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Security
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COVID-19 vaccine surveillance report

Week 4

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Contents

Executive summary	3
Vaccine effectiveness	3
Population impact	3
Vaccine effectiveness	4
Effectiveness against symptomatic disease	4
Effectiveness against hospitalisation	9
Effectiveness against mortality	10
Effectiveness against infection	13
Effectiveness against transmission	13
Population impact	19
Vaccine coverage	19
Vaccination in immunosuppressed individuals	23
Vaccination in pregnancy	24
Vaccination status in cases, deaths and hospitalisations	39
Vaccine impact on proportion of population with antibodies to COVID-19.....	48
Summary of impact on hospitalisations, infections and mortality.....	55
References.....	56

Executive summary

Four coronavirus (COVID-19) vaccines have now been approved for use in the UK. Rigorous clinical trials have been undertaken to understand the immune response, safety profile and efficacy of these vaccines 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).

Vaccine effectiveness

Several studies of vaccine effectiveness have been conducted in the UK against different COVID-19 variants. Vaccine effectiveness against symptomatic disease with the Omicron variant is substantially lower than against the Delta variant, with rapid waning. However, protection against hospitalisation remains high, particularly after 3 doses.

Population impact

The impact of the vaccination programme on the population is assessed by taking into account vaccine coverage, evidence on vaccine effectiveness and the latest COVID-19 disease surveillance indicators.

Vaccine coverage tells us about the proportion of the population that have received one, 2 and 3 doses of COVID-19 vaccines. By 23 January 2022, the overall vaccine uptake in England for dose 1 was 69.0% and for dose 2 was 63.9%. Overall vaccine uptake in England in people with at least 3 doses was 49.0%. In line with the programme rollout, coverage is highest in the oldest age groups.

We present data on COVID-19 cases, hospitalisations and deaths by vaccination status. **These raw data should not be used to estimate vaccine effectiveness** as the data does not take into account inherent biases present such as differences in risk, behaviour and testing in the vaccinated and unvaccinated populations. Vaccine effectiveness is measured in other ways as detailed in the [‘Vaccine Effectiveness’](#) section.

Based on antibody testing of blood donors, 98.7% of the adult population now have antibodies to COVID-19 from either infection or vaccination compared to 24.1% that have antibodies from infection alone.

Vaccine effectiveness

Large clinical trials have been undertaken for each of the COVID-19 vaccines approved in the UK which found that they are highly efficacious at preventing symptomatic disease in the populations that were studied. The clinical trials have been designed to be able to assess the efficacy of the vaccine against laboratory confirmed symptomatic disease with a relatively short follow up period so that effective vaccines can be introduced as rapidly as possible.

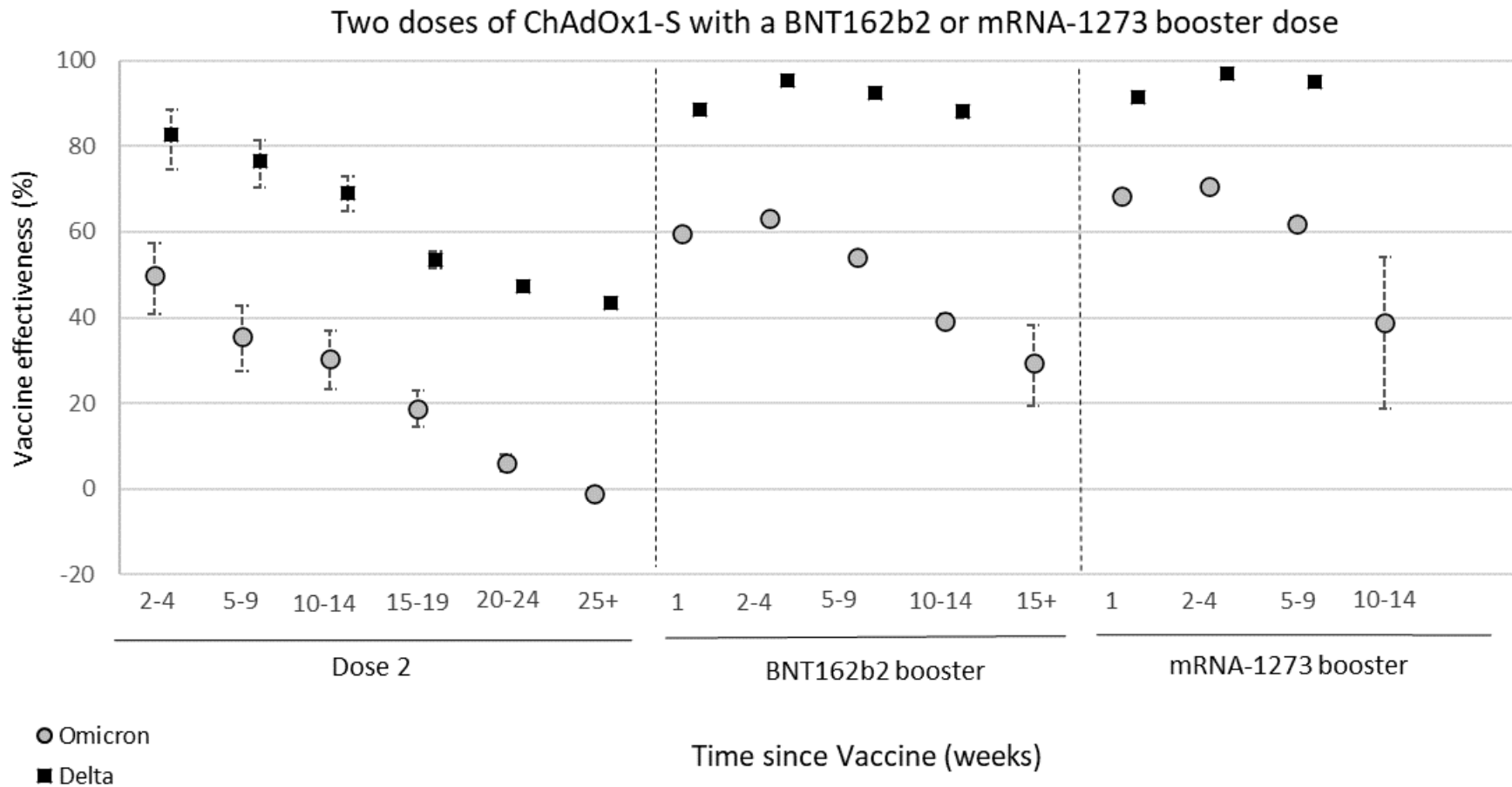
Post implementation real world vaccine effectiveness studies are needed to understand vaccine effectiveness against different outcomes (such as severe disease and onwards transmission), effectiveness in different subgroups of the population and against different variants as well as to understand the duration of protection. Vaccine effectiveness is estimated by comparing rates of disease in vaccinated individuals to rates in unvaccinated individuals. Below we outline the latest real-world evidence on vaccine effectiveness from studies in UK populations. Where available we focus on data related to the Omicron variant which is currently dominant in the UK. The findings are also summarised in Table 2.

Effectiveness against symptomatic disease

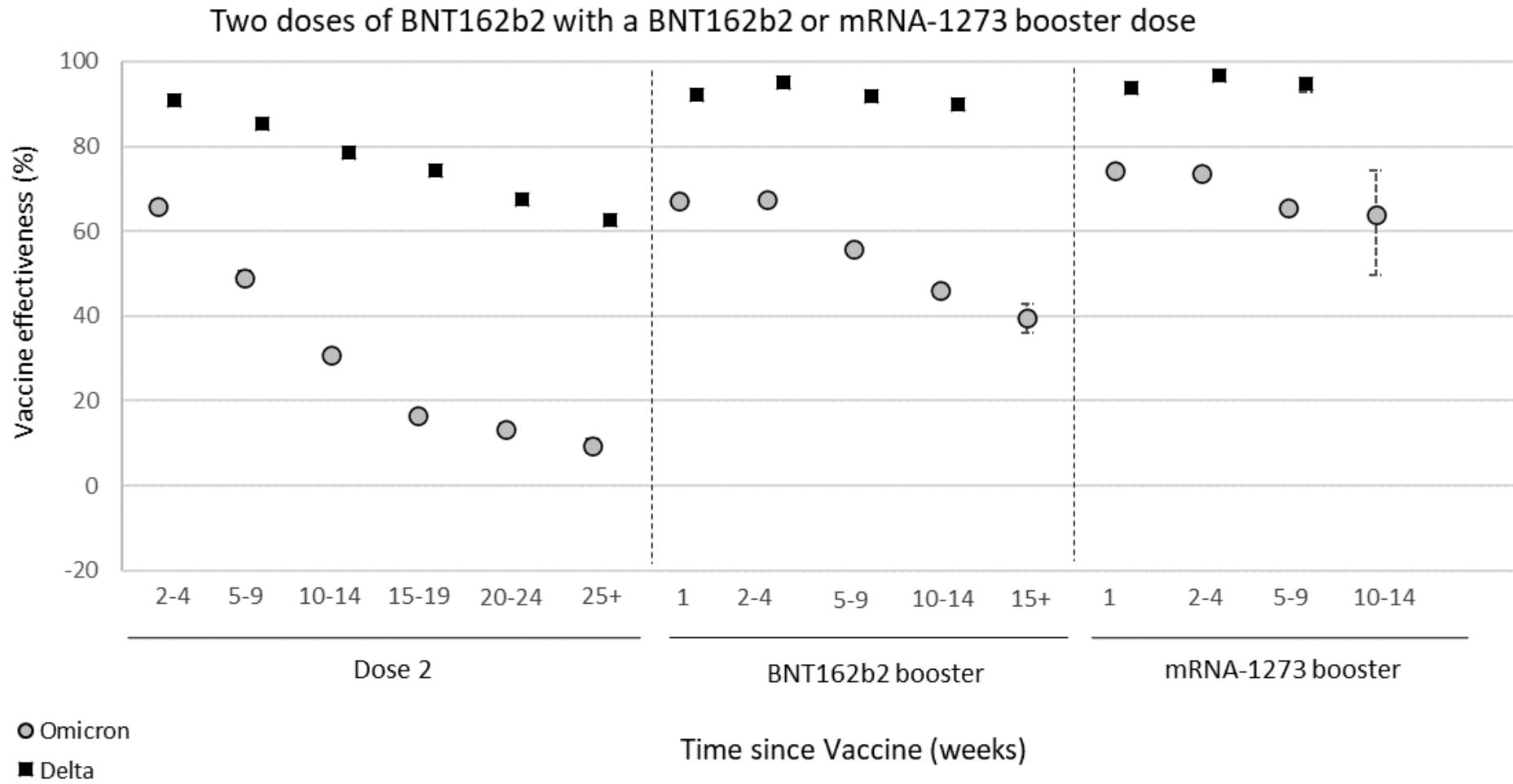
Vaccine effectiveness against symptomatic COVID-19 has been assessed in England based on community testing data linked to vaccination data from the National Immunisation Management System (NIMS), cohort studies such as the COVID-19 Infection Survey and GP electronic health record data. After 2 doses of the AstraZeneca vaccine, vaccine effectiveness against the Omicron variant starts at 45 to 50% then drops to almost no effect from 20 weeks after the second dose. With 2 doses of Pfizer or Moderna effectiveness dropped from around 65 to 70% down to around 10% by 25 weeks after the second dose. Two to 4 weeks after a booster dose of either the Pfizer or Moderna vaccine, effectiveness ranges from around 60 to 75%, dropping to 25 to 40% from 15+ weeks after the booster. Vaccine effectiveness estimates for the booster dose are very similar, irrespective of the primary course received (3). Vaccine effectiveness is generally slightly higher in younger compared to older age groups.

Figure 1. Vaccine effectiveness against symptomatic disease by period after the second and booster doses 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 and Pfizer or Moderna as a booster

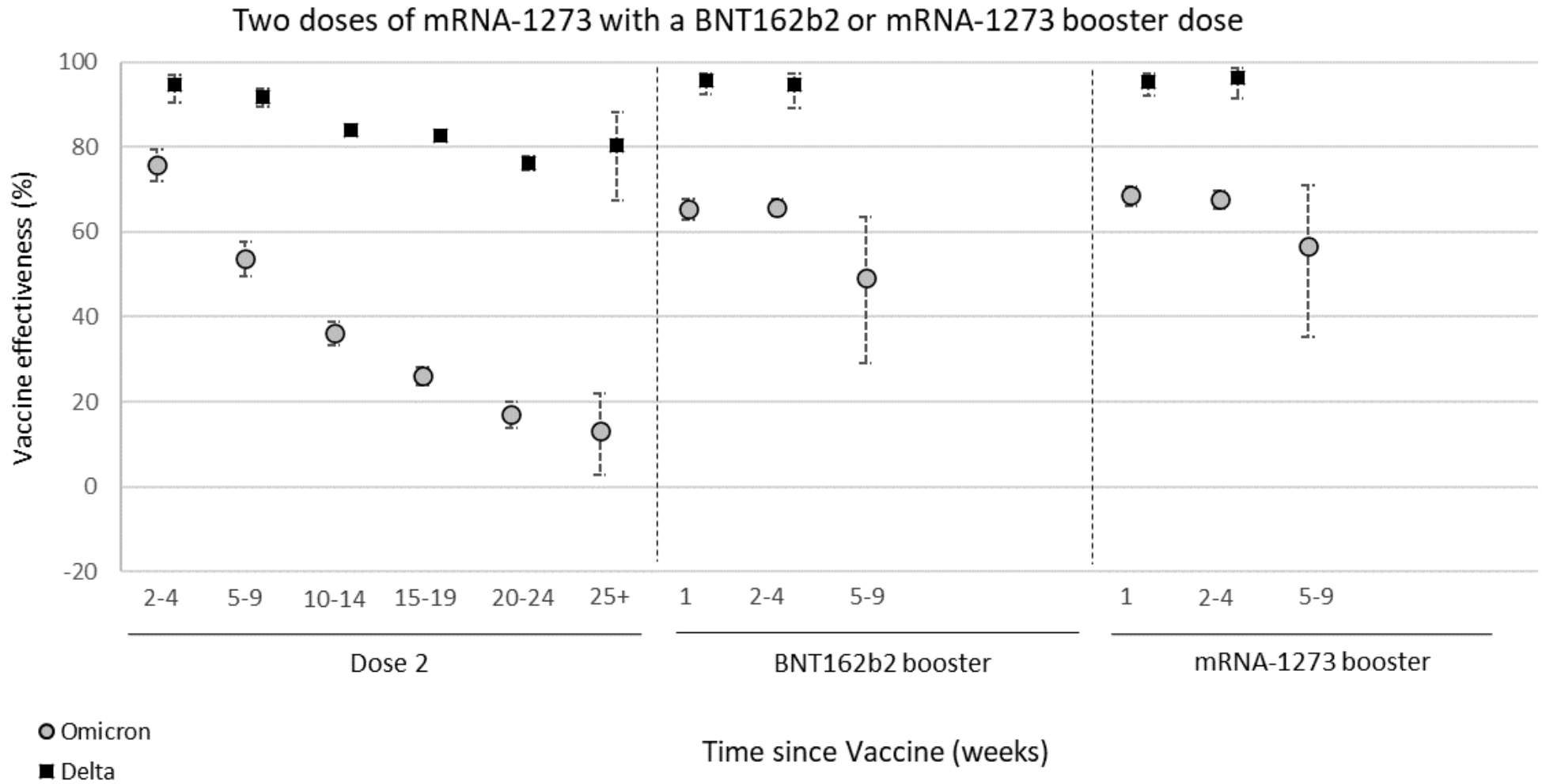
a)



b)



c)



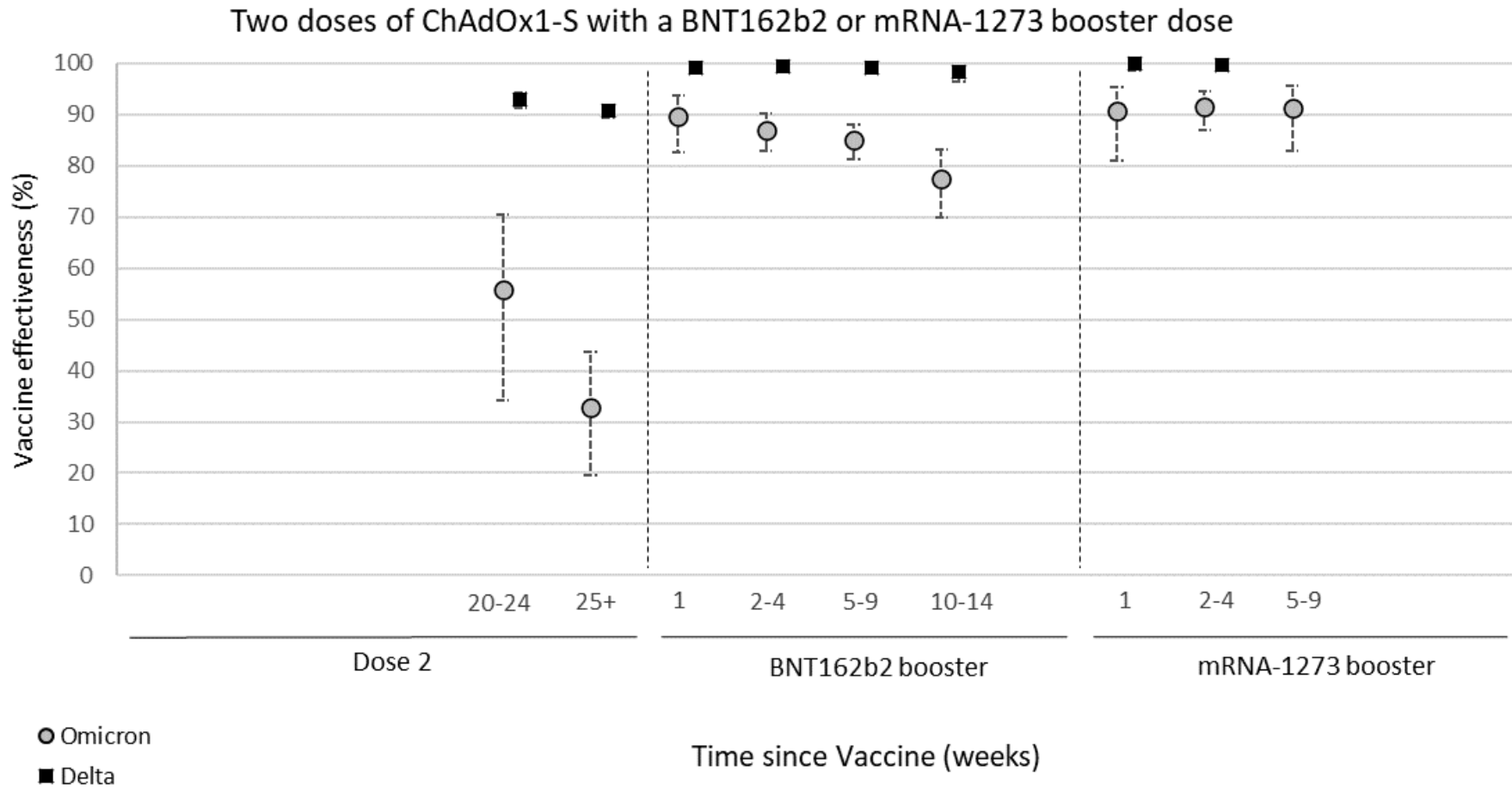
Data (based primarily on the Alpha and Delta variants) suggest that in most clinical risk groups, immune response to vaccination is maintained and high levels of VE are seen with both the Pfizer and AstraZeneca vaccines. Reduced antibody response and vaccine effectiveness were seen after one dose of vaccine among the immunosuppressed group, however, after a second dose the reduction in vaccine effectiveness is smaller (4). Analyses by dosing interval suggest that immune response to vaccination and vaccine effectiveness against symptomatic disease improves with a longer (greater than 6 week interval) compared to a shorter interval of 3 to 4 weeks (5).

Effectiveness against hospitalisation

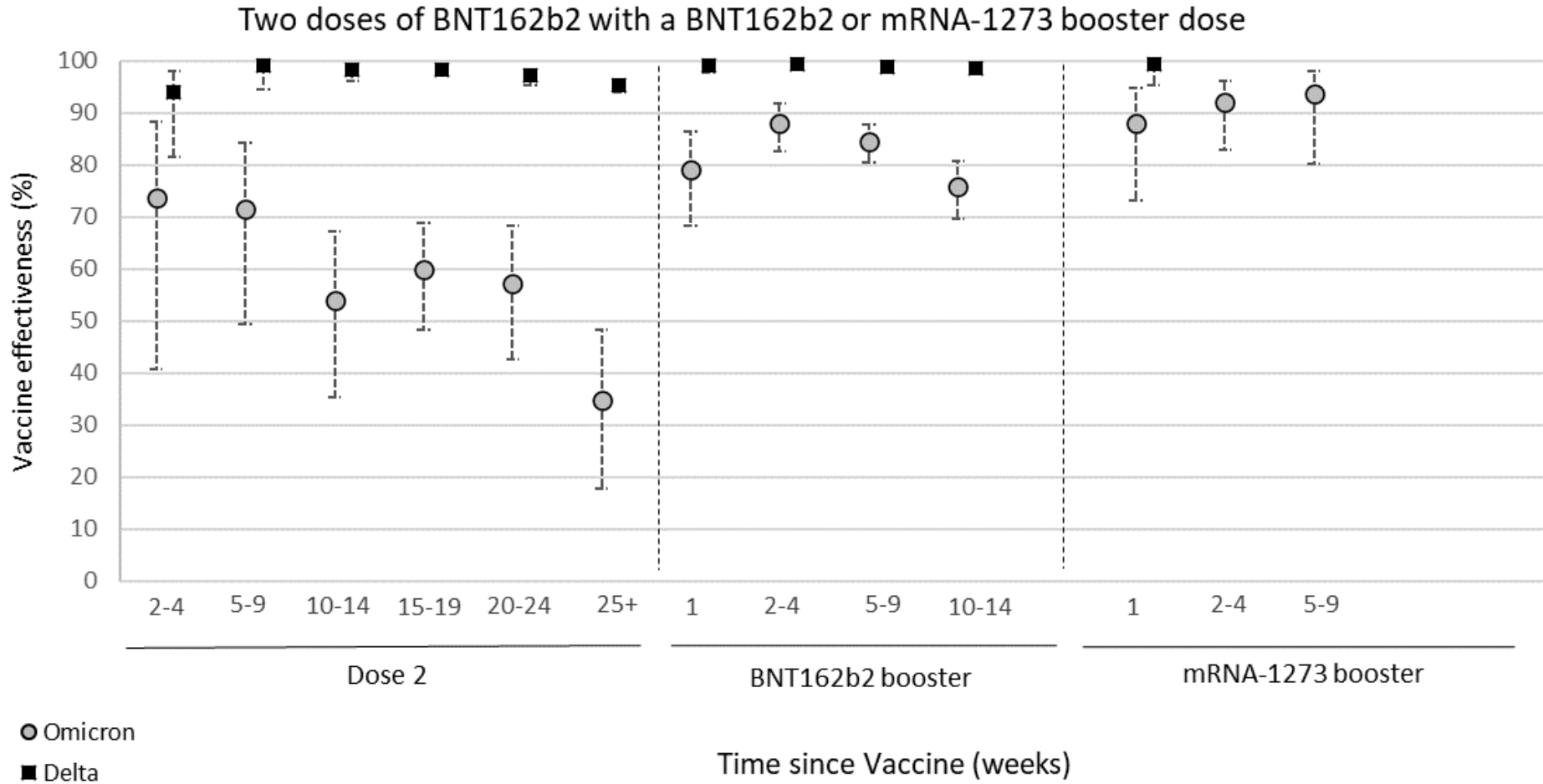
Several studies have estimated vaccine effectiveness against hospitalisation in older ages, all of which indicate higher levels of protection against hospitalisation with all vaccines against the Alpha and Delta variants (6, 7, 8, 9). Vaccine effectiveness against hospitalisation with the Omicron variant has been estimated using a test-negative case control study design (Figure 2). Two doses of either AstraZeneca (ChAdOx1-S) or Pfizer (BNT162b2) vaccines was associated with a vaccine effectiveness of approximately 25 to 35% against hospitalisation following infection with the Omicron variant, after 25+ weeks. After a Pfizer booster (after either primary vaccination course), vaccine effectiveness against hospitalisation started at around 90% dropping to around 75% after 10 to 14 weeks. After a Moderna booster (mRNA-1273) (after either primary vaccination course), vaccine effectiveness against hospitalisation was 90 to 95% up to 9 weeks after vaccination.

Figure 2. Vaccine effectiveness against hospitalisation by period after the second and booster doses 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

a)



b)



Effectiveness against mortality

High levels of protection (over 90%) are also seen against mortality with all 3 vaccines and against both the Alpha and Delta variants with relatively limited waning (6, 10, 11). Vaccine effectiveness against mortality with the Omicron variant has been estimated for those aged 50 years and older by combining the risk of becoming a symptomatic case with the risk of death among symptomatic cases in vaccinated (all vaccines combined) compared to unvaccinated individuals (Table 1). At 25+ weeks following the second dose, vaccine effectiveness was around 60% while at 2 or more weeks following a booster vaccine effectiveness was 95% against mortality.

Table 1. Hazard ratios and vaccine effectiveness against mortality (all vaccine brands combined). OR = odds ratio, HR = hazards ratio, VE = vaccine effectiveness

Dose	Interval after dose	OR v symptomatic disease	HR vs mortality	VE vs mortality
2	25+ weeks	0.93 (0.9-0.96)	0.45 (0.19-1.03)	59% (4-82)
3	2+ weeks	0.41 (0.39-0.42)	0.12 (0.06-0.24)	95% (90-98)

Effectiveness against infection

Although individuals may not develop symptoms of COVID-19 after vaccination, it is possible that they could still be infected with the virus and could transmit to others. Understanding how effective vaccines are at preventing infection is therefore important to predict the likely impact of the vaccination programme on the wider population. In order to estimate vaccine effectiveness against infection, repeat asymptomatic testing of a defined cohort of individuals is required. Studies have now reported on vaccine effectiveness against infection in healthcare workers, care home residents and the general population with the Alpha and Delta variants (12, 13, 14, 15). Generally estimates are similar to or slightly lower than vaccine effectiveness estimates against symptomatic disease and there is evidence of significant waning in protection against infection over time. Estimates for vaccine effectiveness against infection with the Omicron variant are not yet available.

Effectiveness against transmission

As described above, several studies have provided evidence that vaccines are effective at preventing infection. Uninfected individuals cannot transmit; therefore, the vaccines are also provide some protection against transmission. There may be additional benefit, beyond that due to prevention of infection, if some of those individuals who become infected despite vaccination are also at a reduced risk of transmitting (for example, because of reduced duration or level of viral shedding). Several studies have provided evidence of reduced risk of household transmission from vaccinated cases compared to unvaccinated cases (16, 17, 18, 19).

A summary of vaccine effectiveness evidence can be seen in Table 2.

Table 2. Summary of evidence on vaccine effectiveness against different outcomes (a) Omicron (b) Delta (all vaccines combined)

a)

	Dose 2			Dose 3		
	0-3 months	4-6 months	6+ months	0-3 months	4-6 months	6+ months
Infection	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Symptomatic disease	25-70%	5-30%	0-10%	50-75%	40-50%	Insufficient data
Hospitalisation	65-85%	55-65%	30-35%	80-95%	75-85%	Insufficient data
Mortality	Insufficient data	Insufficient data	40-70%	85-99%	Insufficient data	Insufficient data

b)

	Dose 2			Dose 3		
	0-3 months	4-6 months	6+ months	0-3 months	4-6 months	6+ months
Infection	65-80%	50-65%	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Symptomatic disease	65-90%	45-65%	40-60%	90-99%	90-95%	Insufficient data
Hospitalisation	95-99%	80-90%	70-85%	95-99%	Insufficient data	Insufficient data
Mortality	95-99%	90-95%	80-99%	95-99%	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 moderately level of uncertainty
Low Confidence	Little evidence is available at present and results are inconclusive

Effectiveness against Omicron variant BA.2

The Omicron variant sub-lineage known as BA.2 was designated VUI-22JAN-01 on 19 January 2022. An increase in the number of sequences of the Omicron sub-lineage BA.2 was noted in the UK in the week starting the 3 January 2022. Vaccine effectiveness against symptomatic disease following BA.2 infection was analysed in a test-negative case control design, as compared to the Omicron BA.1 sub-lineage. Pillar 2 testing data from symptomatic cases tested between 27 December and 21 January were included. Analysis combined all vaccines (Table 3). Vaccine effectiveness against symptomatic disease was similar for BA.1 and BA.2 sub-lineages of Omicron. After 2 doses effectiveness was 9% (7-10%) and 13% (-26-40%) respectively for BA.1 and BA.2, after 25+ weeks. This increased to 63% (63-64%) for BA.1 and 70% (58-79%) for BA.2 at 2 weeks following a booster vaccine.

Table 3. Vaccine effectiveness against symptomatic disease (all vaccine brands combined) for BA.1 and BA.2. OR = odds ratio, VE = vaccine effectiveness.

Dose	Interval after dose	BA.1 (VE (95% CI))	BA.2 (VE (95% CI))
2	25+ weeks	9% (7-10)	13% (-26-40)
3	2+ weeks	63% (63-64)	70% (58-79)

Vaccine effectiveness publications

UKHSA and collaborators have published a significant amount of [research into vaccine effectiveness](#), which is summarised on pages 4 to 15. The publications listed in table 4 provide further results and details on the methods used.

Table 4. UKHSA publications on the effectiveness of COVID-19 vaccination

Publication	Subject
Effectiveness of BNT162b2 and ChAdOx1 against SARS-CoV-2 household transmission: a prospective cohort study in England	This study reports on vaccine effectiveness against transmission of COVID-19 with the Alpha and Delta variants.
Effectiveness of 3 doses of COVID-19 vaccines against symptomatic COVID-19 and hospitalisation in adults aged 65 years and older	Updated analysis on the effectiveness of 3 doses of COVID-19 vaccines against symptomatic COVID-19 and hospitalisation in adults aged 65 years and older.
Effectiveness of BNT162b2 COVID-19 booster vaccine against covid-19 related symptoms and hospitalization in England	This study provides real world evidence of significant increased protection from the booster vaccine dose against symptomatic disease and hospitalisation irrespective of the primary course.
Effectiveness of COVID-19 vaccines against the Omicron (B.1.1.529) variant of concern	This study reports on the vaccine effectiveness against symptomatic disease with 2 dose courses of BNT1622 and ChAdOx1-S as well as booster doses of BNT162b2 following a primary course of either BNT1622 or ChAdOx1-S.
Effectiveness of BNT162b2 (Comirnaty, Pfizer-BioNTech) COVID-19 booster vaccine against covid-19 related symptoms in England: test negative case-control study	Results from the first UK real-world study by UKHSA show significantly increased protection against symptomatic disease from a booster dose of the Pfizer-BioNTech vaccine in those aged 50 years and older.
Duration of Protection against Mild and Severe Disease by Covid-19 Vaccines	This study reports on the vaccine effectiveness and duration of protection of Comirnaty, Vaxzevria and Spikevax against mild and severe COVID-19 in the UK.
Serological responses and vaccine effectiveness for extended COVID-19 vaccine schedules in England	This study investigates the impact of different dosing schedules on immune response and vaccine effectiveness.

Publication	Subject
Pfizer-BioNTech and Oxford AstraZeneca COVID-19 vaccine effectiveness and immune response among individuals in clinical risk groups	This study reports on the immune response and clinical effectiveness of COVID-19 vaccine among individuals in clinical risk groups. A supplementary appendix is also available to download.
Effectiveness of COVID-19 vaccines against hospital admission with the Delta (B.1.617.2) variant	This study reports on the effectiveness of COVID-19 vaccines on hospitalisation disease with the Delta variant. A supplementary appendix is also available to download.
Effectiveness of Covid-19 Vaccines against the B.1.617.2 (Delta) Variant	This study reports on the effectiveness of COVID-19 vaccines on symptomatic disease with the Delta variant.
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	A study using the SARI watch surveillance system of COVID-19 hospitalisations found high levels of protection against hospitalisation after both a single dose and 2 doses of COVID-19 vaccines.
Effectiveness of BNT162b2 mRNA vaccine and ChAdOx1 adenovirus vector vaccine on mortality following COVID-19	A study on deaths with COVID-19 indicates that COVID-19 vaccines offer high levels of protection against mortality.
Effect of Vaccination on Household Transmission of SARS-CoV-2 in England	Impact of vaccination on household transmission of SARS-COV-2 in England is an analysis to determine whether individuals who have received vaccine, but still become infected with SARS-COV-2 up to 60 days after the first dose, are less likely than unvaccinated cases to transmit to their unvaccinated household contacts.
Vaccine effectiveness of the first dose of ChAdOx1 nCoV-19 and BNT162b2 against SARS-CoV-2 infection in residents of Long-Term Care Facilities (VIVALDI study)	The VIVALDI study found evidence that COVID-19 vaccines were associated with a substantially reduced risk of infection in care home residents.
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	The Avon CAP study, conducted in 2 hospitals in Bristol, found evidence of high levels of protection against hospitalisation in 80+ year olds with a single dose of either vaccine.
COVID-19 vaccine coverage in health-care workers in England and effectiveness of	Early data from PHE's SIREN study shows a promising impact on infection in healthcare

Publication	Subject
BNT162b2 mRNA vaccine against infection (SIREN): a prospective, multicentre, cohort study	workers aged under 65. Healthcare workers in the study are tested for COVID-19 every 2 weeks – whether or not they have symptoms.
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	Early data from routine COVID-19 testing in older adults shows that vaccines are effective at preventing COVID-19 disease and severe outcomes.
Impact of COVID-19 vaccination programme on seroprevalence in blood donors in England, 2021	Report on the Impact of COVID-19 vaccination programme on seroprevalence in blood donors in England, 2021.

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.

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.

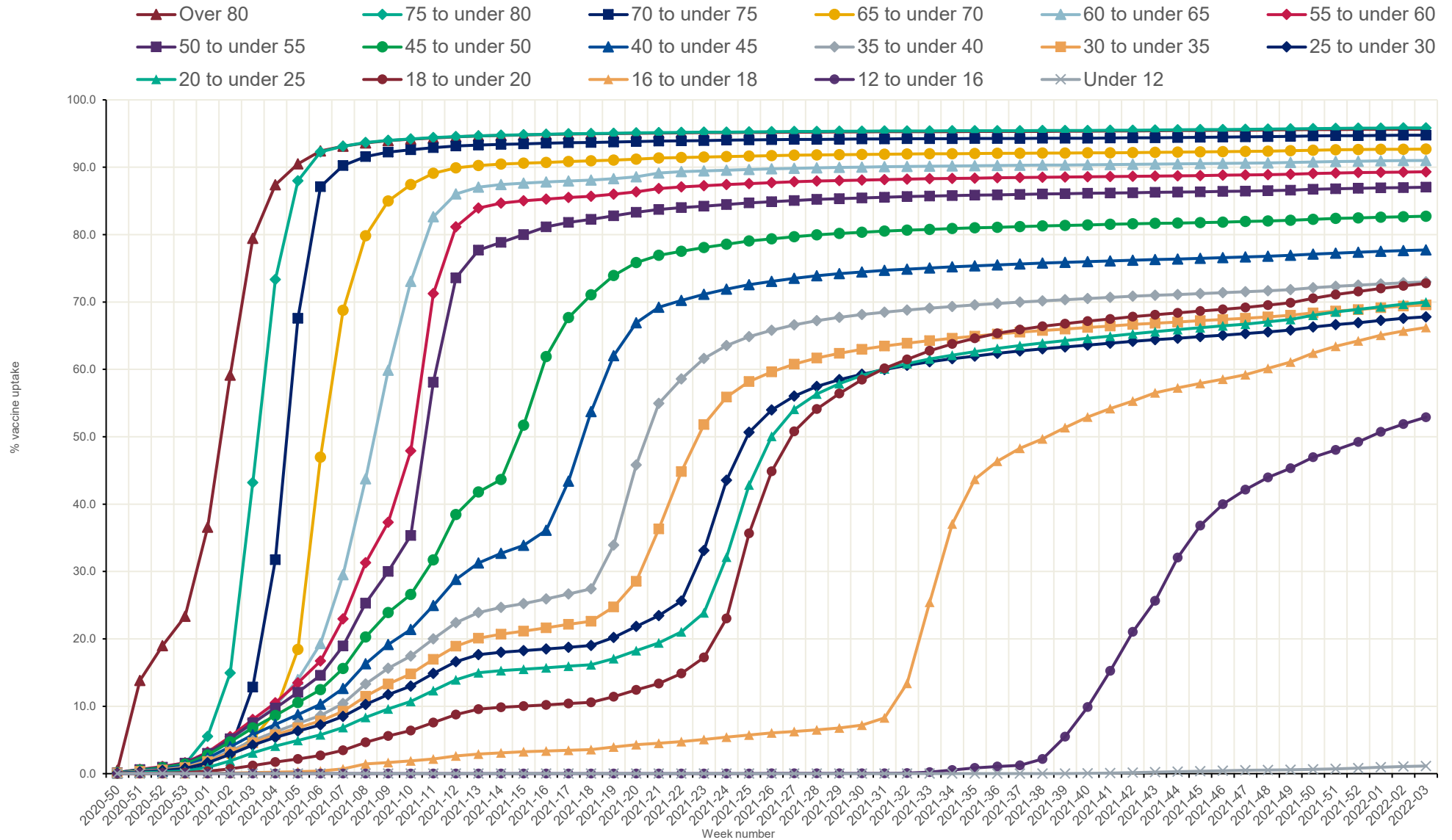
UKHSA and other government and academic partners monitor the impact of the of the vaccination programme on levels of COVID-19 antibodies in the population and different disease indicators, including hospitalisations and mortality. This is done through population-based testing and through modelling which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

Vaccine coverage

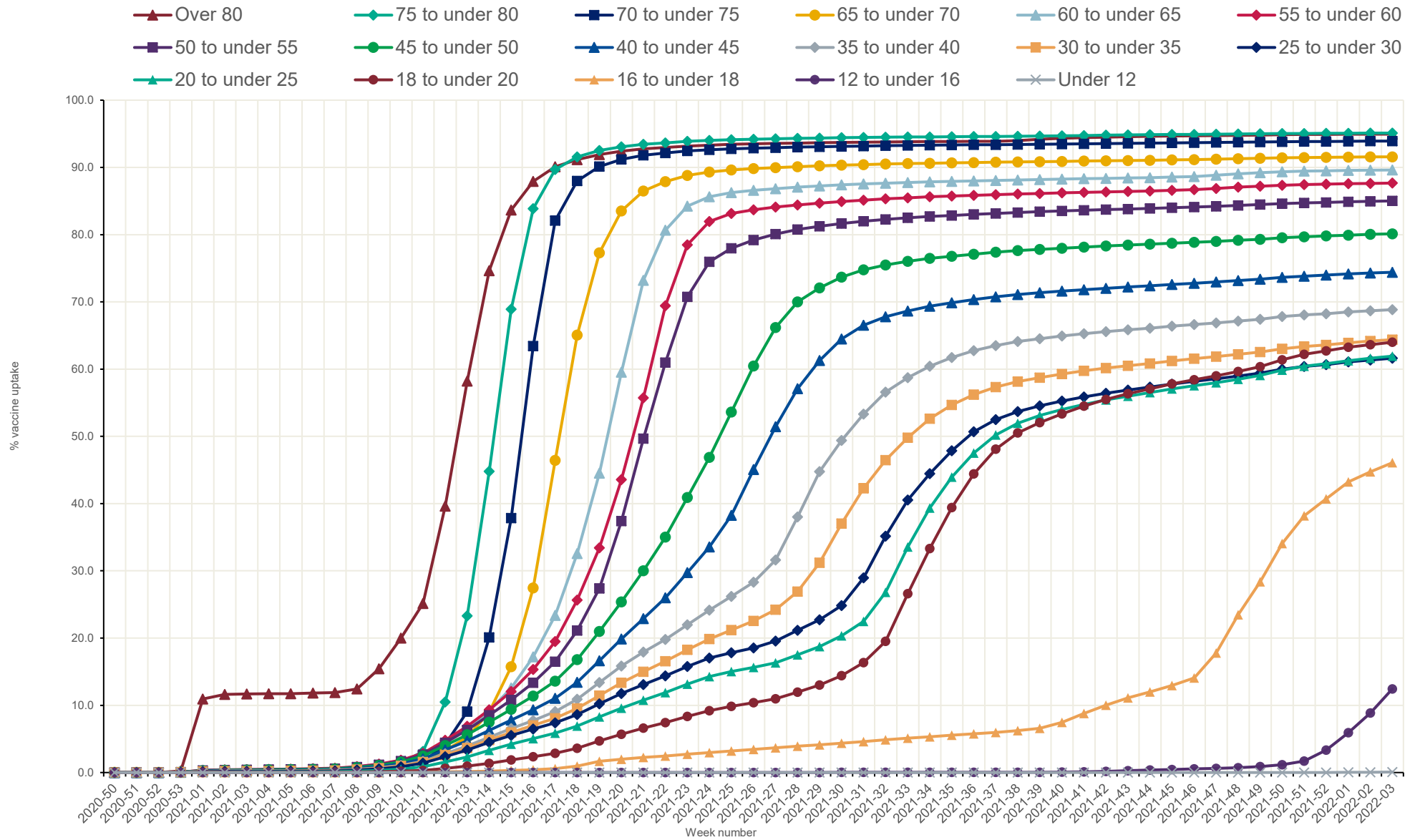
The data in this week's report covers the period from 8 December 2020 to 23 January 2022 (week 3) (Figure 3). It shows the provisional number and percentage of living people in England who have had received one, 2 or 3 doses of a COVID-19 vaccination by age group and week since the start of the programme. Further data on vaccine uptake by age in England can be found in the [national flu and COVID-19 surveillance reports](#). Age is calculated as age on the 31 August 2021, that is, academic cohort for all ages.

Figure 3. Cumulative weekly vaccine uptake by age

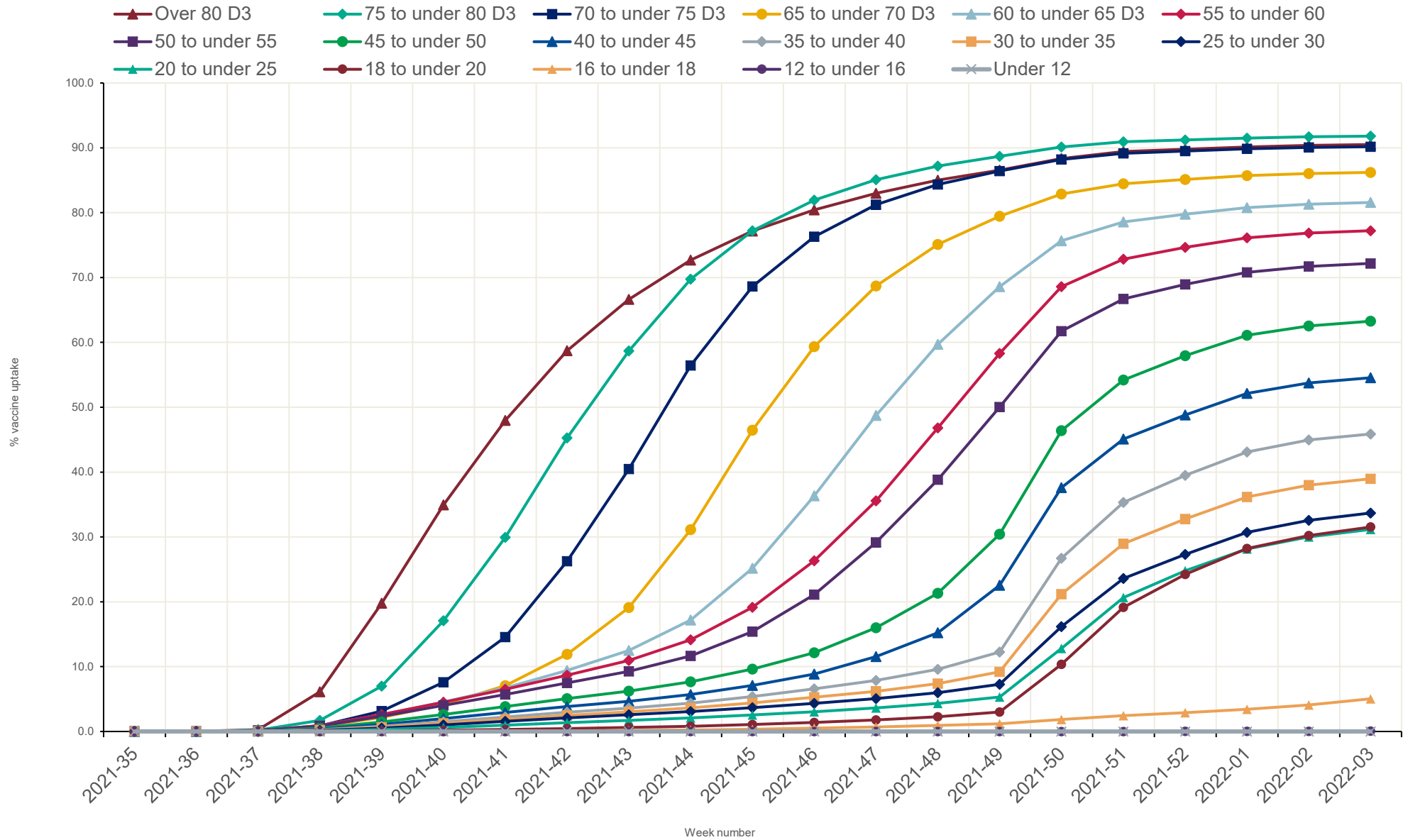
a) Dose 1



b) Dose 2



c) Dose 3 - please note the data for this graph is shown from week 35 (week ending 05/09/2021)



Vaccination in immunosuppressed individuals

Provisional vaccine uptake data in living and resident people identified as immunosuppressed in England to the end of week 3 can be found in Table 5. This shows that vaccine uptake in the 533,374 identified as immunosuppressed was 95.5% for at least dose 1, 94.0% for at least 2 doses and 86.5% for at least 3 doses. Data on vaccine uptake in people with at least 3 doses by age in England can be found in the [National flu and COVID-19 surveillance reports](#).

Table 5. Vaccine uptake in people identified as immunosuppressed in England

Immuno-suppression	People in NIMs Cohort	Numbers vaccinated with at least 1 dose	Percentage vaccine uptake with at least 1 dose	Numbers vaccinated with at least 2 doses	Percentage vaccine uptake with at least 2 doses	Numbers vaccinated with at least 3 doses	Percentage vaccine uptake with at least 3 doses
England	533,374	509,583	95.5	501,540	94.0	461,498	86.5

Detailed information on the [characterisation of the immunosuppressed group by NHS Digital](#) is available.

Vaccination in pregnancy

Vaccination of pregnant women alongside their peers is recommended in the UK and other countries as an important way to protect pregnant women and their unborn children against COVID-19 disease. 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 has been reported after the first SARS-CoV-2 wave in England (20,21) and in Scotland (22,23). Pregnant women who develop severe disease have increased rates of admission to ICU, need for invasive ventilation and pre-term delivery. Data from the US Centers for Disease Control and Prevention (CDC) found that pregnant women were around 3 times more likely to be admitted to ICU and nearly 3 times more likely to require invasive ventilation compared to non-pregnant women with COVID-19 disease and 25% more likely to die (24).

From 16 April 2021, the Joint Committee on Vaccination and Immunisation (JCVI) advised that pregnant women be offered COVID-19 vaccines at the same time as people of the same age or risk group (25). Therefore, any pregnant women not in a high-risk group would likely have received their first dose from mid-April 2021 as part of the general adult population programme in those aged under 50 years. This was offered by decreasing age group (25). As part of the ongoing review of the programme, the JCVI met on 2 December 2021 and considered further data on 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 (26).

Prior to 16 April 2021, COVID-19 vaccine was delivered to priority groups, based on clinical risk and risk of exposure, and delivered in order of priority. On 22 December 2020, JCVI advised that vaccine could be offered to pregnant and breast-feeding women who were in these risk categories. The Pfizer vaccine was rolled out from early December 2020, AstraZeneca vaccine was used from 4 January 2021 and the Moderna vaccine became available from April 2021.

There is evidence of high levels of protection against SARS-CoV-2 infection in pregnant women after COVID-19 vaccination (27, 28, 29) and evidence that vaccination induces higher antibody levels than after disease (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 (23,31) with the most recent study reporting that 90.9% (748 out of 823; 95% CI 88.7–92.7) of SARS-CoV-2 associated with hospital admission, 98% (102 out of 104; 95% CI 92.5–99.7) 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 (22). The researchers also found high 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 COVID-19 vaccine had been administered in more than 18,000 pregnancies to the end of October 2021 (22) and nearly 4,000 women in Wales had received their first dose of vaccine before they gave birth (between 01/01/2021 and 30/11/2021) (32). In the USA more than 180,000 women have indicated they were pregnant at the time they received COVID-19 vaccination to 22 November 2021 (33).

No safety concerns relating to COVID-19 vaccination of pregnant women have been found in published studies to date (34, 35, 36, 37). The rate of vaccine side-effects appears to be similar in pregnant and non-pregnant populations (34).

This report presents data on vaccine coverage and outcomes for women delivering up to the end of October 2021 and updates the early data on COVID-19 vaccination in pregnant women published in the COVID-19 vaccine surveillance report – week 47 [COVID-19 vaccine weekly surveillance reports \(weeks 39 to 3, 2021 to 2022\)](#). Findings continue to be considered preliminary.

Vaccine coverage

COVID-19 vaccine coverage in women before they give birth has increased as more women have become eligible for vaccination. In August 2021, 22.5% of women giving birth had received at least one dose of vaccine. This increased to 32.1% of women who gave birth in September, and 41.3% in October 2021. 29.4% of women who gave birth in October 2021 had received 2 doses of the vaccine (Table 6).

In the overall period between January and October 2021 a total of 442,481 women gave birth of whom 58,165 had received at least one dose of COVID-19 vaccine prior to delivery (39,782 of these women had received at least 2 doses). There were 1,228 women who had received their first dose prior to pregnancy, 3,819 in the first trimester, 16,324 in the second and 19,530 in the third trimester. A further 17,264 women were known to have received dose one before giving birth but without enough information to establish which trimester. Of these women, 15,274 were known to have received this dose in pregnancy, and 1,990 were around the start of pregnancy.

Of all vaccinated women giving birth, 37,627 had received one or more doses of only Pfizer vaccine; 2725 one or more doses of only Moderna; 1,350 one or more doses of only AstraZeneca and the remaining 16,463 of vaccinated women received a mixture of doses:

12,494 received a combination of Pfizer and Moderna and 3,969 received AstraZeneca with Pfizer or Moderna.

Table 6. Overall vaccine coverage in women giving birth, by month of delivery¹

Month	Women giving birth	One or more doses by time of delivery	Two or more doses by time of delivery	Unvaccinated at delivery	Unvaccinated who went on to receive dose(s) after pregnancy to 19/01/2022
Jan-21	41,949	18 (0%)	1 (0%)	41,765 (99.6%)	31,621 (75.7%)
Feb-21	40,093	82 (0.2%)	(0%)	39,872 (99.4%)	30,212 (75.8%)
Mar-21	44,589	293 (0.7%)	25 (0.1%)	44,164 (99%)	33,156 (75.1%)
Apr-21	42,874	489 (1.1%)	94 (0.2%)	42,214 (98.5%)	31,234 (74%)
May-21	44,177	1,249 (2.8%)	306 (0.7%)	42,744 (96.8%)	30,700 (71.8%)
Jun-21	43,813	4,344 (9.9%)	639 (1.5%)	39,312 (89.7%)	26,674 (67.9%)
Jul-21	47,226	7,632 (16.2%)	2,152 (4.6%)	39,403 (83.4%)	25,000 (63.4%)
Aug-21	45,789	10,319 (22.5%)	5,921 (12.9%)	35,275 (77%)	20,610 (58.4%)
Sep-21	46,219	14,828 (32.1%)	9,999 (21.6%)	31,205 (67.5%)	16,155 (51.8%)
Oct-21	45,752	18,911 (41.3%)	13,473 (29.4%)	26,637 (58.2%)	11,795 (44.3%)

¹1,725 women could not be matched with a NIMS record; their vaccine status is therefore unknown, they are excluded from these figures.

Table 7. Vaccine coverage by ethnicity, for women giving birth August to October 2021 (latest 3 months)¹

	Women giving birth in August to October 2021	One or more doses by time of delivery	Two or more doses by time of delivery	Unvaccinated at delivery	Unvaccinated who went on to receive dose(s) after pregnancy to 19/01/2022
Asian	16,563	4,459 (26.9%)	2,768 (16.7%)	12,104 (73.1%)	7,100 (58.7%)
Black	6,265	834 (13.3%)	429 (6.8%)	5,431 (86.7%)	1,765 (32.5%)
Other	5,320	1,476 (27.7%)	1,032 (19.4%)	3,844 (72.3%)	1,712 (44.5%)
Mixed	3,272	845 (25.8%)	559 (17.1%)	2,427 (74.2%)	955 (39.3%)
White	99,234	34,401 (34.7%)	23,252 (23.4%)	64,833 (65.3%)	34,799 (53.7%)
Unknown	7,106	2,043 (28.8%)	1,353 (19%)	4,478 (63%)	2,229 (49.8%)

¹585 women could not be matched with a NIMS record; their vaccine status is therefore unknown, they are excluded from these figures.

Table 8. Vaccine coverage by quintile of deprivation of the small area in which the woman lived, for women giving birth August to October 2021 (latest 3 months)¹

	Women giving birth in August to October 2021	One or more doses by time of delivery	Two or more doses by time of delivery	Unvaccinated at delivery	Unvaccinated who went on to receive dose(s) after pregnancy
1 - most deprived	33,012	6,035 (18.3%)	3,381 (10.2%)	26,977 (81.7%)	10,636 (39.4%)
2	29,593	7,973 (26.9%)	5,077 (17.2%)	21,620 (73.1%)	10,417 (48.2%)
3	26,653	9,237 (34.7%)	6,145 (23.1%)	17,416 (65.3%)	9,730 (55.9%)
4	24,753	9,940 (40.2%)	6,875 (27.8%)	14,813 (59.8%)	9,367 (63.2%)
5 - least deprived	22,394	10,677 (47.7%)	7,784 (34.8%)	11,717 (52.3%)	8,186 (69.9%)
Unknown	1,355	196 (14.5%)	131 (9.7%)	574 (42.4%)	224 (39%)

¹585 women could not be matched with a NIMS record; their vaccine status is therefore unknown, they are excluded from these figures.

Table 9. Vaccine coverage by age of mother, for women giving birth August to October 2021 (latest 3 months)¹

Age	Women giving birth in August to October 2021	One or more doses by time of delivery	Two or more doses by time of delivery	Unvaccinated at delivery	Unvaccinated who went on to receive dose(s) after pregnancy
Under 20	2,562	226 (8.8%)	77 (3%)	2,336 (91.2%)	602 (25.8%)
20 to 24	15,407	2,156 (14%)	904 (5.9%)	13,251 (86%)	4,967 (37.5%)
25 to 29	35,024	7,781 (22.2%)	4,281 (12.2%)	27,243 (77.8%)	13,703 (50.3%)
30 to 34	48,607	18,075 (37.2%)	12,419 (25.5%)	30,532 (62.8%)	17,780 (58.2%)
35 to 39	28,571	12,731 (44.6%)	9,475 (33.2%)	15,840 (55.4%)	9,349 (59%)
40 and above	6,962	3,089 (44.4%)	2,237 (32.1%)	3,873 (55.6%)	2,159 (55.7%)
Unknown	627	(0%)	(0%)	42 (6.7%)	(0%)

¹585 women could not be matched with a NIMS record; their vaccine status is therefore unknown, they are excluded from these figures.

Using the most recent 3-month period, there were 137,760 women who gave birth of whom 44,058 (32.0%) were vaccinated. These women accounted for 76% of all vaccinated women giving birth since January. There were differences in vaccine coverage by both ethnicity (Table 7) and by quintile of deprivation (Table 8). Women of black ethnicity and women living in the most deprived areas in England were least likely to have been vaccinated with one or 2 doses of COVID-19 vaccine before they gave birth. Coverage increased as levels of deprivation decreased (Table 8). Vaccine coverage increased with increasing age group to those aged 35 to 39 years in whom uptake was 43.9% for one dose and 33.2% for 2 doses (Table 9), with similar coverage in women who were aged 40 years or over when they gave birth.

Methods

Data on COVID-19 vaccination status together with details of each vaccine administered is recorded in a central dataset called the National Immunisation Management Service (NIMS)¹. In addition, NHS Digital manages the Hospital Episode Statistics (HES) datasets, containing information about hospital activity in England.

Records of women giving birth ('delivery records') in the months since 1 January 2021 were identified in HES. De-duplication of delivery records resulted in a dataset of women who had given birth with 1 record per woman, 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, 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 diagnoses 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 earliest and latest pregnancy start dates.

¹ NIMS Data controllers are NHSEI and NHSD. The NIMS IT software is commissioned by NHSEI via South Central West CSU and is provided by the System C & Graphnet Care Alliance

3. Where no valid GESTAT_1 was available and there were no codes suggesting term delivery, the first 12 diagnoses 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 earliest and latest pregnancy start dates.
4. In the absence of any additional information in the woman's record (or in conflicting cases where diagnoses 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.

Earliest and latest dates for the start of each trimester were established in a similar way, using the windows of trimester 1: day 0 to day 97 (where day 0 is the earliest or latest pregnancy start date, as established using the method above), trimester 2: day 98 to day 195 and trimester 3: day 196 to delivery. Each woman's delivery record was linked to her record(s) in the NIMS using the NHS Number, establishing her vaccine status as either having had one or more doses before delivery (including any prior to becoming pregnant) or not having had any doses of the vaccine prior to delivery, using the NIMS vaccine records.

For each vaccine dose (this analysis considered doses one to 4) 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 NIMS records extracted on 19 January 2022
Dose in pregnancy: unknown	Dose administered around the start or pregnancy: after the earliest pregnancy start date and before the latest pregnancy start date
Unvaccinated	No vaccine records exist for the woman, based on NHS number

And the following information about trimester

Dose administered pre-pregnancy	Dose administered before the earliest pregnancy start date
Dose administered in trimester 1	Dose administered after the latest pregnancy start date and before the earliest pregnancy start date +97 days
Dose administered in trimester 2	Dose administered after the latest pregnancy start date +98 days and before the earliest pregnancy start date +195 days
Dose administered in trimester 3	Dose administered after the latest pregnancy start date +196 days and before the delivery date
Dose administered post-pregnancy	Dose administered on or after the delivery date based on NIMS records extracted on 19/01/2022
Dose in trimester unknown	Dose administered in the 'gap' between trimesters, because of inaccuracy in establishing pregnancy start date
Unvaccinated	No vaccine records exist for the woman, based on NHS number

The ethnicity, residence and age information used to generate Tables 7 to 9 was taken from the NIMS record. The analysis within this section was carried out on 19 January 2022. The latest HES data available were for October 2021, and HES data since April 2021 are considered provisional.

Pregnancy outcomes

The following figures present rates of women in England who:

1. Gave birth to one or more live-born babies at term without low birthweight; that is, they experienced none of the following adverse outcomes considered (outcomes 2 to 4), according to their delivery record.
2. Gave birth to a stillborn baby (based on recorded diagnoses)
3. Gave birth to a baby with low birthweight (<2,500g) or a very low birthweight (<1,500g). The babies with a very low birthweight are therefore a subset of the low birthweight babies.
4. Gave birth prematurely (<37 weeks gestation), very prematurely (<32 weeks gestation) and extremely prematurely (<28 weeks gestation). The very premature and extremely premature are therefore a subset of women who gave birth prematurely.

These analyses assess whether rates were different in women giving birth between January and October 2021, who received one or more COVID-19 vaccination doses during their pregnancy compared with those who did not (either because they were unvaccinated or had only received vaccine doses prior to pregnancy). The analyses do not take other factors that might affect these outcomes into account, such as age (except for outcome 1 above) and whether the woman was categorised as clinically at risk. However, women who gave birth after 17 April 2021 without the reported complications (outcome 1 above), were also reviewed with vaccinations given from 16 April onwards. This is a more homogenous group of pregnant women who were eligible for vaccination based solely on age and not because they were considered at high risk of exposure or severe disease. Therefore, data are also presented for women giving birth between April and October 2021 for comparison.

Figure 4: Women giving birth January to October 2021 to live-born babies at term without low birthweight

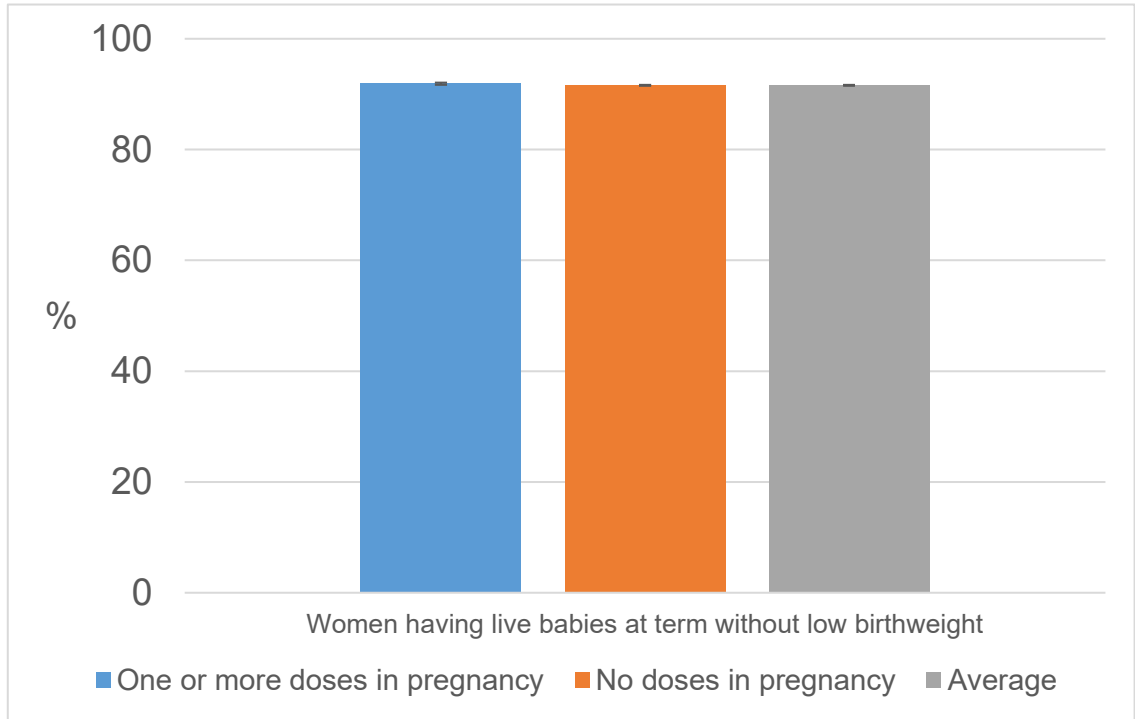


Figure 5: Women giving birth January to October 2021 to live-born babies at term without low birthweight, by age

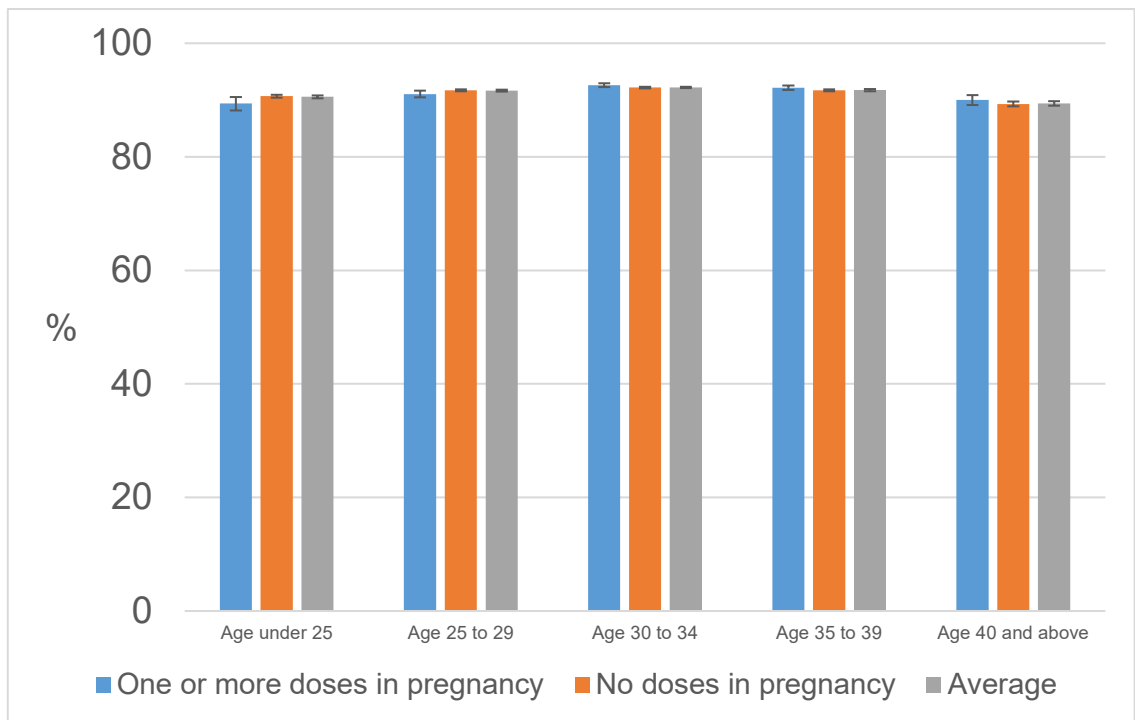


Figure 6: Women giving birth April to October 2021 to live-born babies at term without low birthweight

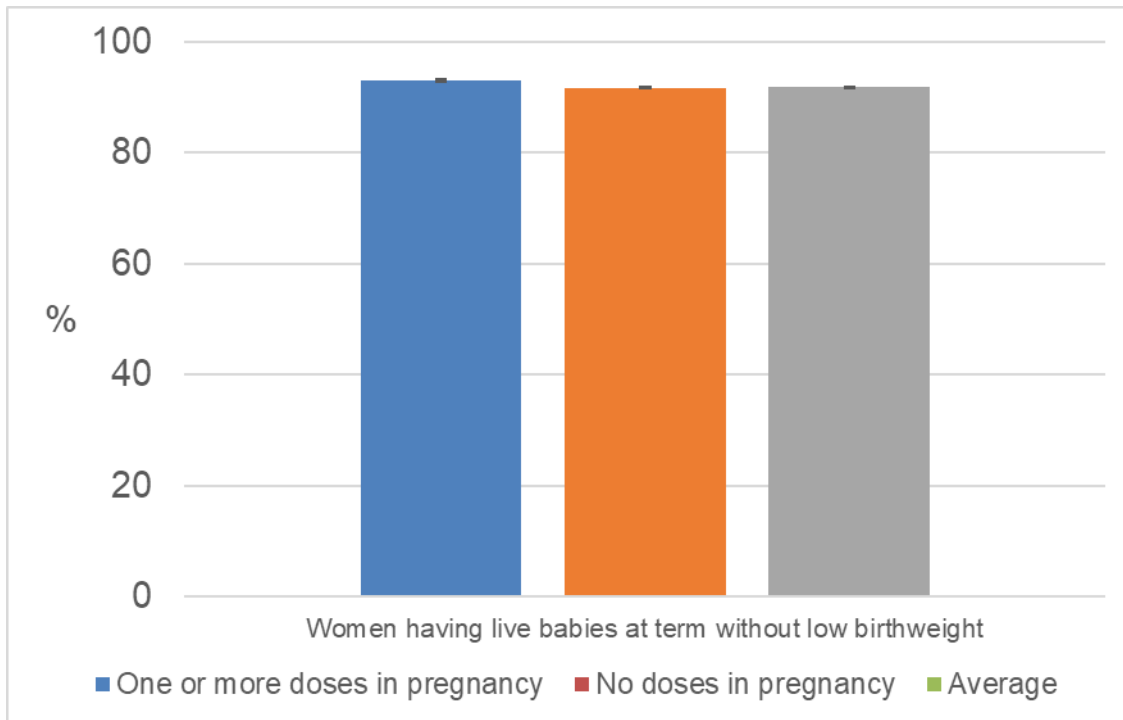


Figure 7: Women giving birth April to October 2021 to live-born babies at term without low birthweight, by age

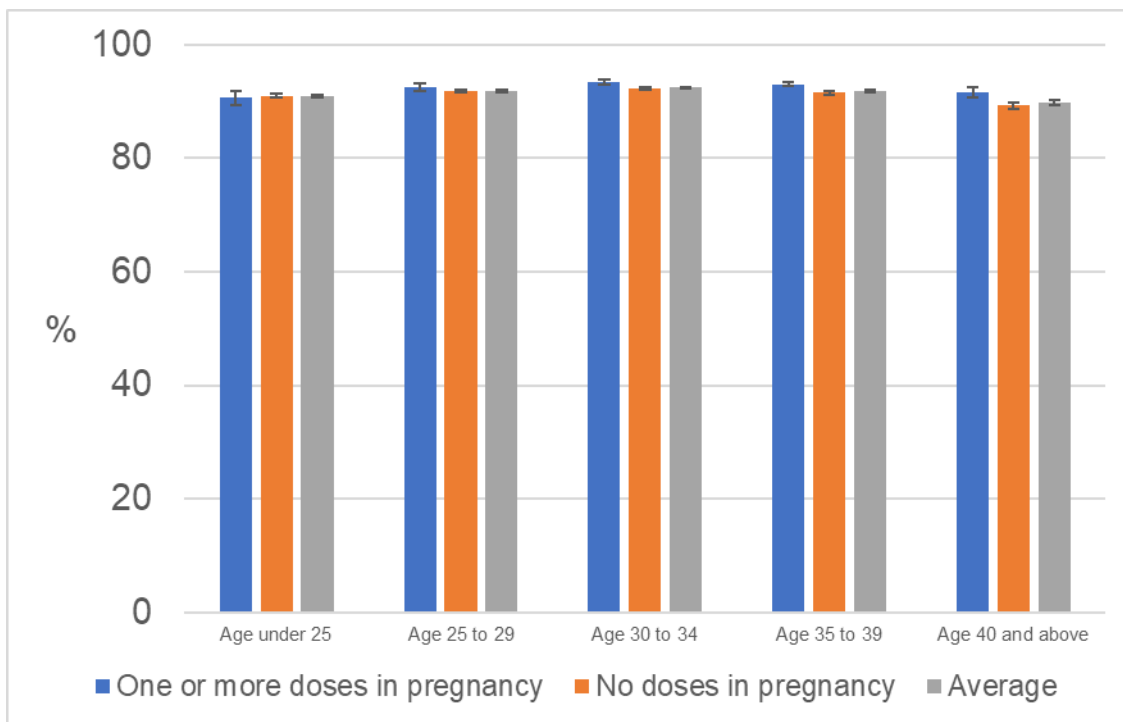


Figure 8: Stillbirths experienced by women giving birth January to October 2021

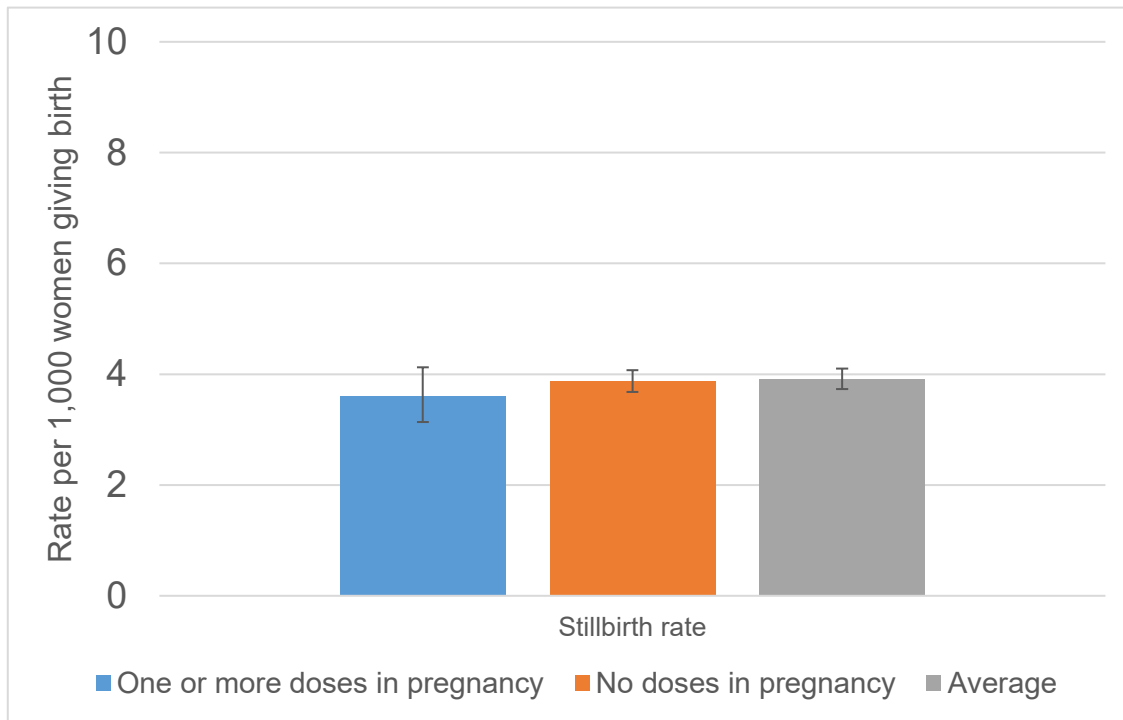


Figure 9: Low birthweight babies to women giving birth January to October 2021

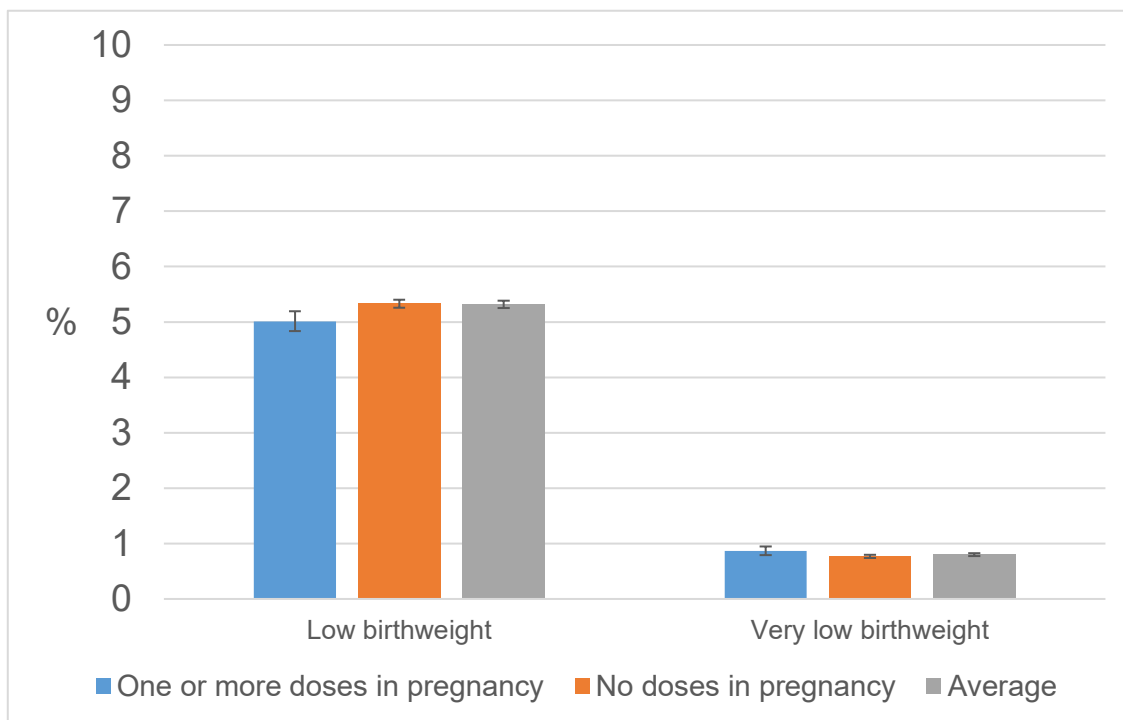
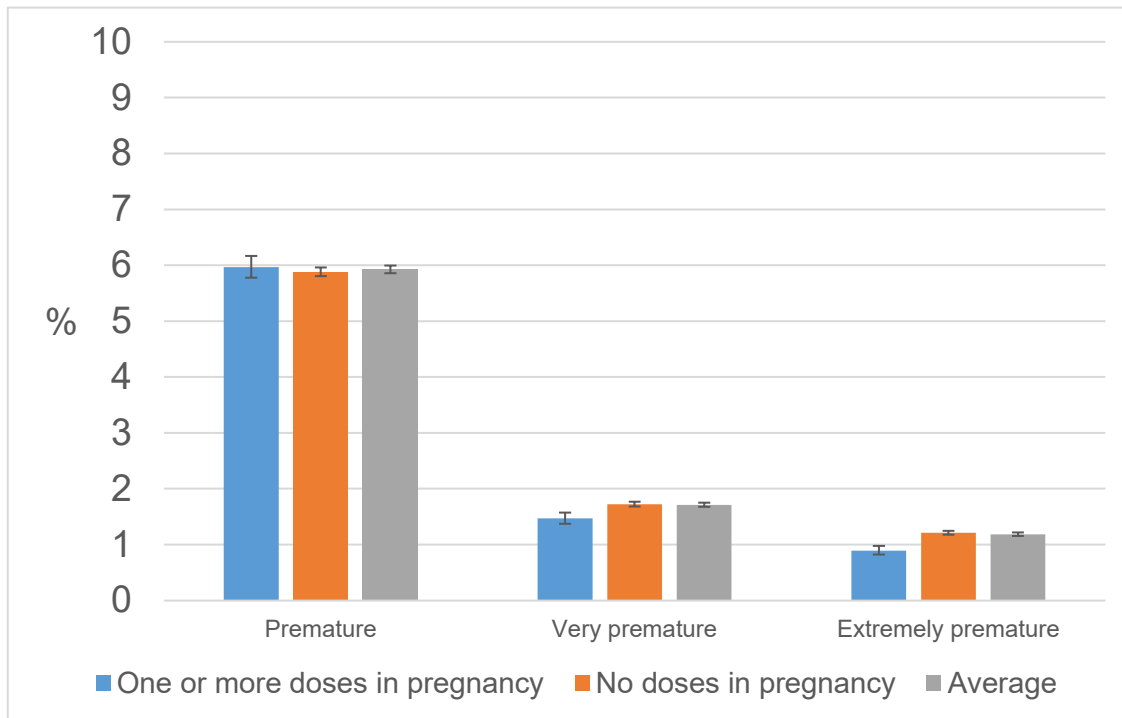


Figure 10: Women giving birth prematurely January to October 2021



The proportion of women giving birth between January and October without adverse outcomes having received one or more doses in pregnancy (91.9% 95%CI 91.6 to 92.1) is similar to the proportion in women who did not receive any doses in pregnancy (91.6% 95%CI 91.5 to 91.6) (Figure 4). These positive outcomes were similar across all age groups in vaccinated and unvaccinated women (Figure 5). For the more recent period (women vaccinated from 16 April and delivering from 17 April 2021), when all pregnant women were routinely offered vaccination on the basis of age, women who had received at least one dose of COVID-19 vaccine during their pregnancy were more likely to give birth without any of the reported adverse outcomes than women who had not been vaccinated in pregnancy (92.9% 95%CI 92.7 to 93.1 compared with 91.6% 95%CI 91.5 to 91.7) (Figure 6). This difference was more apparent in those aged 30 years and older (Figure 7).

The stillbirth rate for women who gave birth having received one or more doses in pregnancy (3.60 per 1,000, 95%CI 3.14 to 4.13) was similar to the rate for those who had not received any doses in pregnancy (3.90 per 1,000, 95%CI 3.71 to 4.10) giving birth between January and October 2021 (Figure 8). In the same period, the proportion of women who had received one or more doses in pregnancy giving birth to babies with low birthweight (5.01%, 95%CI 4.84 to 5.19) was comparable to those who had not received any doses in pregnancy (5.33%, 95%CI 5.26 to 5.40) (Figure 6). Similarly, 0.87% (95%CI 0.79 to 0.95) of women who had received one or more doses in pregnancy and 0.77% (95%CI 0.74 to 0.80) of those who had not, gave birth to a very low birthweight baby (Figure 9).

The proportion of women who received one or more doses in pregnancy having premature births was 5.97% (95%CI 5.78 to 6.17), compared with 5.88% (95%CI 5.81 to 5.96) in those

who had not (Figure 10). The proportion of women with very premature births was 1.47% (95%CI 1.37 to 1.57) in those who received one or more dose in pregnancy and 1.72% (95%CI 1.68 to 1.77) in those who had not. The proportion of women with extremely premature births was 0.89% (95%CI 0.82 to 0.97) in those who received one or more dose in pregnancy and 1.21% (95%CI 1.18 to 1.25) in those who had not.

Interpretation and limitations

The first women to be offered COVID-19 vaccine were those who were categorised as at risk of severe disease and women of older age who are at increased risk of the 3 adverse outcomes presented here (given the medical conditions that placed them in this category), together with healthcare professionals at higher risk of COVID-19 exposure. Women with underlying conditions that put them at very high risk of serious complications of COVID-19 will thus account for a relatively high proportion of early deliveries in women who had received one or more doses of the vaccine before 16 April 2021. It is therefore very reassuring that women who had received at least one dose of the vaccine in pregnancy were as likely to deliver live born babies at term without low birthweight and had no overall increased risk of any adverse outcome through January to October.

These findings support the conclusions on vaccine safety from COVID-19 vaccine surveillance report – week 47 ([COVID-19 vaccine weekly surveillance reports \(weeks 39 to 3, 2021 to 2022\)](#)).

More detailed statistical analyses are planned (see [COVID-19 vaccination in pregnancy surveillance protocol \(publishing.service.gov.uk\)](#)). The adverse pregnancy outcomes considered are routinely reported as official statistics annually by ONS, however HES data were used to monitor outcomes more quickly than ONS data allow. There are recognised limitations of the datasets including the level of completeness of the relevant fields.

Methods

The same methods as used to establish coverage figures were used to group records of deliveries into those who had received at least one dose of the vaccine during their pregnancy and those who had not. The definition of this second group includes any women who received dose(s) only prior to pregnancy and those who received their first dose after delivery, as well as those unvaccinated as of 19 January 2022. Outcomes are also presented by age at delivery, using the woman's date of birth as recorded in NIMS.

To identify deliveries where adverse outcomes were experienced; the following criteria were applied. The outcomes are related: for example babies born prematurely are more likely to be born with low birthweight, and therefore a delivery may have more than one adverse outcome. Stillbirths were identified as records where any one or more of the first 12 diagnoses was the following: Z37.1: Single stillbirth; Z37.3 Twins, one liveborn and one stillborn; Z37.4 Twins, both stillborn; Z37.6: Other multiple births, some liveborn; Z37.7: Other multiple births, all stillborn.

Low birthweight and very low birthweight deliveries were identified as records where any of the first 4 babies born had a known birthweight between 500g and 2,499g (1,499g or lower for very low birthweight).

Premature deliveries were identified as records where the gestational length was less than 37 weeks (less than 32 weeks for very premature, and less than 28 weeks for extremely premature).

Low birthweight is by convention presented as a percentage of all deliveries with known birthweights, and prematurity usually presented as a percentage of all deliveries with known gestational length. However here they are presented as percentages of all deliveries, to reduce the chance of significant findings arising from a change in the overall success of recording these fields during the pandemic. Figures will therefore differ from official statistics and should be considered for surveillance purposes only.

Confidence intervals were calculated using the Wilson Score method (38). A confidence interval is a range of values that is used to quantify the imprecision in the estimate of a particular indicator. Specifically it quantifies the imprecision that results from random variation in the measurement of the indicator. A wider confidence interval shows that the indicator value presented is likely to be a less precise estimate of the true underlying value.

Main findings

COVID-19 vaccination is the safest and most effective way for women to protect themselves and their babies against severe COVID-19 disease.

COVID-19 vaccine coverage in pregnant women at delivery has increased as more women have become eligible for vaccination reaching 41.3% for women who gave birth in October 2021 having had one or more dose before their baby was born. This is in line with coverage reported across the UK with 42.8% of women in Scotland and 41.0% in Wales delivering in October 2021 who had received any dose and their first dose of COVID-19 vaccine respectively prior to delivery.

As in the previous report, coverage increased with decreasing levels of deprivation and women of black ethnicity had the lowest vaccine coverage. Coverage increased with increasing age group to 35 to 39 years.

Whilst coverage has improved since the August coverage presented in the 25 November report (week 47 [COVID-19 vaccine weekly surveillance reports \(weeks 39 to 3, 2021 to 2022\)](#)) across all groups it continues to highlight inequalities consistent with those seen [across the entire](#)

[COVID-19 vaccination programme](#). The percentage point differences between the groups with highest and lowest coverage were greater than those in the November report.

It is very reassuring that women who had received at least one dose of the vaccine in pregnancy were as likely to deliver live born babies at term without low birthweight as women who were not vaccinated in pregnancy.

The group of women who were most likely to be immunised on the basis of their age group alone (vaccinated from 16 April 2021 and giving birth from 17 April 2021) were significantly more likely to deliver live born babies at term without low birthweight than women giving birth in the same period who were not vaccinated in pregnancy.

The specific outcomes that were considered (stillbirth, low birthweight and premature delivery) were similar in women who were and were not vaccinated whilst pregnant.

Vaccination status in cases, deaths and hospitalisations

Vaccination status of COVID-19 cases, deaths and hospitalisations by week of specimen date over the past 4 weeks up to week 2 (up to 16 January 2022) are shown in tables 10 to 12.

These data are published to help understand the implications of the pandemic to the NHS, for example understanding workloads in hospitals, and to help understand where to prioritise vaccination delivery. **These raw data should not be used to estimate vaccine effectiveness.** We have published a [blog post](#) to accompany this section of the vaccine surveillance report.

Methods

COVID-19 cases and deaths identified through routine collection from the Second Generation Surveillance System (SGSS) and from UKHSA EpiCell's deaths data, as described [in the technical summary](#), were linked to the National Immunisation Management System (NIMS) to derive vaccination status, using an individual's NHS number as the unique identifier.

Attendance to emergency care at NHS trusts was derived from the Emergency Care DataSet (ECDS) managed by NHS Digital. The same data source was used to identify COVID-19 cases where the attendance to emergency care resulted in admission to an NHS trust.

ECDS is updated weekly, and cases are linked to these data twice weekly. Data from ECDS are subject to reporting delays as, although NHS trusts may update data daily, the mandatory deadline for submission is by the 21st of every month. This means that for weeks immediately following the 21st of a month, numbers may be artificially low and are likely to be higher in later versions of the report.

Data from ECDS also only report on cases who have been presented to emergency care and had a related overnight patient admission and do not show those who are currently in hospital with COVID-19. As such, it is not appropriate for use for surveillance of those currently hospitalised with COVID-19. In addition, these data will not show cases who were directly admitted as inpatients without presenting to emergency care.

The outcome of overnight inpatient admission following presentation to emergency care, was limited to those occurring within 28 days of the earliest specimen date for a COVID-19 case. Deaths include those who died (a) within 28 days of the earliest specimen date or (b) within 60 days of the first specimen date or more than 60 days after the first specimen date with COVID-19 mentioned on the death certificate.

The rate of COVID-19 cases, hospitalisation, and deaths in fully vaccinated and unvaccinated groups was calculated using vaccine coverage data for each age group extracted at the mid-point of the reporting period from the National Immunisation Management Service.

Results

The rate of a positive COVID-19 test varies by age and vaccination status. The rate of a positive COVID-19 test is substantially lower in vaccinated individuals compared to unvaccinated individuals up to the age of 29. In individuals aged greater than 30, the rate of a positive COVID-19 test is higher in vaccinated individuals compared to unvaccinated (Table 13). This is likely to be due to a variety of reasons, including differences in the population of vaccinated and unvaccinated people as well as differences in testing patterns.

The rate of hospitalisation within 28 days of a positive COVID-19 test increases with age, and is substantially greater in unvaccinated individuals compared to vaccinated individuals.

The rate of death within 28 days or within 60 days of a positive COVID-19 test increases with age, and again is substantially greater in unvaccinated individuals compared to fully vaccinated individuals.

Interpretation of data

These data should be considered in the context of the vaccination status of the population groups shown in the rest of this report. In the context of very high vaccine coverage in the population, even with a highly effective vaccine, it is expected that a large proportion of cases, hospitalisations and deaths would occur in vaccinated individuals, simply because a larger proportion of the population are vaccinated than unvaccinated and no vaccine is 100% effective. This is especially true because vaccination has been prioritised in individuals who are more susceptible or more at risk of severe disease. Individuals in risk groups may also be more at risk of hospitalisation or death due to non-COVID-19 causes, and thus may be hospitalised or die **with** COVID-19 rather than **from** COVID-19.

The vaccination status of cases, inpatients and deaths should not be used to assess vaccine effectiveness because of differences in risk, behaviour and testing in the vaccinated and unvaccinated populations. The case rates in the vaccinated and unvaccinated populations are crude rates that do not take into account underlying statistical biases in the data. There are likely to be systematic differences between vaccinated and unvaccinated populations, for example:

- testing behaviour is likely to be different between people with different vaccination status, resulting in differences in the chances of being identified as a case
- many of those who were at the head of the queue for vaccination are those at higher risk from COVID-19 due to their age, their occupation, their family circumstances or because of underlying health issues
- people who are fully vaccinated and people who are unvaccinated may behave differently, particularly with regard to social interactions and therefore may have differing levels of exposure to COVID-19

- people who have never been vaccinated are more likely to have caught COVID-19 in the weeks or months before the period of the cases covered in the report. This gives them some natural immunity to the virus which may have contributed to a lower case rate in the past few weeks

These biases become more evident as more people are vaccinated and the differences between the vaccinated and unvaccinated population become systematically different in ways that are not accounted for without undertaken formal analysis of vaccine effectiveness. Vaccine effectiveness has been formally estimated from a number of different sources and is described on pages 4 to 15 in this report.

Denominator

The potential sources of denominator data are either the National Immunisation Management Service (NIMS) or the Office for National Statistics (ONS) mid-year population estimates. Each source has its strengths and limitations which have been described in detail on the [NHS website](#) and [GOV.Wales](#).

NIMS may over-estimate denominators in some age groups, for example because people are registered with the NHS but may have moved abroad. However, as it is a dynamic register, such patients, once identified by the NHS, are able to be removed from the denominator. On the other hand, ONS data uses population estimates based on the 2011 census and other sources of data. When using ONS, vaccine coverage exceeds 100% of the population in some age groups, which would in turn lead to a negative denominator when calculating the size of the unvaccinated population.

UKHSA uses NIMS throughout its COVID-19 surveillance reports including in the calculation rates of COVID-19 infection, hospitalisation and deaths by vaccination status because it is a dynamic database of named individuals, where the numerator and the denominator come from the same source and there is a record of each individual's vaccination status. Additionally, NIMS contains key sociodemographic variables for those who are targeted and then receive the vaccine, providing a rich and consistently coded data source for evaluation of the vaccine programme. Large scale efforts to contact people in the register will result in the identification of people who may be overcounted, thus affording opportunities to improve accuracy in a dynamic fashion that feeds immediately into vaccine uptake statistics and informs local vaccination efforts.

Sources of further information

UKHSA has published a [blog post to accompany this section of the report](#).

The Office of the Statistics Regulator [has published a blog post](#).

UKHSA has published a significant amount of [research into vaccine effectiveness](#) which is summarised on pages 4 to 15 of this report.

The Office for National Statistics has published research into the [risk of testing positive for COVID-19 by vaccination status](#), impact of Delta on viral burden and vaccine effectiveness (4), and the [risk of death by vaccination status](#).

Table 10. COVID-19 cases by vaccination status between week 52 2021 and week 3 2022

Please note that corresponding rates by vaccination status can be found in Table 13.

Cases reported by specimen date between week 52 2021 (w/e 02/01/2022) and week 3 2022 (w/e 23/01/2022)	Total	Unlinked*	Not vaccinated	Received one dose (1 to 20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date¹	Third dose ≥14 days before specimen date¹
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]						
Under 18	683,221	44,076	506,720	7,242	104,524	19,568	1,091
18 to 29	603,773	53,619	103,692	5,764	36,145	303,486	101,067
30 to 39	568,148	42,049	82,142	3,222	22,511	250,980	167,244
40 to 49	443,556	28,056	39,207	1,237	10,376	156,178	208,502
50 to 59	364,486	21,104	19,212	583	4,804	79,596	239,187
60 to 69	202,664	11,997	7,258	297	1,779	22,901	158,432
70 to 79	106,103	6,379	2,526	117	693	6,010	90,378
80 or over	62,458	5,760	1,664	44	641	6,142	48,207

* Individuals whose NHS numbers were unavailable to link to the NIMS.

¹ In the context of very high vaccine coverage in the population, even with a highly effective vaccine, it is expected that a large proportion of cases, hospitalisations and deaths would occur in vaccinated individuals, simply because a larger proportion of the population are vaccinated than unvaccinated and no vaccine is 100% effective. This is especially true because vaccination has been prioritised in individuals who are more susceptible or more at risk of severe disease. Individuals in risk groups may also be more at risk of hospitalisation or death due to non-COVID-19 causes, and thus may be hospitalised or die with COVID-19 rather than because of COVID-19.

Table 11. COVID-19 cases presenting to emergency care (within 28 days of a positive specimen) resulting in an overnight inpatient admission by vaccination status between week 52 2021 and week 3 2022

Please note that corresponding rates by vaccination status can be found in Table 13.

Cases presenting to emergency care (within 28 days of a positive test) resulting in overnight inpatient admission, by specimen date between week 52 2021 (w/e 02/01/2022) and week 3 2022 (w/e 23/01/2022)	Total	Unlinked*	Not vaccinated	Received one dose (1 to 20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date ¹	Third dose ≥14 days before specimen date ¹
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]						
Under 18	1,835	85	1,597	10	118	21	4
18 to 29	1,445	32	522	10	140	580	161
30 to 39	1,395	11	546	9	105	513	211
40 to 49	1,349	27	389	7	92	482	352
50 to 59	1,696	17	461	10	76	530	602
60 to 69	1,866	21	446	13	66	480	840
70 to 79	2,683	11	411	6	68	576	1,611
80 or over	4,025	6	435	3	96	817	2,668

* Individuals whose NHS numbers were unavailable to link to the NIMS.

¹ In the context of very high vaccine coverage in the population, even with a highly effective vaccine, it is expected that a large proportion of cases, hospitalisations and deaths would occur in vaccinated individuals, simply because a larger proportion of the population are vaccinated than unvaccinated and no vaccine is 100% effective. This is especially true because vaccination has been prioritised in individuals who are more susceptible or more at risk of severe disease. Individuals in risk groups may also be more at risk of hospitalisation or death due to non-COVID-19 causes, and thus may be hospitalised or die with COVID-19 rather than because of COVID-19.

Table 12. COVID-19 deaths (a) within 28 days and (b) within 60 days of positive specimen or with COVID-19 reported on death certificate, by vaccination status between week 52 2021 and week 3 2022

Please note that corresponding rates by vaccination status can be found in Table 13.

(a)

Death within 28 days of positive COVID-19 test by date of death between week 52 2021 (w/e 02/01/2022) and week 3 2022 (w/e 23/01/2022)	Total**	Unlinked*	Not vaccinated	Received one dose (1 to 20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date¹	Third dose ≥14 days before specimen date¹
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]						
Under 18	13	0	10	0	2	1	0
18 to 29	28	1	16	0	2	8	1
30 to 39	69	0	32	0	4	27	6
40 to 49	104	1	49	0	8	36	10
50 to 59	291	4	112	1	16	113	45
60 to 69	609	13	192	1	27	234	142
70 to 79	993	4	224	3	43	339	380
80 or over	2,530	13	375	4	79	803	1,256

* Individuals whose NHS numbers were unavailable to link to the NIMS.

** number of deaths of people who had had a positive test result for COVID-19 and either died within 60 days of the first positive test or have COVID-19 mentioned on their death certificate.

¹ In the context of very high vaccine coverage in the population, even with a highly effective vaccine, it is expected that a large proportion of cases, hospitalisations and deaths would occur in vaccinated individuals, simply because a larger proportion of the population are vaccinated than unvaccinated and no vaccine is 100% effective. This is especially true because vaccination has been prioritised in individuals who are more susceptible or more at risk of severe disease. Individuals in risk groups may also be more at risk of hospitalisation or death due to non-COVID-19 causes, and thus may be hospitalised or die with COVID-19 rather than because of COVID-19.

(b)

Death within 60 days of positive COVID-19 test by date of death between week 52 2021 (w/e 02/01/2022) and week 3 2022 (w/e 23/01/2022)	Total**	Unlinked*	Not vaccinated	Received one dose (1 to 20 days before specimen date)	Received one dose, ≥21 days before specimen date	Second dose ≥14 days before specimen date¹	Third dose ≥14 days before specimen date¹
	[These data should be interpreted with caution. See information below in footnote about the correct interpretation of these figures]						
Under 18	13	0	10	0	2	1	0
18 to 29	38	2	23	1	2	9	1
30 to 39	95	1	47	0	6	33	8
40 to 49	134	2	59	0	10	48	15
50 to 59	380	8	147	1	23	142	59
60 to 69	734	15	230	1	31	287	170
70 to 79	1188	5	244	4	48	436	451
80 or over	2,900	14	392	4	85	985	1,420

* Individuals whose NHS numbers were unavailable to link to the NIMS.

** number of deaths of people who had had a positive test result for COVID-19 and either died within 60 days of the first positive test or have COVID-19 mentioned on their death certificate.

¹ In the context of very high vaccine coverage in the population, even with a highly effective vaccine, it is expected that a large proportion of cases, hospitalisations and deaths would occur in vaccinated individuals, simply because a larger proportion of the population are vaccinated than unvaccinated and no vaccine is 100% effective. This is especially true because vaccination has been prioritised in individuals who are more susceptible or more at risk of severe disease. Individuals in risk groups may also be more at risk of hospitalisation or death due to non-COVID-19 causes, and thus may be hospitalised or die with COVID-19 rather than because of COVID-19.

Table 13. Unadjusted rates of COVID-19 infection, hospitalisation and death in vaccinated and unvaccinated populations.

Please note that the following table should be read in conjunction with pages 39 to 42 of this report, and the footnotes provided on page 47.

	Cases reported by specimen date between week 52 2021 (w/e 02/01/22) and week 03 2022 (w/e 23/01/22)		Cases presenting to emergency care (within 28 days of a positive test) resulting in overnight inpatient admission, by specimen date between week 52 2021 (w/e 02/01/22) and week 03 2022 (w/e 23/01/22)		Death within 28 days of positive COVID-19 test by date of death between week 52 2021 (w/e 02/01/22) and week 03 2022 (w/e 23/01/22)		Death within 60 days of positive COVID-19 test by date of death between week 52 2021 (w/e 02/01/22) and week 03 2022 (w/e 23/01/22)	
	[see information on population bases and unadjusted rates in footnotes 1 and 2 below this table]							
	Unadjusted rates among persons vaccinated with at least 3 doses (per 100,000)	Unadjusted rates among persons not vaccinated (per 100,000) ^{1,2}	Unadjusted rates among persons vaccinated with at least 3 doses (per 100,000)	Unadjusted rates among persons not vaccinated (per 100,000) ²	Unadjusted rates among persons vaccinated with at least 3 doses (per 100,000)	Unadjusted rates among persons not vaccinated (per 100,000) ²	Unadjusted rates among persons vaccinated with at least 3 doses (per 100,000)	Unadjusted rates among persons not vaccinated (per 100,000) ²
Under 18	2,290.5	4,935.1	8.4	15.6	0.0	0.1	0.0	0.1
18-29	3,477.9	3,361.8	5.5	16.9	0.0	0.5	0.0	0.7
30-39	4,489.6	2,996.7	5.7	19.9	0.2	1.2	0.2	1.7
40-49	4,499.0	2,389.5	7.6	23.7	0.2	3.0	0.3	3.6
50-59	3,894.4	1,928.0	9.8	46.3	0.7	11.2	1.0	14.8
60-69	2,971.6	1,367.2	15.8	84.0	2.7	36.2	3.2	43.3
70-79	1,995.7	1,051.4	35.6	171.1	8.4	93.2	10.0	101.6
≥80	1,920.9	1,365.2	106.3	356.9	50.0	307.7	56.6	321.6

¹ Comparing case rates among vaccinated and unvaccinated populations should not be used to estimate vaccine effectiveness against COVID-19 infection. Vaccine effectiveness has been formally estimated from a number of different sources and is summarised on pages 4 to 15 in this report.

The rates are calculated per 100,000 in people who have received either 3 doses of a COVID-19 vaccine or in people who have not received a COVID-19 vaccine. These figures are updated each week as the number of unvaccinated individuals and individuals vaccinated with 3 doses in the population changes.

The case rates in the vaccinated and unvaccinated populations are unadjusted crude rates that do not take into account underlying statistical biases in the data and there are likely to be systematic differences between these 2 population groups. For example:

- testing behaviour is likely to be different between people with different vaccination status, resulting in differences in the chances of being identified as a case
- many of those who were at the head of the queue for vaccination are those at higher risk from COVID-19 due to their age, their occupation, their family circumstances or because of underlying health issues
- people who are fully vaccinated and people who are unvaccinated may behave differently, particularly with regard to social interactions and therefore may have differing levels of exposure to COVID-19
- people who have never been vaccinated are more likely to have caught COVID-19 in the weeks or months before the period of the cases covered in the report. This gives them some natural immunity to the virus which may have contributed to a lower case rate in the past few weeks

² Case rates are calculated using NIMS - a database of named individuals from which the numerator and the denominator come from the same source and there is a record of each individuals vaccination status. Further information on the use of NIMS as the source of denominator data is presented on page 41 of this report.

Unadjusted case rates among persons vaccinated have been formatted in grey to further emphasise the caution to be employed when interpreting these data.

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 2021 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 the 8 December 2020 (week 50) with a phased roll out by age and risk group. From the beginning of September 2021, a third dose was offered to individuals with severe immunosuppression. A booster dose was introduced from 16 September 2021 for individuals aged 50 years and over, frontline health and social care staff, individuals aged 16 to 49 with certain underlying health conditions and household contacts of immunosuppressed individuals. Eligibility for booster doses was extended to individuals aged 40 years and over from 22 November and from December to those aged 18 to 39 in a phased rollout by age group. Booster doses are generally given at least 6 months after the second dose, although the minimum interval was reduced to at least 3 months from the second or third dose in an effort to accelerate the roll out with the emergence of the Omicron variant.

Please note that this section will be updated monthly. Last update was published on 13 January 2022.

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 7 full days post vaccination, and for at least 28 days post recovery if side-effects following vaccination or COVID-19 infection.

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

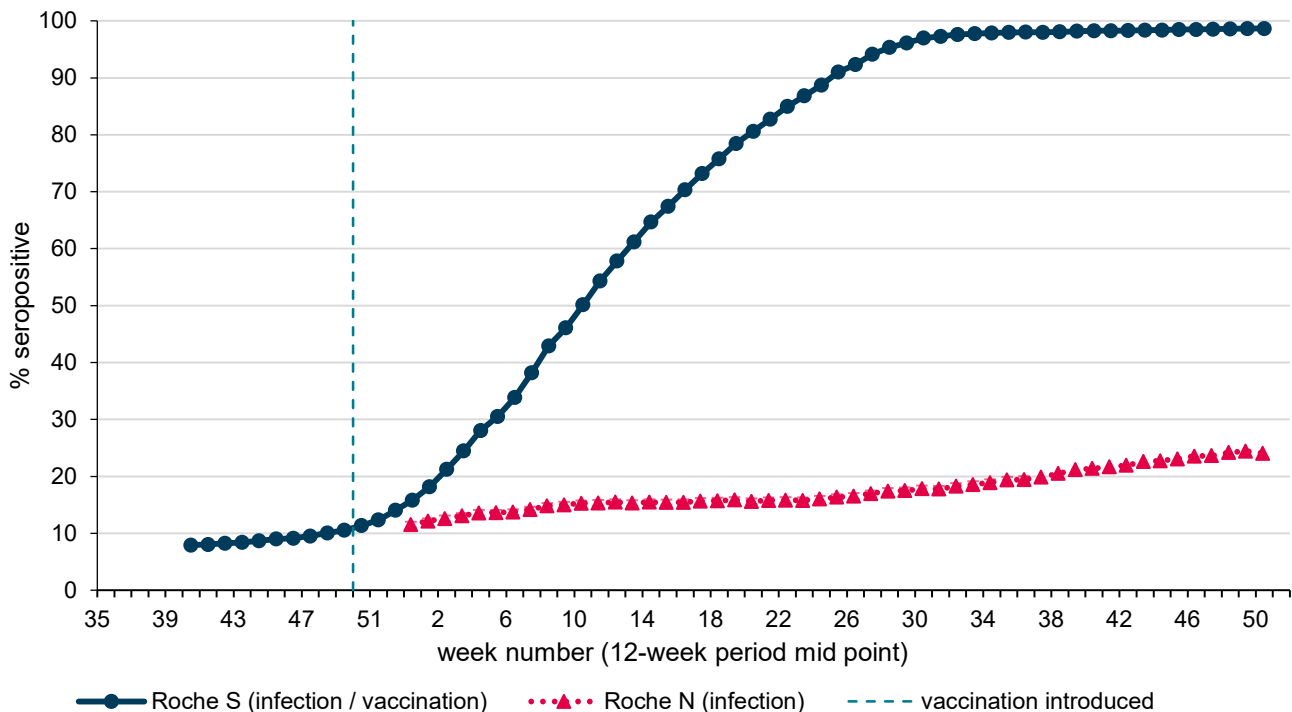
weeks previously, and are unlikely to reflect the recent increase in infection due to the Omicron variant. Seroprevalence estimates reported are based on seropositivity which are unadjusted for the sensitivity and specificity of the assays used.

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 24.1% (95% CI 23.3% - 24.9%) using the Roche N assay and 98.7% (95% CI 98.4% - 98.9%) using the Roche S assay for the period 8 November to 31 December (weeks 45 to 52 2021). 2,855 out of 12,163 were Roche N positive and 11,848 out of 12,010 samples were Roche S positive. This compares with 20.5% (95% CI 19.9% - 21.1%) Roche N seropositivity and 98.1% (95% CI 97.9% - 98.3%) Roche S seropositivity for the period of 16 August to 7 November 2021 (weeks 33 to 44 2021).

Seropositivity (weighted by region, age group and sex) varies over time. Figure 11 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 11. 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 12).

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

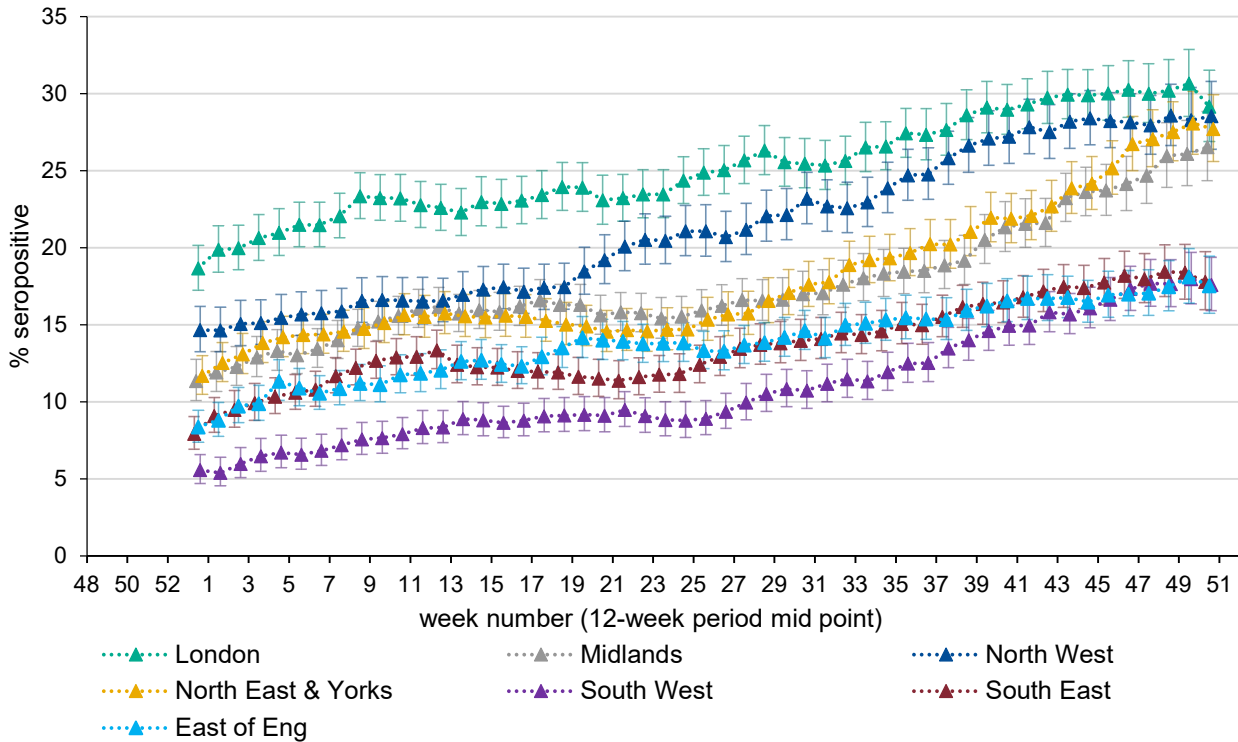


Table 14. Roche N seropositivity (95%CI) estimates by NHS region

NHS region	Weeks 33 to 44	Weeks 45 to 52
East of England	15.9% (14.6% - 17.3%)	17.5% (15.8% - 19.5%)
London	28.6% (27.0% - 30.2%)	29.2% (26.9% - 31.5%)
Midlands	19.2% (17.6% - 20.8%)	26.5% (24.3% - 28.8%)
North East and Yorkshire	21.0% (19.5% - 22.7%)	27.7% (25.6% - 29.9%)
North West	26.6% (24.9% - 28.4%)	28.5% (26.4% - 30.8%)
South East	16.1% (14.8% - 17.6%)	17.8% (16.0% - 19.7%)
South West	14.0% (12.7% - 15.4%)	17.6% (15.9% - 19.4%)

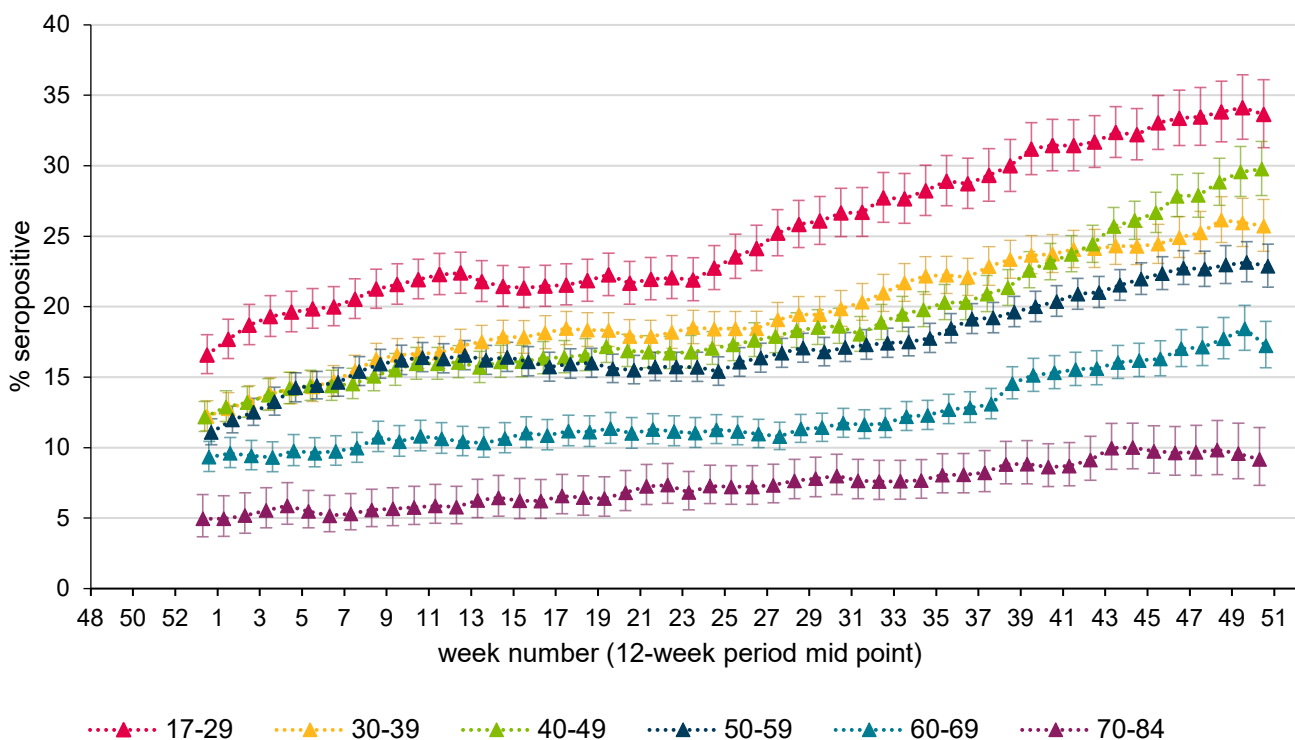
Increases in Roche N seropositivity have recently been observed across all regions (Table 14) compared to the previous 12-week period with the most notable increases in the Midlands and North East and Yorkshire regions.

London has consistently seen the highest Roche N seropositivity although levels have remained relatively stable in recent weeks. Seropositivity in the North West has continued to increase and is approaching similar levels to London. Whilst seropositivity has consistently been lowest in the South West, recent increases have resulted in the region reaching similar levels to those observed in the East of England and the South East. With the emergence of the Omicron variant considerable increases in COVID-19 case rates in England have been observed across all regions with the highest case rates are in the North West and North East ([Weekly national Influenza and COVID-19 surveillance report week 1](#)). However the impact of the Omicron wave is not currently evident in the most recent seroprevalence data, given that it takes approximately 2 to 3 weeks to developing an antibody response following infection and the 28 day deferral for individuals to donate following infection.

Prevalence by age group

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

Figure 13. 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 13) 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 15. Roche N seropositivity (95%CI) estimates by age group

Age group	Weeks 33 to 44	Weeks 45 to 52
17-29	30.0% (28.2% - 31.9%)	33.6% (31.3% - 36.1%)
30-39	23.3% (22.0% - 24.7%)	25.7% (23.9% - 27.6%)
40-49	21.3% (20.1% - 22.6%)	29.8% (27.9% - 31.7%)
50-59	19.6% (18.6% - 20.7%)	22.9% (21.4% - 24.4%)
60-69	14.5% (13.4% - 15.7%)	17.2% (15.7% - 19.0%)
70-84	8.8% (7.4% - 10.4%)	9.2% (7.3% - 11.4%)

Increases in Roche N seropositivity have recently been observed across all age groups (Table 15) compared to the previous 12-week period. In the most recent period, the largest increase in seropositivity was observed in those aged 40 to 49, this age group has the second highest seropositivity after the 17 to 29 year olds. In England, COVID-19 case rates for weeks 48 to 52 increased across all age groups with the highest rates in individuals aged 20 to 29 followed by 30 to 39 years olds ([Weekly national Influenza and COVID-19 surveillance report week 1](#)).

Roche S seropositivity in blood donors has plateaued and is now over 96% across all age groups.

Seropositivity estimates for S antibody in blood donors are likely to be higher than would be expected in the general population and this probably reflects 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) blood donors are potentially less likely to be exposed to natural infection than age matched individuals in the general population (ii) waning of the N antibody response over time and (iii) recent observations from UK Health Security Agency (UKHSA) surveillance data that N antibody levels are lower in individuals who acquire infection following 2 doses of 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, initially amongst individuals aged 50 years and above who were prioritised for vaccination as part of the phase 1 programme and subsequently in younger adults as part of phase 2 of the vaccination programme. The impact of the booster vaccination programme 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 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 PHE/UKHSA surveillance over the past few months has found that over 97% 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 programme. In the previous report, groupings of antibody level ranges were updated to better illustrate changes over time.

Figure 14 shows monthly categorised Roche S levels in N-antibody negative individuals by age group. Almost all tested S-antibody negative during December. In the 3 oldest age groups, the impact of first vaccine dose, then second vaccine dose, can be seen from January through June, as the profile of population antibody levels increases. Then from June through September the profile of antibody levels in these cohorts gradually decreases, consistent with waning. During October there was a small increase in percentage of donors with very high antibody levels of 10,000+ AU/ml for the 50 to 84 age group, following the initiation of the booster programme. In November the proportion of donors with very high antibody levels of 10,000+ AU/ml increased further particularly in those aged 70 to 84 years. In December large increases were observed in the proportion of donors aged 50 to 69 with very high antibody levels of 10,000+ AU/ml. Increases were also observed in younger age groups as the booster programme was accelerated due to the emergence of the Omicron variant. The higher profile of antibody levels in the youngest age group, is likely a result of a combination of factors including stronger immune responses in younger individuals and the higher antibody levels produced after mRNA vaccination.

Figure 15 shows categorised Roche S levels in N-antibody positive individuals, those likely to have experienced past infection. Pre-vaccination antibody levels will be influenced by time since infection, variant and severity of infection, as well as individual factors such as underlying health conditions and age. At the start of the vaccination rollout in December 2020 antibody levels typically sat within the range of 0.8 to 2,500 AU/ml, after vaccination antibody levels typically exceed 2,500 AU/ml. In November more than half of donors aged 70 to 84 years had very high antibody levels of 25,000+ AU/ml. In December increases in the proportion of donors with very high antibody levels of 25,000+ AU/ml were observed across all age groups with the largest increases in the 50 to 69 age groups. Comparing Figure 14 with Figure 15, 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.

Researchers across the globe are working to better understand what antibody levels mean in terms of protection against COVID-19. Current thinking is that there is no threshold antibody level that offers complete protection against infection, but instead that higher antibody levels are likely to be associated with lower probability of infection.

Figure 14. Categorised Roche S antibody levels by age group and month in N negative samples, December 2020 to December 2021

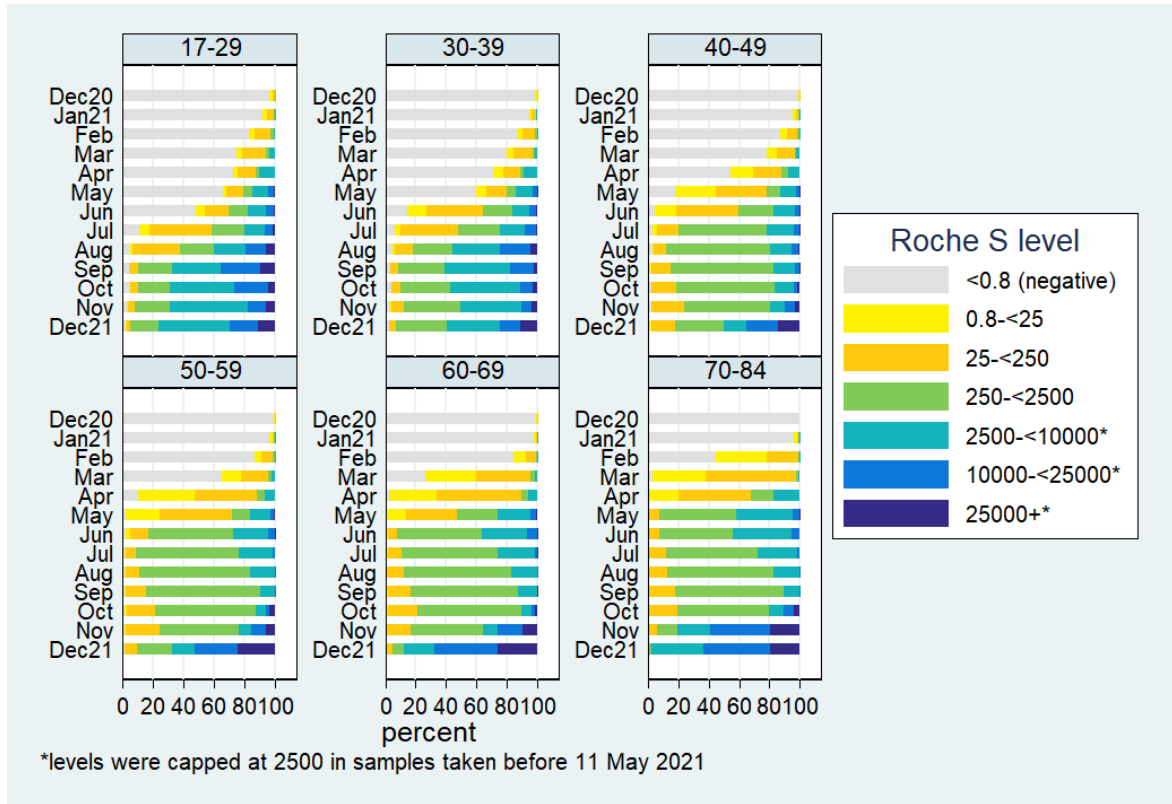
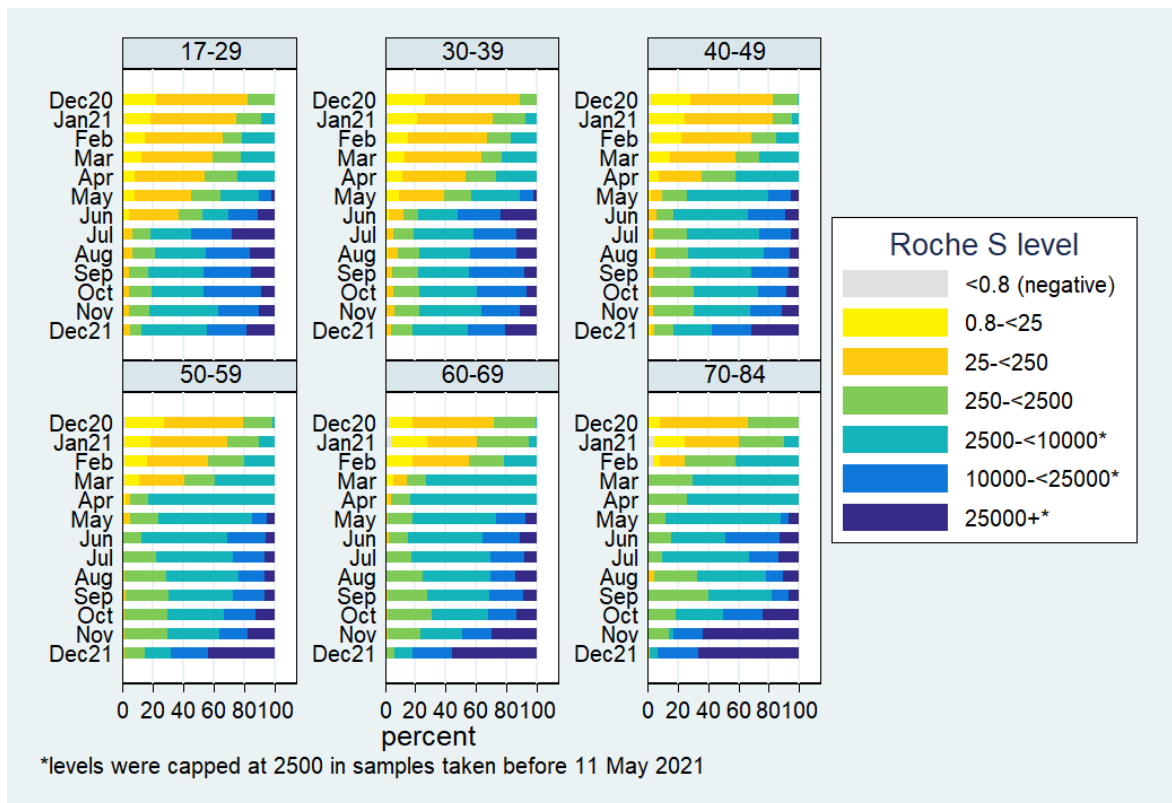


Figure 15. Categorised Roche S antibody levels by age group and month in N positive samples, December 2020 to December 2021



Summary of impact on hospitalisations, infections and mortality

UKHSA previously reported on the number of hospitalisations directly averted by vaccination. In total, around 261,500 hospitalisations have been prevented in those aged 45 years and over up to 19 September 2021.

UKHSA and University of Cambridge MRC Biostatistics Unit previously reported on the direct and indirect impact of the vaccination programme on infections and mortality. Estimates suggest that 127,500 deaths and 24,144,000 infections have been prevented as a result of the COVID-19 vaccination programme, up to 24 September.

Neither of these models will be updated going forward. This is due to these models being unable to account for the interventions that would have been implemented in the absence of vaccination. Consequently, over time the state of the actual pandemic and the no-vaccination pandemic scenario have become increasingly less comparable. For further context surrounding this figure and for previous estimates, please see previous vaccine surveillance reports.

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