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

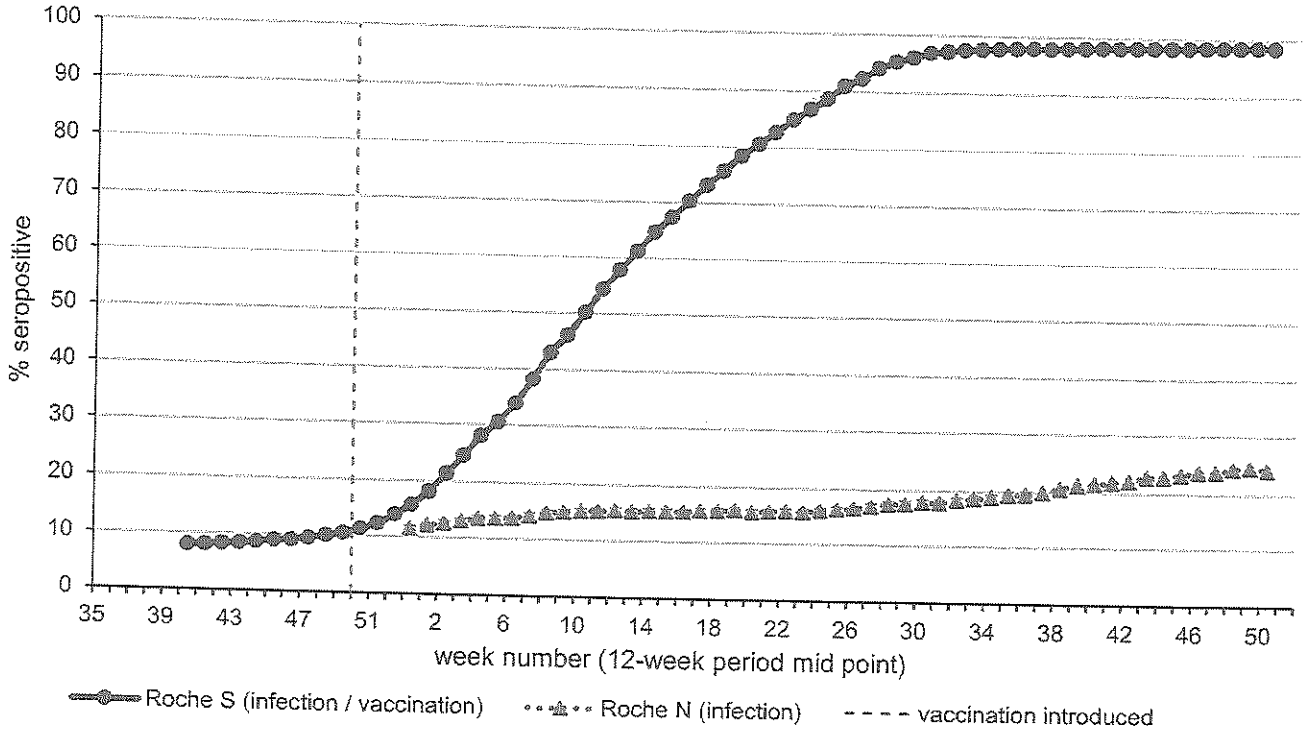
weeks previously, and are unlikely to reflect the recent increase in infection due to the Omicron variant. Seroprevalence estimates reported are based on seropositivity which are unadjusted for the sensitivity and specificity of the assays used.

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.

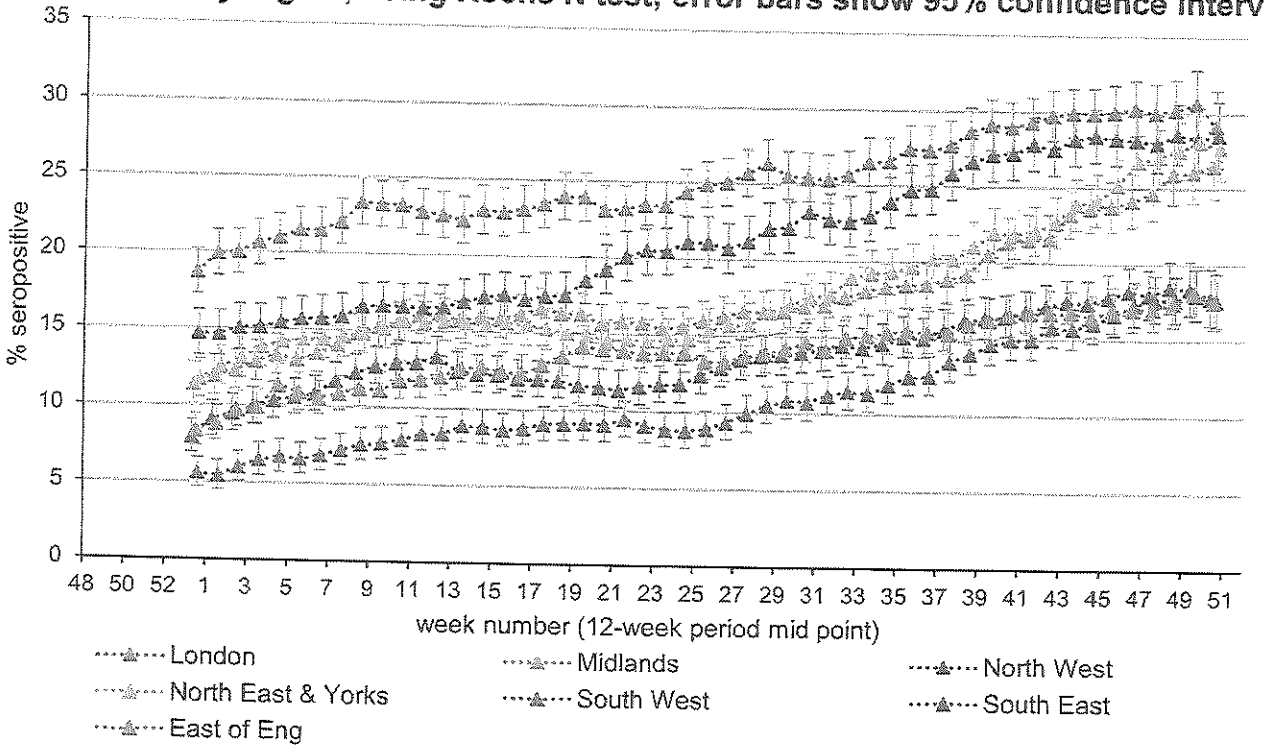


Table 14. Roche N seropositivity (95%CI) estimates by NHS region

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%)

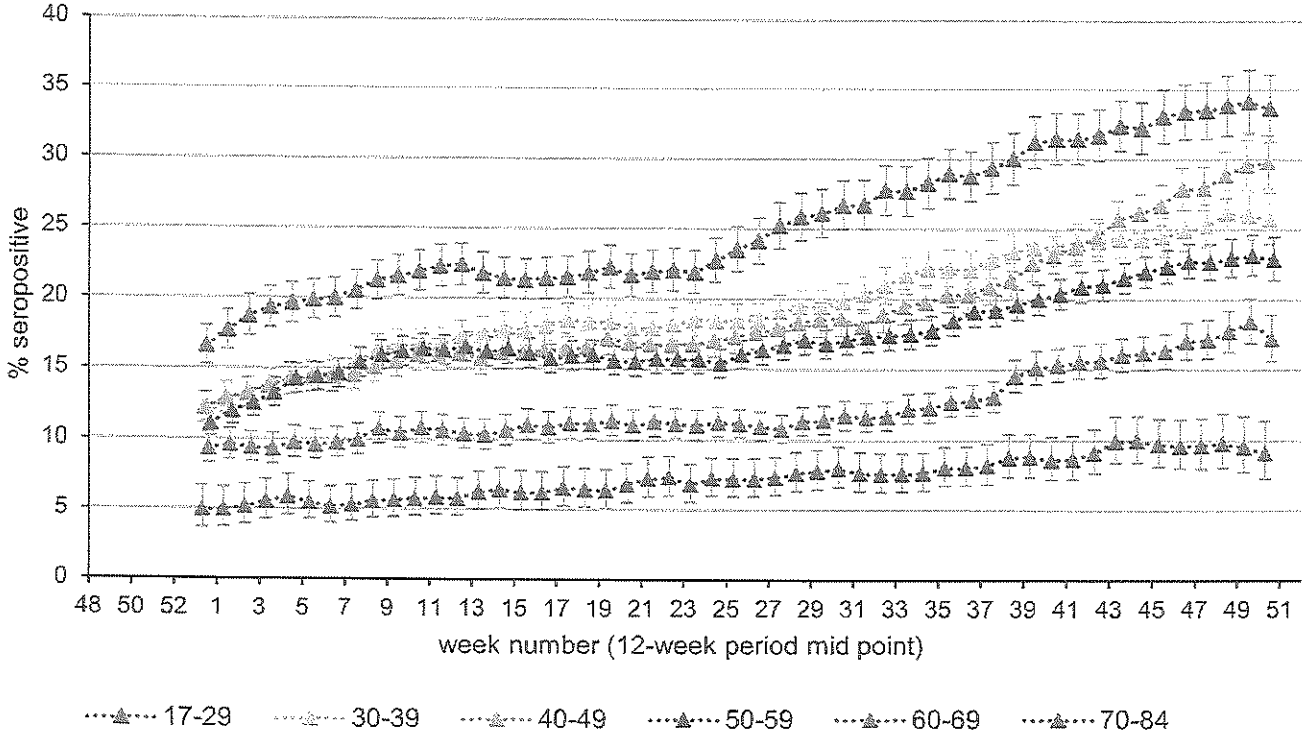
Increases in Roche N seropositivity have recently been observed across all regions (Table 14) compared to the previous 12-week period with the most notable increases in the Midlands and North East and Yorkshire regions.

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

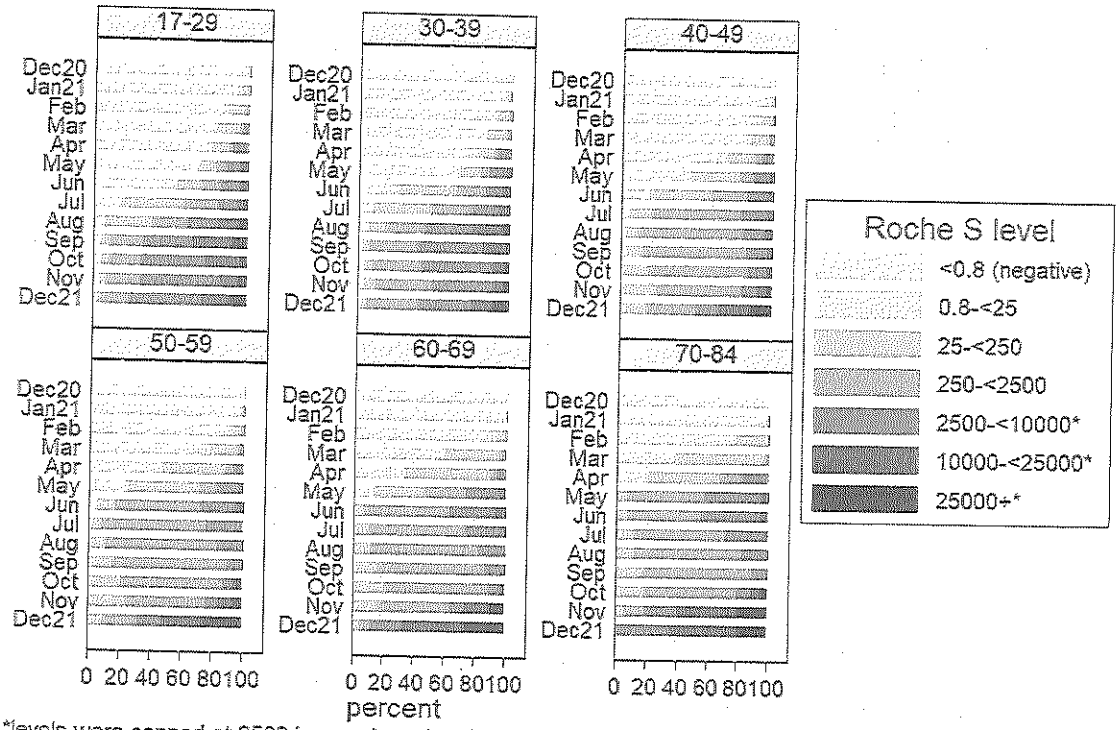
The Roche S assay that the UKHSA uses for serological surveillance is fully quantitative, meaning that it measures the level of antibodies in a blood sample; an antibody level above 0.8 AU/ml (approximately 1 IU/ml using the WHO standard) is deemed positive. The PHE/UKHSA surveillance over the past few 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.

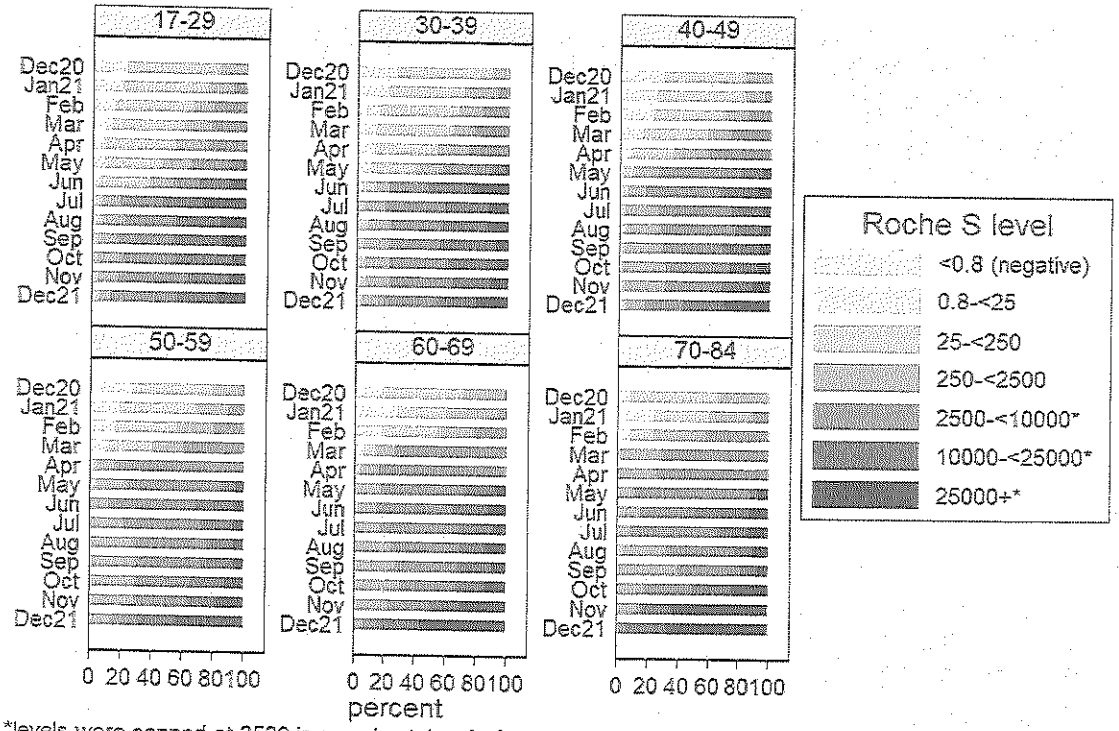
Researchers across the globe are working to better understand what antibody levels mean in terms of protection against COVID-19. Current thinking is that there is no threshold antibody level that offers complete protection against infection, but instead that higher antibody levels are likely to be associated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



*levels were capped at 2500 in samples taken before 11 May 2021

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



*levels were capped at 2500 in samples taken before 11 May 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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