster) VE waned to 68.2%. This analysis is also likely to include some incidental deaths of individuals who died with COVID-19 as opposed to from COVID-19, and therefore, we suspect the true VE against mortality is likely higher than the estimates presented here.

Table 3. Vaccine effectiveness against mortality in those aged 65 years and older (all vaccine brands combined) (VE = vaccine effectiveness, CI = confidence intervals)

Dose	Interval after dose (weeks)	VE (95% CI)
2	40+	49.7 (41.5 to 56.7)
3	2 to 4	85.0 (80.8 to 88.2)
	5 to 9	83.1 (80.3 to 85.5)
	10 to 14	79.5 (76.6 to 82.0)
	15 to 19	75.6 (72.3 to 78.6)
	20 to 24	68.8 (64.3 to 72.7)
	25 to 39	62.6 (57.4 to 67.2)
	40+	56.9 (43.1 to 67.4)
4	2 to 4	80.9 (76.8 to 84.3)
	5 to 9	79.5 (75.8 to 82.7)
	10 to 14	71.2 (66.2 to 75.5)
	15 to 19	68.2 (61.2 to 73.9)
	20+	68.2 (58.4 to 75.7)

Consensus vaccine effectiveness estimates

These estimates are from an expert group convened by UKHSA to assess the literature on vaccine effectiveness.

Table 4. Consensus estimates of relative vaccine effectiveness against BA.4, BA.5, BQ.1 and CH1.1 Omicron for a booster dose of COVID-19 vaccine compared to 6+ months since the last dose (at least 2 doses)

Vaccine product of booster dose	Outcome	0 to 1 months	2 to 3 months	4 to 6 months	6+ months	Consensus narrative
Monovalent*	**All infection****	30% (20-40%)	20% (10-30%)	10% (0-20%)	0% (0-5%)	Post 4th dose estimates appear similar to post 3 dose estimates for the same time period, restoring VE to similar levels provided by the first booster dose (pre waning). VE estimates may differ depending on whether individuals have had a prior infection. Some studies suggest VE estimates may be slightly higher against Omicron BA.1/BA.2 compared to Omicron BA.4/BA.5.
Monovalent*	**Symptomatic****	40% (30-50%)	40% (30-50%)	10% (0-20%)	Insufficient data	Post 4th dose estimates appear similar to post 3 dose estimates for the same time period, restoring VE to similar levels provided by the first booster dose (pre waning). VE estimates may differ depending on whether individuals have had a prior infection.
Monovalent*	**Hospitalisation**	55% (40-65%)	45% (30-55%)	20% (15-25%)	0% (0-5%)	These estimates are based on UKHSA test negative case control using SUS data on hospitalisations in age 75+ with 2+ days stay and respiratory coded and other published studies covering autumn 2023. Note: As absolute VE had waned to about 70% at 6+ months post dose 3, a relative VE of 50% would increase this back to an absolute VE of 85% compared to unvaccinated. Some studies suggest VE estimates against hospitalisation are similar for BA.2 versus BA.4/BA.5.
Monovalent*	**Mortality**	Insufficient data	Insufficient data	Insufficient data	Insufficient data	
Bivalent*	**All infection****	30% (20-40%)	20% (10-30%)	10% (0-20%)	0% (0-5%)	Estimates for the BA.1/BA.2 bivalent booster are not too different from what is being seen with BA.4/BA.5 bivalent boosters.
Bivalent*	**Symptomatic****	40% (30-50%)	40% (30-50%)	10% (0-20%)	Insufficient data	
Bivalent*	**Hospitalisation**	55% (40-65%)	45% (30-55%)	30% (20-60%)	Insufficient data	Estimates for the BA.1/BA.2 bivalent booster are not too different from what is being seen with BA.4/BA.5 bivalent boosters. There is some evidence that VE against hospitalisation is slightly lower against CH1.1 compared to BA.4/BA.5.
Bivalent*	**Mortality**	60% (20-80%)	55% (20-75%)	35% (10-75%)	Insufficient data	

The table presents estimates of VE compared to 6+ months since last dose (at least 2 doses) (estimates agreed by the vaccine expert panel)
* Refers to either Pfizer or Moderna
** Estimates were not stratified according to monovalent or bivalent

High confidence	Evidence from multiple studies which is consistent and comprehensive.
Medium confidence	Evidence is emerging from a limited number of studies or with a moderate level of uncertainty.
Low confidence	Little evidence is available, and results are inconclusive.

Table 5. Consensus estimates of relative vaccine effectiveness against XBB Omicron for a booster dose of COVID-19 vaccine compared to 3+ months since autumn 2022 booster

Vaccine product of booster dose	Outcome	0 to 1 months	2 to 3 months	4 to 6 months	6+ months	Consensus narrative
SP-Monovalent	**Hospitalisation**	45% (30-65%)	30% (10-45%)	Insufficient data	Insufficient data	
Pfizer BA4/5 Bivalent	**Hospitalisation**	45% (30-65%)	30% (10-45%)	Insufficient data	Insufficient data	

High confidence	Evidence from multiple studies which is consistent and comprehensive.
Medium confidence	Evidence is emerging from a limited number of studies or with a moderate level of uncertainty.
Low confidence	Little evidence is available, and results are inconclusive.

Vaccine effectiveness publications

UKHSA and collaborators have published a significant amount of research into vaccine effectiveness. Further results and details of methods used can be accessed at the Monitoring reports of the effectiveness of COVID-19 vaccination page.

Population impact

Vaccines typically have both direct effects on those who are vaccinated and indirect effects on the wider population due to a reduced probability that people will come into contact with an infected individual. The overall impact of the vaccination programme may therefore extend beyond that estimated through vaccine effectiveness analysis alone.

Estimating the impact of a vaccination programme is challenging as there is no completely unaffected control group. Furthermore, the effects of the vaccination programme need to be differentiated from that of other interventions (for example lockdowns or outbreak control measures), changes in behaviour and any seasonal variation in COVID-19 activity.

UKHSA and other government and academic partners monitor the impact of the vaccination programme on levels of COVID-19 antibodies in the population and different disease indicators, including hospitalisations and mortality. This is done through population-based testing and through modelling which combines vaccine coverage rates in different populations, estimates of vaccine effectiveness and disease surveillance indicators.

Estimation of hospitalisations averted from the autumn 2022 bivalent booster programme

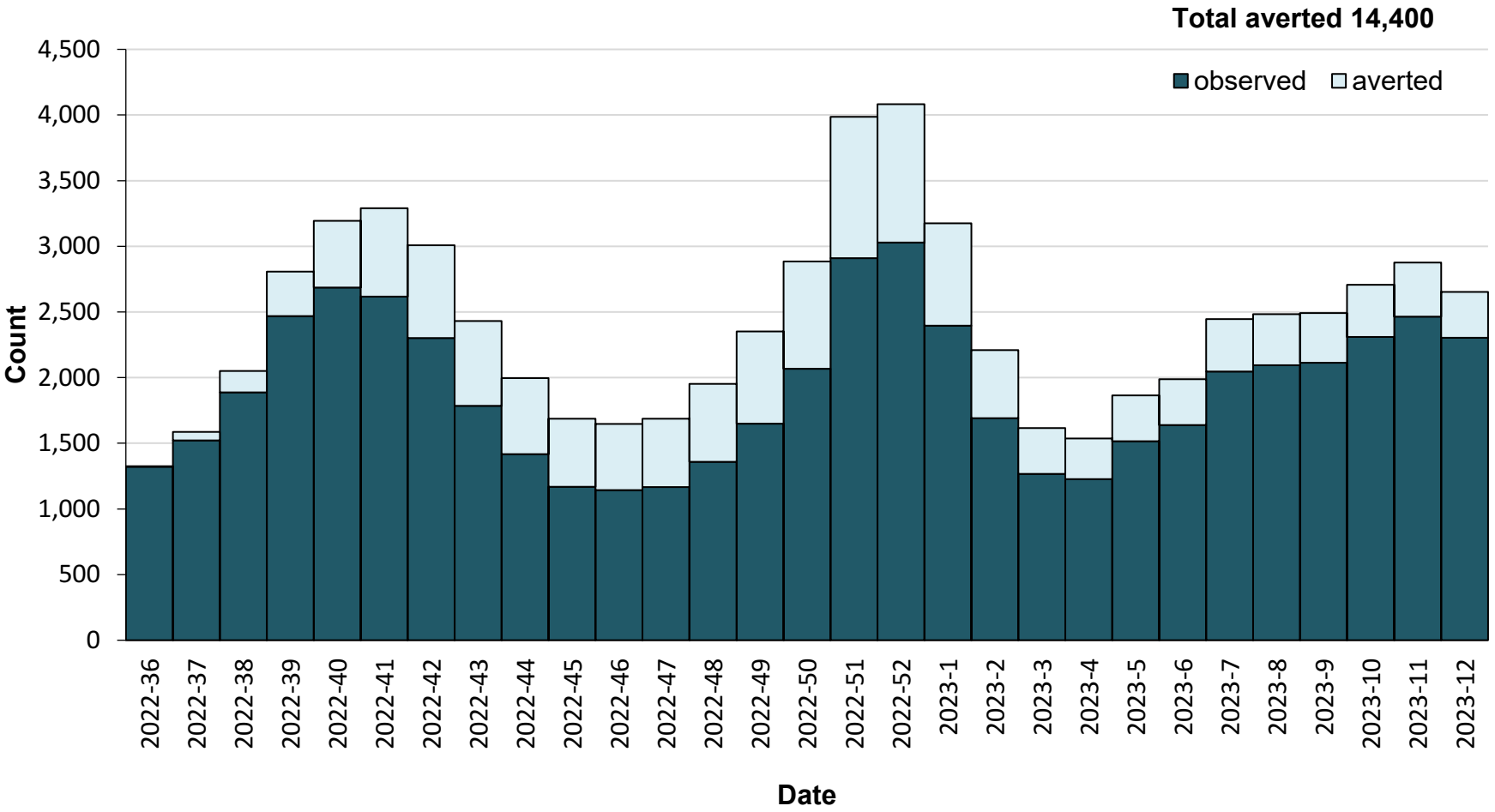
The autumn 2022 vaccination programme was offered to all adults aged 50 years and older as well as those aged 5 to 49 years in clinical risk groups and frontline health and social care workers (JCVI statement on the COVID-19 booster vaccination programme for autumn 2022: update 3 September 2022). The main vaccines used during this programme were bivalent ancestral/Omicron BA.1 mRNA vaccines. The number of hospitalisations averted in those aged 50 years and over during the autumn 2022 COVID-19 vaccine booster campaign was estimated by considering: (a) vaccine effectiveness against hospitalisation of the booster doses from this period and how it wanes (1) (b) vaccine coverage, and (c) observed hospitalisations. Hospitalisations were defined as admissions with a respiratory code in the primary diagnosis field which were associated with a positive COVID-19 test or as admissions where COVID-19 was the primary diagnosis using hospital admission data from the secondary uses service (SUS).

The relative vaccine effectiveness (rVE) of receiving a bivalent BA.1 booster vaccine in addition to at least 2 doses of a prior monovalent vaccine was used in the calculation. This was taken to be 40%, 50%, 40%, 30%, 20%, 20%, 10% in months 1 to 7 after vaccination, respectively, to allow for waning following a peak in the second month, which has been seen following booster doses (10). Coverage by the end of the 2022 varied from 45% for those aged 50 to 54 to 82% for those aged 70 to 74.

In each week the impact of vaccination was calculated as the cumulative coverage in that week multiplied by the estimated effectiveness for that week. For example, 70% uptake and 30% effectiveness gives an estimated 21% reduction. The expected number of hospitalisations in the absence of vaccination is then calculated as observed divided by 1 minus the reduction (for example 1 - 0.28) and the averted as expected minus observed. This was done across 5-year age bands and across weeks 36 of 2022 to 12 of 2023 and then summed to get an overall estimate.

Figure 1 shows the observed and estimated averted hospitalisations by week. In total an estimated 14,400 hospitalisations were averted in adults aged 50 years and older in England as a result of the vaccination in the autumn 2022 COVID-19 vaccine booster programme. Note that this calculation is a direct calculation and does not include any additional cases prevented from herd immunity. It also does not include cases averted where COVID-19 exacerbated a non-respiratory condition that led to hospitalisation.

Figure 1. Observed COVID-19 hospitalisation and the estimated number averted from vaccination by week autumn to winter 2022 to 2023, aged 50+



Vaccination in pregnancy

Pregnant women have been included in the groups of people at greatest risk of severe COVID-19 illness advised by the Joint Committee on Vaccination and Immunisation (JCVI) to have a dose of COVID-19 vaccine in autumn 2023. Vaccination of pregnant women is strongly recommended by the Royal College of Obstetricians and Gynaecologists and the Royal College of Midwives.

Increased severity of COVID-19 disease in pregnant and recently pregnant women was reported after the first SARS-CoV-2 wave in England (13, 14,) and Scotland (15, 16) when Alpha and Delta variants were dominant. The disease is generally reported to be milder during the Omicron variant era with reduced risk of complications in pregnant women when compared to the Delta period (17, 18). The risks of some adverse outcomes were found to be lower for COVID-19 Omicron disease at delivery than Alpha or Delta but still raised compared to pregnant women without COVID-19 disease in a more recent study in the USA (19). When the Omicron variant emerged it was associated with higher rates of infection in pregnant women when compared to Delta (18) and led to intensive care admission, particularly in those who remain unvaccinated (20). Pregnant women who develop severe disease have been found to have increased rates of maternal admission to critical care or death, venous thromboembolism, pre-term delivery and very pre-term delivery due to medical intervention (21).

From 16 April 2021, the JCVI advised that pregnant women be offered COVID-19 vaccines at the same time as people of the same age or risk group (22). Therefore, any pregnant women not in a high-risk group would likely have received their first dose in mid-April 2021 as part of the general adult population programme in those aged under 50 years which was offered by decreasing age group (22). As part of the ongoing review of the programme, the JCVI met on 2 December 2021 and considered further data on the severity of SARS-CoV-2 infection in pregnant women and their pregnancies together with data on vaccine safety. As a result, pregnant women were added to the UK's priority COVID-19 vaccine list (23). The booster dose made available to all individuals with severe immunosuppression from September 2021 and then extended to all eligible adults in England from 30 November 2021, was important to confer high levels of protection against Omicron strains (see report section vaccine effectiveness). Pregnant women were included as one of the priority groups to be offered the autumn 2022 COVID-19 booster dose using the Pfizer-BioNTech and Moderna bivalent vaccines.

There is evidence of high levels of protection against SARS-CoV-2 infection in pregnant women after COVID-19 vaccination (24 to 27) and evidence that vaccination induces higher antibody levels than after disease (27). There is also evidence from studies in England and the USA that 2 doses of mRNA COVID-19 vaccination during pregnancy might help prevent COVID-19 hospitalisations in young infants under 6 months of age (28) with increased protection observed after a booster dose (29). Between February and September 2021, 0.4% of 1,714 pregnant women with COVID-19 symptoms who required hospital treatment in the UK had received 2 doses of COVID-19 vaccine and, of 235 pregnant women who were admitted to intensive care

with COVID-19 disease in that period, none had received 2 doses of vaccine (30). Similar findings have been reported from Scotland with the report that 90.9% (748 out of 823; 95% CI 88.7 to 92.7) of SARS-CoV-2 associated with hospital admissions, 98% (102 out of 104; 95% CI 92.5 to 99.7) of SARS-CoV-2 associated with critical care admission and all baby deaths, occurred in pregnant women who were unvaccinated at the time of their COVID-19 diagnosis (16, 31). The researchers also found a higher extended perinatal mortality rate for women who gave birth within 28 days of a COVID-19 diagnosis compared to rates across the pandemic period and in women vaccinated and going on to give birth within 28 days.

COVID-19 vaccines used in the UK programme do not contain live SARS-CoV-2 virus and therefore cannot infect a pregnant woman or her unborn child with the virus. Whilst as is commonly the case in trials of medicinal products, pregnant women were excluded from the original COVID-19 vaccine trials, there is accumulating experience and evidence of the safe and effective use of mRNA vaccines (such as the Pfizer-BioNTech or Moderna) in pregnant women. In Scotland, the COVID-19 vaccine had been administered to more than 30,000 pregnant women by the end of March 2022 (32). In the USA data collected by the US Centre for Disease Control indicated that around 71% of pregnant people were fully vaccinated before or during pregnancy in the week ending 20 August 2022 (33).

No safety concerns relating to COVID-19 vaccination of pregnant women have been found in published studies to date (21, 33 to 38). The rate of vaccine side effects appears to be similar in pregnant and non-pregnant populations (33). Studies from Norway, the USA and Scotland have found no association between COVID-19 vaccination and the risk of miscarriage (35 to 38).

Findings continue to be provisional and are not directly comparable between reports as data is updated through the complete period under consideration. This section of the report summarises data on coverage of the 2022 autumn boost, published in the COVID-19 vaccine surveillance report in week 41 of 2023, and additionally the coverage for women who had received a bivalent vaccine after August 2023 and before they gave birth in September or October 2023. An Autumn dose was recommended to those at higher risk of severe COVID-19 disease in the population who had not been boosted for at least 3 months, including pregnant women. Autumn vaccination of pregnant women began in September 2023.

Vaccine coverage

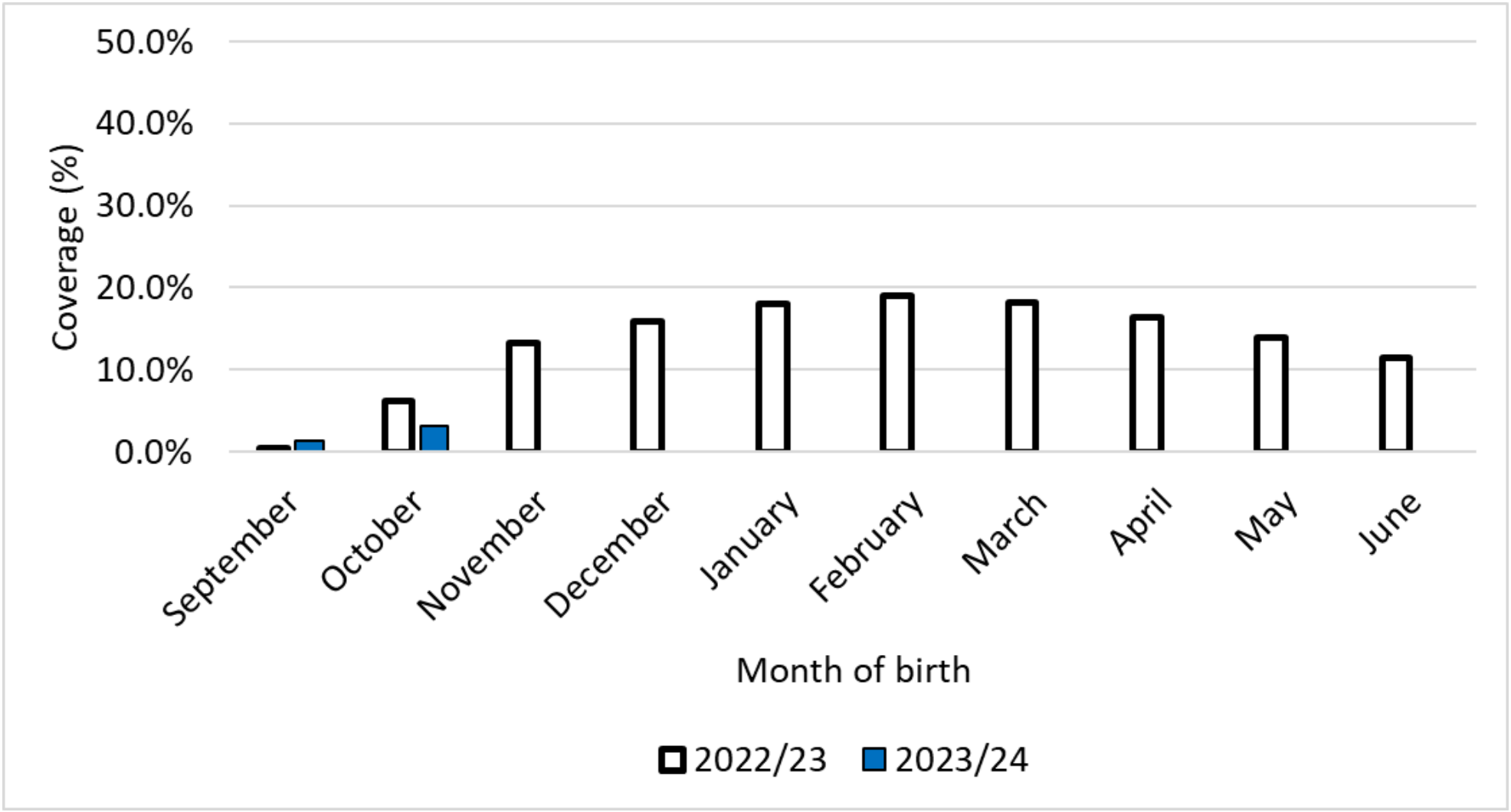
Please see COVID-19 vaccine quarterly surveillance reports (September 2021 to June 2023) – GOV.UK (www.gov.uk) for previously published data. By October 2022 most first, second and third doses of vaccine given to women who gave birth were administered before the start of their pregnancy.

Based on data for women who gave birth and could be linked to their vaccination records extracted in October 2023, a small proportion of women who gave birth in September (0.5%) 2022 had received an autumn dose prior to delivery, rising to 18.1% in January 2023 and peaking at 19.0% in February 2023 (Figure 2). Only 13.1% of women had received the autumn

2022 dose before giving birth between September 2022 and June 2023. A very small proportion of women (1.3% in the 10-month period) received the autumn 2022 boost after they gave birth, 25.5% of women who gave birth had not received any doses of COVID-19 vaccine.

Early Autumn 2023 COVID-19 vaccine coverage for women who gave birth in September or October 2023 suggests similar levels with 1.3% and 3.2% uptake respectively (Figure 2). In this 2-month period 26.6% of women had not had any doses of COVID-19 vaccine at any time before they gave birth.

Figure 2. Figure 1. Autumn 2022 COVID-19 vaccine dose coverage in pregnancy in women who gave birth between September 2022 and June 2023 and Autumn 2023 dose coverage in pregnancy in women who gave birth between September 2023 and October 2023



Methods

Please see earlier reports for methods to generate data on women who gave birth between September 2022 to June 2023.

Data on COVID-19 vaccination status together with details of each vaccine administered is recorded in a central data set called the IIS (previously NIMS)[1]. In addition, NHS Digital manages the Hospital Episode Statistics (HES) data sets, containing information about hospital activity in England.

Records of women giving birth ('delivery records') in the months between 1 September 2023 and 31 October 2023 were identified in HES. De-duplication of delivery records resulted in a data set of women who had given birth, identified by her NHS Number, and the latest 'delivery episode' associated with her. An 'earliest' and 'latest' likely pregnancy start date were assigned to each woman's record, using the known delivery date and further information from her record, where available:

1. Where a valid gestational age was recorded (GESTAT_1 between 24 and 42), the woman's earliest pregnancy start date was calculated by taking the number of weeks away from the delivery date and then calculating an additional earlier week, to account for GESTAT_1 recording completed weeks of pregnancy. In a similar way, the latest pregnancy start date was calculated by taking the number of weeks of GESTAT_1 away from the delivery date.

2. Where no valid GESTAT_1 was available, the first 12 diagnostic codes were examined to identify any with a code suggesting delivery at term (O60.2). In this case, the gestational age at delivery was assumed to be between 37 and 42 completed weeks of pregnancy, and a similar method was used to establish the earliest and latest pregnancy start dates.

3. Where no valid GESTAT_1 was available and there were no codes suggesting term delivery, the first 12 diagnosis codes were examined to identify any suggesting pre-term delivery (O60.1 or O60.3). In this case, the gestational age at delivery was assumed to be between 24 and 36 completed weeks of pregnancy, and these values were used to establish the earliest and latest pregnancy start dates.

4. In the absence of any additional information in the woman's record (or in conflicting cases where diagnostic codes suggesting both term and pre-term delivery appeared in the same record), the gestational age at delivery was assumed to be between 24 and 42 completed weeks of pregnancy, and these values were used to establish earliest and latest pregnancy start dates.

Each woman's delivery record was linked to her record(s) in the IIS using the NHS Number, establishing her vaccine status as either having had one or more doses before delivery

[1] IIS Data controllers are NHSEI and NHSD.

(including any prior to becoming pregnant) or not having had any doses of the vaccine prior to giving birth, using the IIS vaccine records. For a woman to be identified as having had the autumn booster dose bivalent vaccine was recorded in IIS on or after 1 September 2023 to 31 October 2023.

For each vaccine dose in the 2023 autumn dose period the woman was known to have received, the following information was ascertained:

Dose administered pre-pregnancy	Dose administered before the earliest pregnancy start date
Dose administered in pregnancy	Dose administered after the latest pregnancy start date and before the delivery date
Dose administered post-pregnancy	Dose administered on or after the delivery date based on IIS records extracted on 17 January 2024
Dose in pregnancy: unknown	Dose administered around the start of pregnancy: after the earliest pregnancy start date and before the latest pregnancy start date
Unvaccinated	No vaccine records exist for the woman, based on the NHS number

The ethnicity, residence and age information when used was taken from the IIS record. The analysis within this section was carried out on 17 January 2024. The latest HES data available was for October 2023, and all HES data since April 2023 is considered provisional.

Interpretation and limitations

There are recognised limitations of the data sets including the level of completeness of the relevant fields. HES birth data was used to monitor coverage and found similar very low levels of uptake in women who gave birth in the first 2 months of the programme. Further breakdown of these data by age, ethnicity and deprivation scores will be undertaken when more eligible women have given birth, but previous reports have shown increasing uptake with increasing age and in more affluent populations with differences by broad ethnic categories showing white women have the highest coverage.

Main findings

COVID-19 vaccination is the safest and most effective way for women to protect themselves and their pregnancies against severe COVID-19 disease. The JCVI has advised that women who are pregnant are in a clinical risk group within the COVID-19 autumn vaccine programmes. Unvaccinated women who became pregnant were strongly encouraged to come forward for vaccination during the autumn 2022 booster programme. Women who were pregnant and had previously been vaccinated were offered a booster dose (Joint Committee on Vaccination and Immunisation (JCVI) updated statement on the COVID-19 vaccination programme for autumn

2022). Pregnancy is a risk category that has been included by the JCVI for the autumn 2023 COVID-19 vaccine dose. Only 2.3% of women who gave birth had received the autumn 23 COVID-19 vaccine in the first 2 months of the offer.

Vaccine impact on proportion of population with antibodies to COVID-19

Seroprevalence

The results from testing samples provided by healthy adult blood donors aged 17 years and older, supplied by the NHS Blood and Transplant (NHS BT collection) between weeks 35 2020 and week 52 2023 are summarised. As of week 44 2020, approximately 250 samples from each geographic NHS region are tested each week.

The COVID-19 vaccination campaign began on 8 December 2020 (week 50) with a phased roll out by age and risk group. Booster doses have been offered from the beginning of September 2021. Booster doses are typically offered in spring and autumn to populations in risk groups. A spring 2023 booster was introduced from 3 April 2023 for adults aged 75 years and older, older adults in care homes and immunosuppressed individuals aged 5 years and older. The offer of the spring 2023 booster was available until the end June 2023 and was offered at least 3 months after the last dose. The 2023 autumn booster programme began in September 2023 for adults aged 65 and older, people in clinical risk groups, older adults in care homes, health and social care workers and individuals who live closely with or are carers for clinically vulnerable people. We intend to monitor the programme and its impact on seroprevalence in the coming months.

Please note that this section will be updated quarterly. This update was published on 25 January 2024.

Seroprevalence in blood donors aged 17 years and older

The results presented here are based on testing samples with Roche nucleoprotein (N) and Roche spike (S) antibody assays.

Nucleoprotein (Roche N) assays only detect post-infection antibodies, whereas spike (Roche S) assays will detect both post-infection antibodies and vaccine-induced antibodies. Thus, changes in seropositivity for the Roche N assay reflect the effect of natural infection. Increases in seropositivity as measured by S antibody reflect both infection and vaccination. Antibody responses to both targets reflect infection or vaccination occurring at least 2 to 3 weeks previously given the time taken to generate a COVID-19 antibody response. Currently donors are asked to defer donations for at least 48 hours post vaccination (previously 7 days), and for

at least 7 days following resolution of any COVID-19 symptoms (previously 28 days, changes were implemented during January 2022).

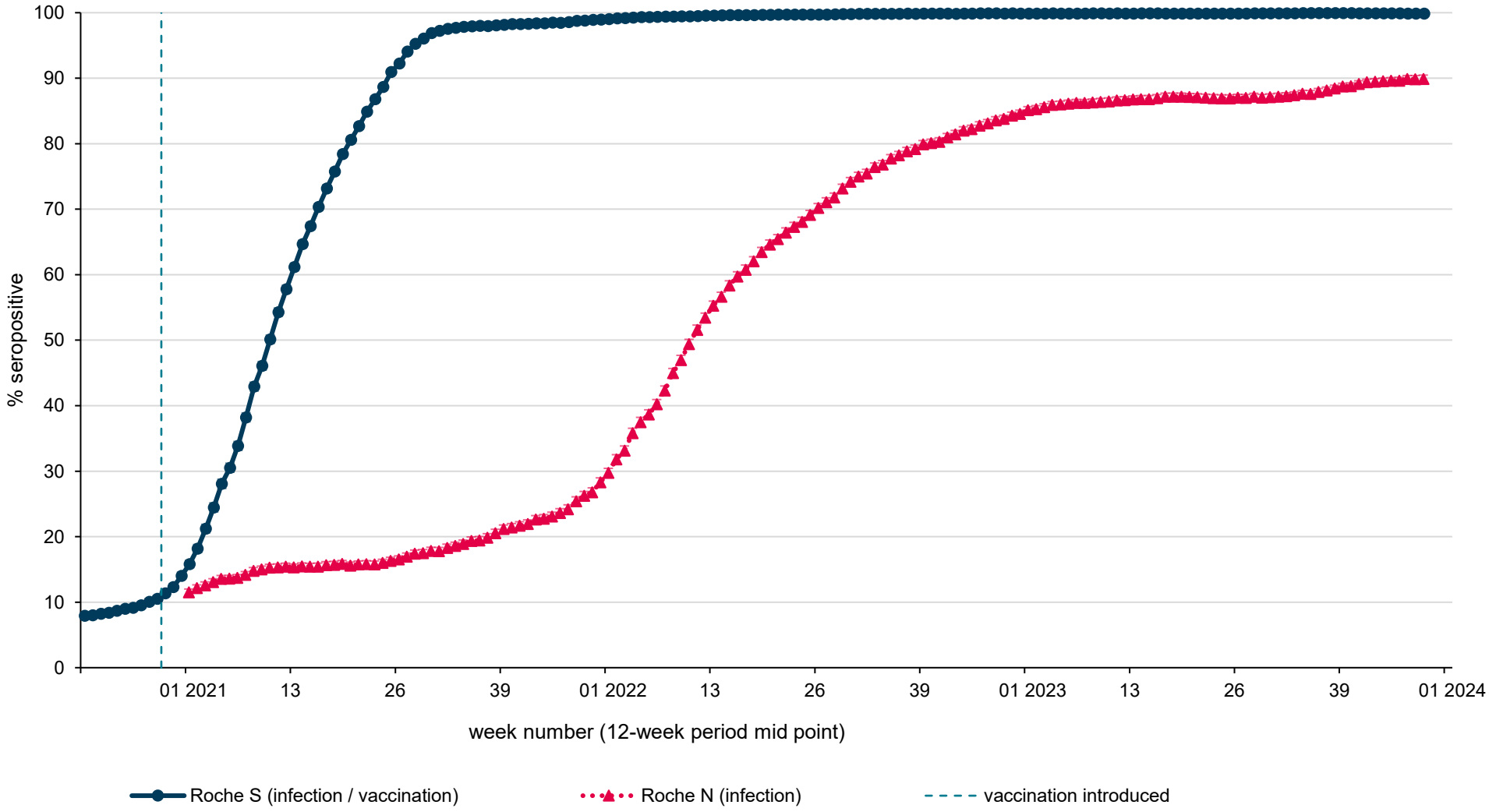
This report presents Roche N and Roche S seropositivity estimates on the same set of samples, using a 12-week rolling prevalence for national, age group and regional estimates. Seropositivity estimates are plotted using the mid-point of a 12-weekly rolling period that reduces to 8 weeks in the most recent weeks to allow for a more representative current estimate of seropositivity. However, this also means the data will reflect seroprevalence several weeks previously. Seroprevalence estimates reported are based on seropositivity which are unadjusted for the sensitivity and specificity of the assays used.

National prevalence

Overall population weighted (by age group, sex and NHS region) antibody prevalence among blood donors aged 17 years and older in England was 89.9% (95% CI 89.3% to 90.5%) using the Roche N assay and 99.9% (95% CI 99.7% to 99.9%) using the Roche S assay for the period 8 November to 31 December 2023 (week 45 to week 52 2023). 10,754 out of 12,009 were Roche N positive and 11,880 out of 11,893 samples were Roche S positive. This compares with 88.2% (95% CI 87.6% to 88.6%) Roche N seropositivity and 99.9% (95% CI 99.9% to 100%) Roche S seropositivity for the period of 16 August to 5 November 2023 (week 33 to week 44 2023).

Seropositivity (weighted by region, age group and sex) varies over time. Figure 3 shows the overall 12-weekly rolling proportion seropositive over time for the Roche N and Roche S assays. Seropositivity estimates are plotted weekly using the mid-point of a rolling 12-weekly period.

Figure 3. Overall 12-weekly rolling SARS-CoV-2 antibody seroprevalence (% seropositive) in blood donors



Regional prevalence of infection over time

Seropositivity (weighted by age group and sex) using the Roche N assay which detects infection only, varies by region (Figure 4).

Figure 4: 12-weekly rolling SARS-CoV-2 antibody seroprevalence (% seropositive) in blood donors by region, using Roche N test; error bars show 95% confidence intervals.

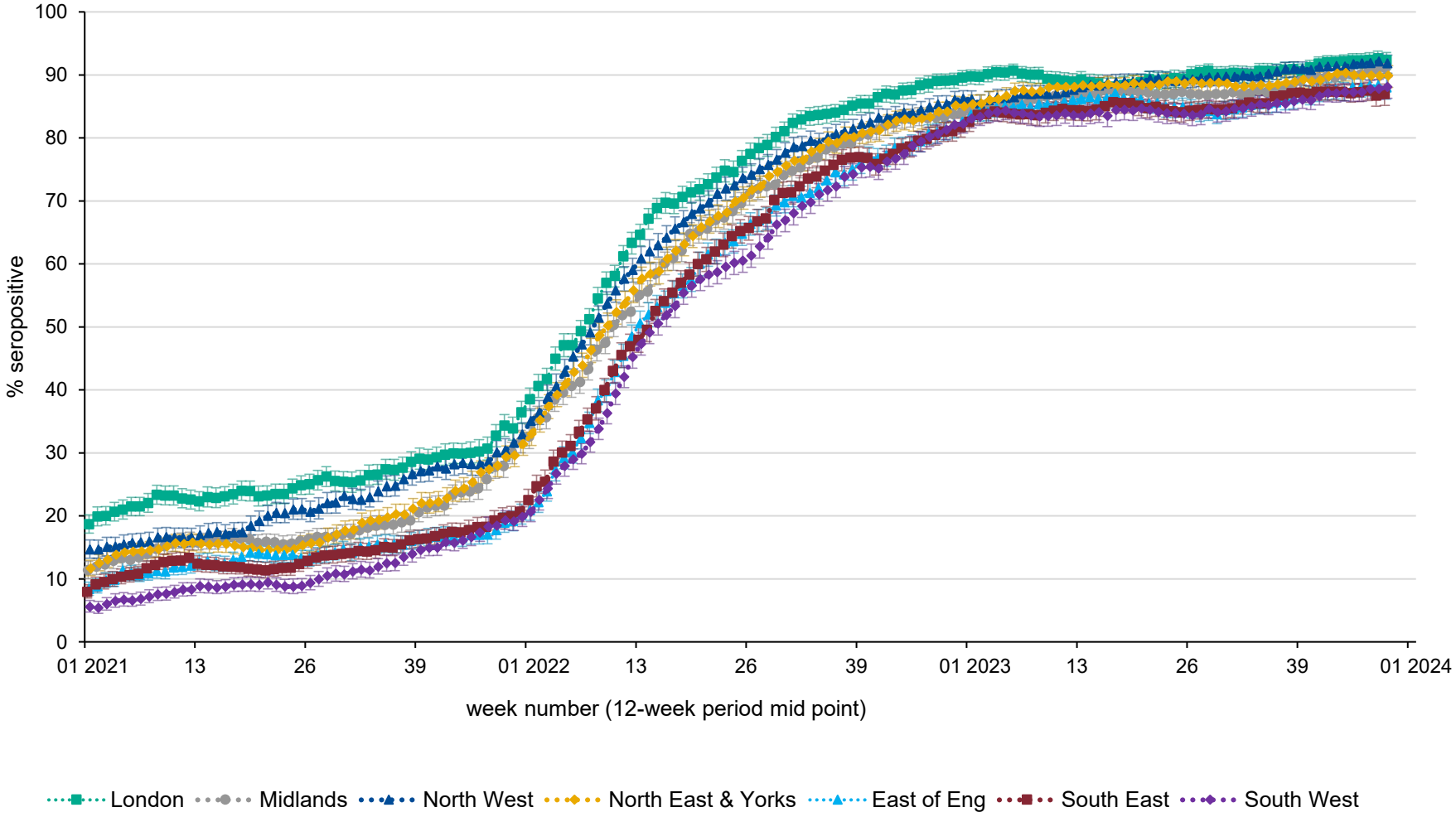


Table 6. Roche N seropositivity (95% CI) estimates by NHS region

NHS region	Weeks 33 to 44 2023	Weeks 45 to 52 2023
East of England	86.0% (84.5% - 87.4%)	88.0% (86.2% - 89.7%)
London	90.8% (89.5% - 92.0%)	92.3% (90.9% - 93.6%)
Midlands	87.6% (86.2% - 88.8%)	91.1% (89.5% - 92.5%)
North East and Yorkshire	88.8% (87.4% - 90.0%)	89.9% (88.0% - 91.5%)
North West	90.9% (89.7% - 92.0%)	91.8% (90.3% - 93.1%)
South East	86.7% (85.3% - 88.0%)	87.0% (85.2% - 88.6%)
South West	85.4% (84.0% - 86.7%)	88.1% (86.3% - 89.7%)

Roche N seropositivity has increased slightly in all regions compared to the previous 12-week period (Table 6). Estimates have increased by 0.3 to 3.5% between the 2 periods.

The difference in seropositivity by region has narrowed over time with the lowest seropositivity observed in the East of England, South West and the South East. The highest seropositivity has consistently been observed in London, closely followed by the North West.

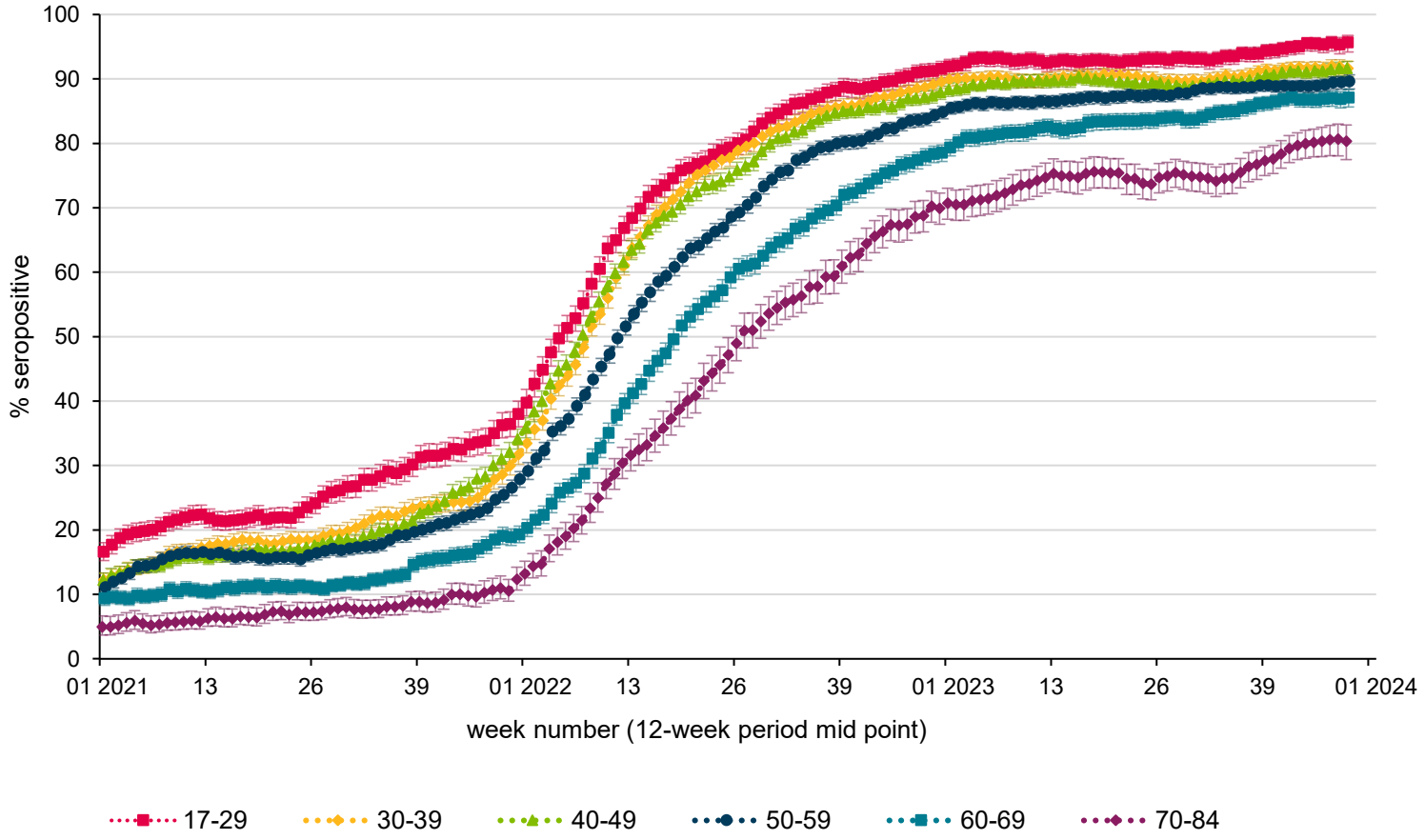
Overall COVID-19 case rates through Pillar 1, between weeks 44 and 51 2023, have first decreased then increased in all regions and overall positivity through Respiratory Datamart similarly decreased to week 47 and subsequently increased to week 51 (Weekly national Influenza and COVID-19 surveillance report week 1 2024).

Pillar 1 testing is undertaken by NHS hospitals and UKHSA labs for those with a clinical need and some health and social care workers. Testing recommendations have been updated and routine asymptomatic testing through NHS settings has been paused since the end of August 2022, which will have an impact on Pillar 1 case rates and positivity rates. Changes in testing practices is likely to influence a range of surveillance indicators highlighting the importance of maintaining the serosurveillance programme to provide consistent data on exposure to infection and vaccine impact in the population over time.

Prevalence by age group

Seropositivity estimates by age group using the Roche N assay are presented below.

Figure 5. Population weighted 12-weekly rolling SARS-CoV-2 antibody seroprevalence (% seropositive) in blood donors from the Roche N assay by age group



Based on testing samples using the Roche N assay (Figure 5) as a marker of infection, the highest seropositivity continues to be observed in those aged 17 to 29 and the lowest in those aged 70 to 84.

Table 7. Roche N seropositivity (95% CI) estimates by age group

Age group	Weeks 33 to 44 2023	Weeks 45 to 52 2023
17 to 29	93.9% (92.6% - 94.9%)	95.6% (94.2% - 96.8%)
30 to 39	90.7% (89.7% - 91.6%)	91.6% (90.3% - 92.7%)
40 to 49	89.8% (88.8% - 90.7%)	91.6% (90.4% - 92.7%)
50 to 59	88.7% (87.8% - 89.5%)	89.6% (88.4% - 90.6%)
60 to 69	85.7% (84.5% - 86.7%)	87.1% (85.7% - 88.3%)
70 to 84	76.4% (74.0% - 78.5%)	80.3% (77.5% - 82.9%)

N seropositivity has increased slightly across age groups (Table 7) compared to the previous 12-week period.

In England, Pillar 1 COVID-19 case rates for weeks 44 to 51 2023, first decreased to around week 47 to 48 then subsequently increased across all age groups with the highest rates seen in individuals aged 85 years and older (Weekly national Influenza and COVID-19 surveillance report week 1 2024). The high, static seropositivity implies that the majority of recent COVID-19 cases have experienced prior infection.

Roche S seropositivity in blood donors has plateaued and is now over 99% across all age groups. Historical seropositivity estimates for S antibody in blood donors are likely to have risen more steeply than would be expected in the general population, reflecting the fact that donors are more likely to be vaccinated. Seropositivity estimates for N antibody will underestimate the proportion of the population previously infected due to (i) waning of the N antibody response over time and (ii) observations from UK Health Security Agency (UKHSA) surveillance data that N antibody levels are lower in individuals who acquire infection following vaccination. These lower N antibody responses in individuals with breakthrough infections (post-vaccination) compared to primary infection likely reflect the shorter and milder infections in these patients. Patients with breakthrough infections do have significant increases in S antibody levels consistent with boosting of their antibody levels.

Vaccination has made an important contribution to the overall Roche S increases observed since the roll out of the vaccination programme. The impact of the booster vaccination programmes can be assessed by monitoring Roche S antibody levels across the population over time.

Roche S levels by age group and month

The Roche S assay that the UK Health Security Agency (UKHSA) uses for serological surveillance is fully quantitative, meaning that it measures the level of antibodies in a blood sample; an antibody level above 0.8 au/ml (approximately 1 IU/ml using the WHO standard) is deemed positive. The UKHSA surveillance since Autumn 2021 has found that over 99% of the population of blood donors test positive for S-antibodies, which may have resulted from either COVID-19 infection or vaccination. With such high seropositivity, it is important to look at population antibody levels in order to assess the impact of the vaccination booster programmes. Figure 6 shows monthly categorised Roche S levels in N-antibody negative individuals by age group over the past year. From January 2023 the proportion of donors aged 50 to 84 years with very high antibody levels of 25,000+ au/ml decreased, with the lowest levels seen in August and September. An increase in highest antibody levels can be seen in October and November 2023 in those aged 50 to 84, with the highest increase seen in those aged 70 to 84; this increase follows the autumn 2023 COVID-19 vaccine booster offer.

By 31 December 2023, 70.2% of all people aged 65 years and older, living in England, had been vaccinated with a Autumn 2023 booster dose (Weekly national Influenza and COVID-19 surveillance report week 1 2024).

Figure 7 shows categorised Roche S levels in N-antibody positive individuals, those likely to have experienced past infection. Antibody levels will be influenced by vaccination history, time since infection, variant and severity of infection, as well as individual factors such as underlying health conditions and age. Since January 2023 decreases were seen in the proportion of donors with very high antibody levels of 25,000+ au/ml, especially in those aged between 50 to 84 years following the autumn 2022 vaccination campaign. Increases in the highest antibody levels were seen in October 2023 following rollout of the autumn 2023 booster vaccination, especially in those aged 60 to 84.

Comparing Figure 6 with Figure 7, the overall higher profile of antibody levels in those who have experienced past infection is evident; both vaccination post infection and breakthrough infection following vaccination are expected to boost existing antibody levels.
Whilst it is thought that there is no threshold antibody level that offers complete protection against infection, higher antibody levels are likely to be associated with lower probability of infection.

Figure 6: Categorised Roche S antibody levels by age group and month in N negative samples, January 2023 to December 2023.

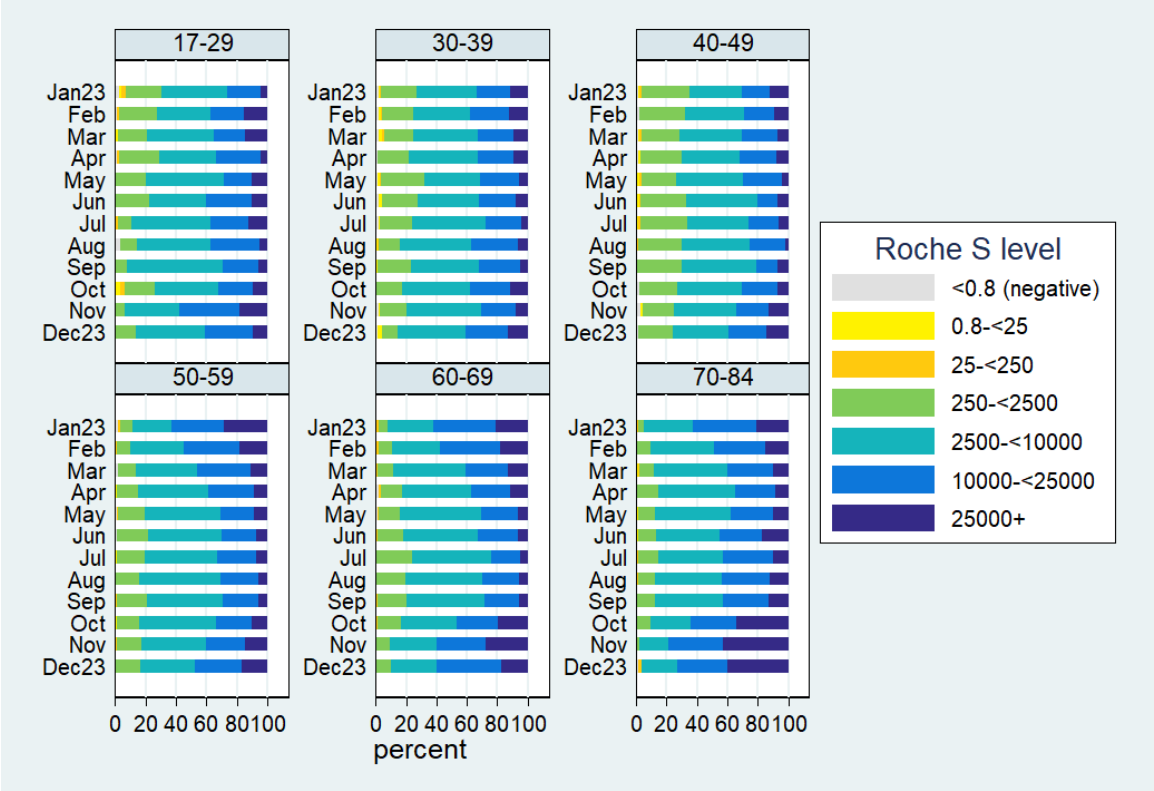
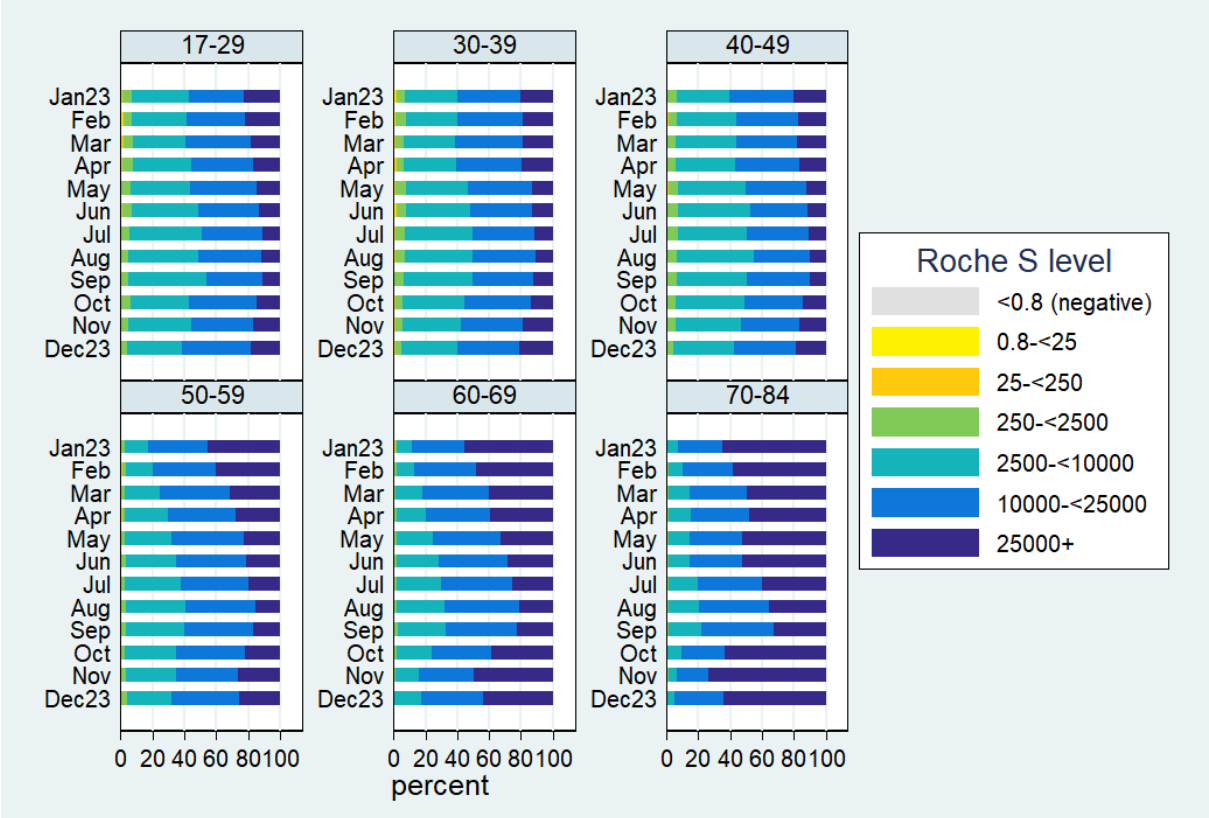


Figure 7: Categorised Roche S antibody levels by age group and month in N positive samples, January 2023 to December 2023.



SARI-Watch surveillance data

It was decided to drop this analysis from the report due to the limited additional insight it currently affords. Although consecutive analyses tend to show a similar picture with the majority of admissions occurring in the elderly, with a high proportion vaccinated on admission as they are a highly vaccinated group, these outputs are increasingly based on small volumes of data from a small number of trusts leading to high levels of uncertainty in interpretation and multiple instances of small cells sizes within the current stratifications. Should data volumes increase, and interpretability improve, we would consider reintroducing similar analyses to future reports.

References

1. Public Health England (PHE). COVID-19: vaccine surveillance strategy 2021
2. Medicines and Healthcare Products Regulatory Agency. 'Coronavirus vaccine: weekly summary of Yellow Card reporting 2021'
3. Lopez Bernal J, Andrews N, Gower C, Robertson C, Stowe J, Tessier E and others. 'Effectiveness of the Pfizer-BioNTech and Oxford-AstraZeneca vaccines on COVID-19-related symptoms, hospital admissions, and mortality in older adults in England: test negative case-control study' British Medical Journal 2021: volume 373, page 1,088
4. Kirsebom F, Andrews N, Sachdeva R, Stowe J, Ramsay M, Lopez Bernal J. 'Effectiveness of ChAdOx1S COVID-19 booster vaccination against the Omicron and Delta variants in England' Nat Commun 13, 7688 (2022).
5. Vasileiou E, Simpson CR, Robertson C, Shi T, Kerr S, Agrawal U and others. 'Interim findings from first-dose mass COVID-19 vaccination roll-out and COVID-19 hospital admissions in Scotland: a national prospective cohort study' The Lancet 2021: volume 397, issue 10,285, pages 1,646 to 1,657
6. Hyams C, Marlow R, Maseko Z, King J, Ward L, Fox K and others. 'Effectiveness of BNT162b2 and ChAdOx1 nCoV-19 COVID-19 vaccination at preventing hospitalisations in people aged at least 80 years: a test-negative, case-control study' Lancet Infectious Diseases 2021: volume 21, issue 11, pages 1,539 to 1,548
7. Ismail SA, Vilaplana TG, Elgohari S, Stowe J, Tessier E, Andrews N and others. 'Effectiveness of BNT162b2 mRNA and ChAdOx1 adenovirus vector COVID-19 vaccines on risk of hospitalisation among older adults in England: an observational study using surveillance data' PHE Preprints 2021
8. Stowe J, Andrews N, Kirsebom F and others. Effectiveness of COVID-19 vaccines against Omicron and Delta hospitalisation, a test negative case-control study Nature Communications 2022: volume 13, article 5,736
9. Nyberg T, Ferguson NM, Nash SG, Webster HH, Flaxman S, Andrews N, Hinsley W, Bernal JL, Kall M, Bhatt S, Blomquist P, Zaidi A, Volz E, Aziz NA, Harman K, Funk S, Abbott S, COVID-19 Genomics UK (COG-UK) consortium, Hope R, Charlett A, Chand M, Ghani AC, Seaman SR, Dabrera G, De Angelis D, Presanis AM, Thelwall S. 'Comparative analysis of the risks of hospitalisation and death associated with SARS-CoV-2 Omicron (B.1.1.529) and Delta (B.1.617.2) variants in England: a cohort study' Lancet 2022: volume 399, issue 10,332, pages 1,303 to 1,312
10. Kirsebom FC, Andrews N, Stowe J, Ramsay M, Lopez Bernal J. 'Duration of protection of ancestral-strain monovalent vaccines and effectiveness of bivalent BA.1 boosters against COVID-19 Hospitalisation in England: A test-negative case-control study' The Lancet Infectious Diseases 2023: volume 23, issue 11, pages 1,235 to 43. doi:10.1016/s1473-3099(23)00365-1
11. Kirsebom FC, Harman K, Lunt RJ, Andrews N, Groves N, Abdul Aziz N and others. 'Vaccine effectiveness against hospitalisation estimated using a test-negative case-

control study design, and comparative odds of hospital admission and severe outcomes with COVID-19 sub-lineages Bq.1, ch.1.1. and XBB.1.5 in England' The Lancet Regional Health – Europe 2023: volume 35, page 100,755. doi:10.1016/j.lanepe.2023.100755

12. Kirsebom FC, Andrews N, Stowe J, Dabrera G, Ramsay M, Bernal JL. Effectiveness of the adjuvanted Sanofi/GSK (VidPrevtyn beta) and Pfizer-BioNTech (Comirnaty original/omicron Ba4-5) bivalent vaccines against hospitalisation amongst adults aged 75 years and older in England, estimated using a test-negative case control study design. medRxiv 2023 (Pre-print); doi:10.1101/2023.09.28.23296290
13. Vousden N and others. 'Severity of maternal infection and perinatal outcomes during periods of SARS-CoV-2 wildtype, alpha, and delta variant dominance in the UK: prospective cohort study' British Medical Journal Journals 2022
14. Kadiwar S and others. 'Were pregnant women more affected by COVID-19 in the second wave of the pandemic?' The Lancet 2021: volume 397, issue 10,284, pages 1,539 to 1,540
15. University of Edinburgh. 'Outputs and information for the public'
16. Public Health Scotland. 'Scottish Intensive Care Society Audit Group report on COVID-19, 23 September 2021'
17. Adhikari EH and others. 'COVID-19 cases and disease severity in pregnancy and neonatal positivity associated with Delta (B.1.617.2) and Omicron (B.1.1.529) variant predominance' Journal of the American Medical Association 2022: volume 327, issue 15, pages 1,500 to 1,502
18. Stock SJ, Moore E and others. 'Pregnancy outcomes after SARS-CoV-2 infection in periods dominated by delta and omicron variants in Scotland: a population-based cohort study' The Lancet Respiratory Medicine: volume 10, issue 12, pages 1,129 to 1,136
19. Carlson J, Simeone RM, Ellington S, Galang R, DeSisto CL, Fleming-Dutra K, Riley L, Meaney-Delman D, Tong VT. 'Pre-Delta, Delta, and Omicron Periods of the Coronavirus Disease 2019 (COVID-19) Pandemic and Health Outcomes During Delivery Hospitalization' Obstetrics and Gynecology 2024: volume 143, issue 1, pages 131 to 138. doi: 10.1097/AOG.0000000000005449. Epub 2023 Nov 2. PMID: 37917932
20. Engjom HM, Ramakrishnan R, Vousden N and others. 'Severity of maternal SARS-CoV-2 infection and perinatal outcomes of women admitted to hospital during the omicron variant dominant period using UK Obstetric Surveillance System data: prospective, national cohort study' British Medical Journal Medicine 2022
21. Lindsay L, Calvert C, Shi T and others. 'Neonatal and maternal outcomes following SARS-CoV-2 infection and COVID-19 vaccination: a population-based matched cohort study' Nature Communications 2023: volume 14, article 5,275
22. Joint Committee on Vaccination and Immunisation (JCVI). 'JCVI issues new advice on COVID-19 vaccination for pregnant women'
23. UKHSA 'Pregnant women urged to come forward for COVID-19 vaccination'

24. JCVI 'JCVI announcement regarding COVID-19 vaccination during pregnancy and next steps'
25. Goldshtein I and others. 'Association between BNT162b2 vaccination and incidence of SARS-CoV-2 infection in pregnant women' Journal of the American Medical Association 2021: volume 326, issue 8, pages 728 to 735
26. Dagan N and others. 'Effectiveness of the BNT162b2 mRNA COVID-19 vaccine in pregnancy' Nature Medicine 2021: volume 27, issue 10, pages 1,693 to 1,695
27. Gray KJ and others. 'Coronavirus disease 2019 vaccine response in pregnant and lactating women: a cohort study' American Journal of Obstetrics and Gynecology 2021: volume 225, issue 3, pages 303 e1 to e17
28. Halasa NB, Olson SM, Staat MA and others. 'Effectiveness of maternal vaccination with mRNA COVID-19 vaccine during pregnancy against COVID-19-associated hospitalisation in infants aged under 6 months: 17 states, July 2021 to January 2022' MMWR Morbidity and Mortality Weekly Report 2022: volume 71, pages 264 to 270
29. Kirsebom F and others. 'Vaccine effectiveness against mild and severe disease in pregnant mothers and their infants in England' medRxiv 2023 (Pre-print)
30. UK Obstetric Surveillance System (UKOSS). 'Key information on COVID-19 in pregnancy | UKOSS | NPEU'
31. Stock S and others. 'SARS-CoV-2 infection and COVID-19 vaccination rates in pregnant women in Scotland' Nature Medicine 2022: volume 28, pages 504 to 512
32. Public Health Scotland. 'Public Health Scotland COVID-19 statistical report 19 May 2022'
33. Centers for Disease Control and Prevention. 'CDC COVID data tracker: vaccination among pregnant people' (viewed 30 August 2022)
34. Shimabukuro TT and others. 'Preliminary findings of mRNA COVID-19 vaccine safety in pregnant persons' New England Journal of Medicine 2021: volume 384, issue 24, pages 2,273 to 2,282
35. Kharbanda EO and others. 'Spontaneous abortion following COVID-19 vaccination during pregnancy' Journal of the American Medical Association 2021: volume 326, issue 16, pages 1,629 to 1,631
36. Magnus MC and others. 'COVID-19 vaccination during pregnancy and first trimester miscarriage' New England Journal of Medicine 2021
37. Zauche LH and others. 'Receipt of mRNA COVID-19 vaccines and risk of spontaneous abortion' New England Journal of Medicine 2021: volume 385, issue 16, pages 1,533 to 1,535
38. Stock S and others. 'A population-based matched cohort study of early pregnancy outcomes following COVID-19 vaccination and SARS-CoV-2 infection' Nature Communications 2022: volume 12, article 6124

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