Public Health England

Protecting and improving the nation's health

COVID-19 vaccine surveillance report

Week 23

Contents

Summary

Three 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.

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 Public Health England 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 which indicate that a single dose of either vaccine is between 55 and 70% effective against symptomatic disease, with higher levels of protection against severe disease including hospitalisation and death. Additional protection is seen after a second dose. There is now also evidence from a number of studies that the vaccines are effective at protecting against infection and transmission.

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 1 and 2 doses of COVID-19 vaccines. By 9 June 2021, the overall vaccine uptake in England for dose 1 was 54.4% and 38.2% for dose 2. In line with the programme rollout, coverage is highest in the oldest age groups.

Based on antibody testing of blood donors, 77.4% of the adult population now have antibodies to COVID-19 from either infection or vaccination compared to 15.1% that have antibodies from infection alone. Over 98% of adults aged 50 or older have antibodies from either infection or vaccination. The latest estimates indicate that the vaccination programme has averted 42,000 hospitalisations and over 14,000 deaths in older adults.

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. It is important to continue to evaluate the effectiveness of vaccines in the 'real world', as this may differ to clinical trial efficacy. The clinical trials are also performed in order 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. Nevertheless, understanding the effectiveness against different outcomes (such as severe disease and onwards transmission), effectiveness in different subgroups of the population and understanding the duration of protection are equally important in decision making around which vaccines should be implemented as the programme evolves, who they should be offered to and whether booster doses are required.

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. The majority of this data relates to a period when the main circulating virus was the B.1.1.7 variant, emerging data on effectiveness against symptomatic disease with the B.1.617.2 variant is also summarised below. 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 NIMS and from the COVID Infection Survey. Current evidence is primarily from older adults, who were among the earliest group vaccinated. Estimates of vaccine effectiveness range from around 55 to 70% after 1 dose, with little evidence of variation by vaccine or age group (3, 4, 5). Data on 2 doses is indicates effectiveness of around 65 to 90% (3, 6).

The majority of existing estimates relate to a period when the VOC-20DEC-01 (B.1.1.7) variant was the main circulating strain. PHE has undertaken analysis of vaccine effectiveness against symptomatic disease with VOC21-APR-02 (B.1.617.2), using the national genomic and immunisation datasets. The full methodology and analysis are available here (7). These findings suggest that while there is a reduction in vaccine effectiveness against VOC-21APR-02 (B.1.617.2) after 1 dose, any reduction in vaccine effectiveness after 2 doses of vaccine is likely to be small. These data combine all vaccines, and a breakdown by vaccine is provided in the full analysis.

After a single dose there was a 17% absolute reduction in vaccine effectiveness against symptomatic disease with B.1.617.2 compared to B.1.1.7, but only a modest reduction in vaccine effectiveness after 2 doses (Table 1).

Table 1: Vaccine effectiveness for VOC-20DEC-01 (B.1.1.7) and VOC21-APR-02 (B.1.617.2) by dose for any vaccine

Vaccination status	Vaccine Effectiveness	
	VOC-20DEC-01 (B.1.1.7)	VOC21-APR-02 (B.1.617.2)
Dose 1	50.2 (46.7 to 53.5)	33.2 (25.8 to 39.9)
Dose 2	88.4 (85.7 to 90.7)	80.8 (76.3 to 84.4)

Effectiveness against hospitalisation

Several studies have estimated the effectiveness against hospitalisation in older adults, all of which indicate higher levels of protection against hospitalisation after a single dose than that seen against symptomatic disease, around 75 to 85% after 1 dose of the Pfizer-BioNTech or Oxford-AstraZeneca vaccine (3, 8, 9, 10). Data on 2 doses is only currently available for the Pfizer-BioNTech vaccine and indicates effectiveness against hospitalisation of around 90 to 95% (10).

Effectiveness against mortality

Data is also emerging which suggests high levels of protection against mortality. Studies linking community COVID-19 testing data, vaccination data and mortality data indicate that both the Pfizer-BioNTech and Oxford-AstraZeneca vaccines are around 75 to 80% effective at preventing death with COVID-19 after a single dose (3, 11). Data on 2 doses is only currently available for the Pfizer-BioNTech vaccine and indicates effectiveness against dying with COVID-19 of around 95 to 99% (11).

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 Pfizer-BioNTech, estimates of effectiveness against infection range from around 55 to 70%, with the Oxford-AstraZeneca vaccine they range from around 60 to 70% (5, 12, 13, 14). Estimates for 2 doses are currently only available

for the Pfizer-BioNTech vaccine and indicate effectiveness against infection of 70 to 90% (5,12).

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 effective at preventing transmission. Data from Scotland has also shown that household contacts of vaccinated healthcare workers are at reduced risk of becoming a case, which is in line with the studies on infection (15). 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). A household transmission study in England found that household contacts of cases vaccinated with a single dose had approximately 35 to 50% reduced risk of becoming a confirmed case of COVID-19. This study used routine testing data so would only include household contacts that developed symptoms and went on to request a test via pillar 2. It cannot exclude asymptomatic secondary cases or mildly symptomatic cases who chose not to request a COVID-19 test (16).

Table 2. Summary of evidence on vaccine effectiveness against different outcomes

Outcome	Vaccine effectiveness			
	Pfizer-BioNTech		Oxford-AstraZeneca	
	1 dose	2 doses	1 dose	2 doses
Symptomatic disease	55-70%	85-90%	55-70%	65-90%
Hospitalisation	75-85%	90-95%	75-85%	No data
Mortality	75-80%	95-99%	75-80%	No data
Infection	55-70%	70-90%	60-70%	No data
Transmission (secondary cases)*	45-50%	No data	35-50%	No 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 in reducing symptomatic secondary cases in households of a symptomatic index case

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.

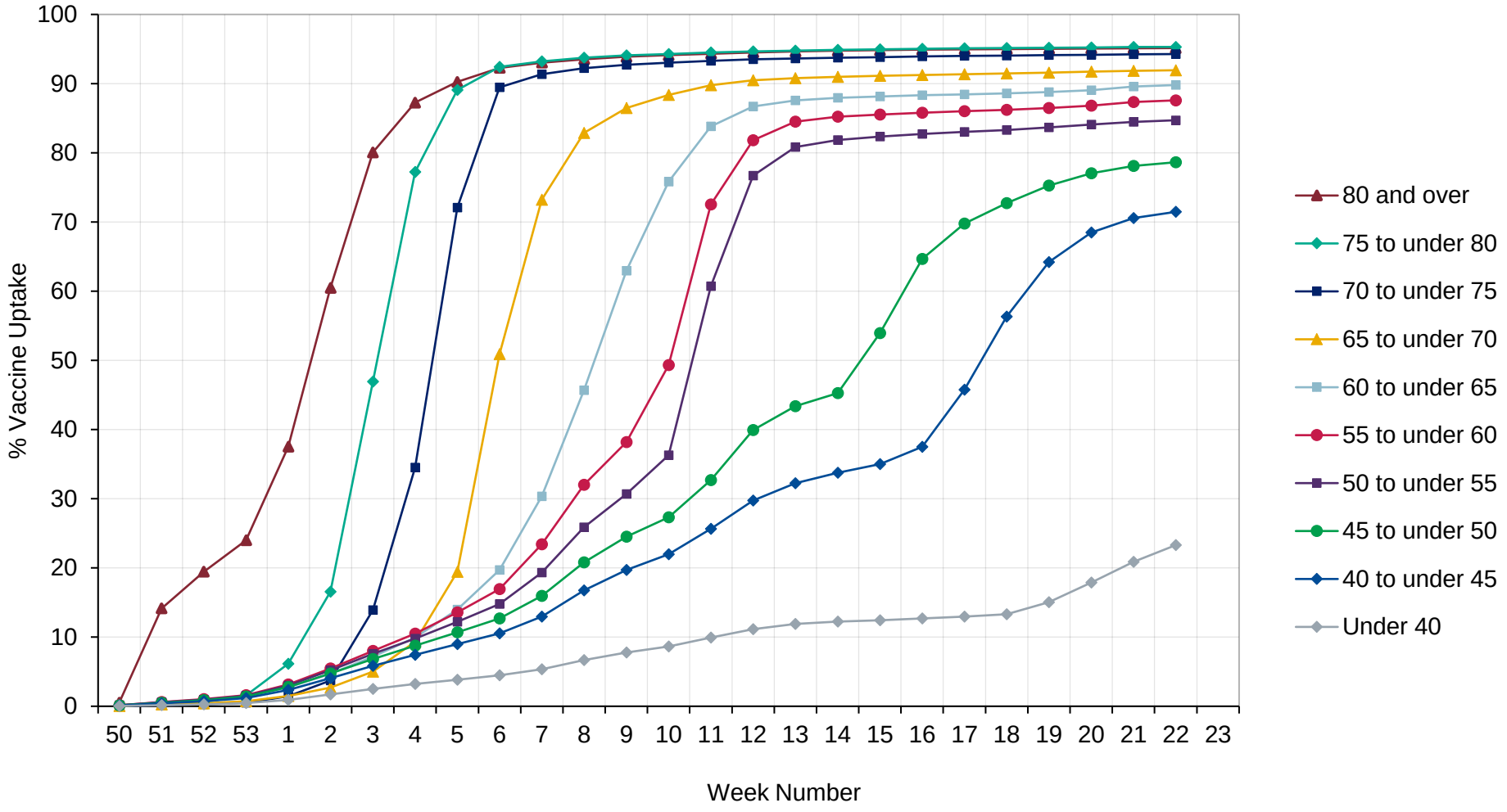
PHE and other government and academic partners monitor the impact of the of the vaccination programme on levels of COVID-19 antibodies in the population and different disease indicators, including hospitalisations and mortality. This is done through population-based testing and through modelling which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

Vaccine Coverage

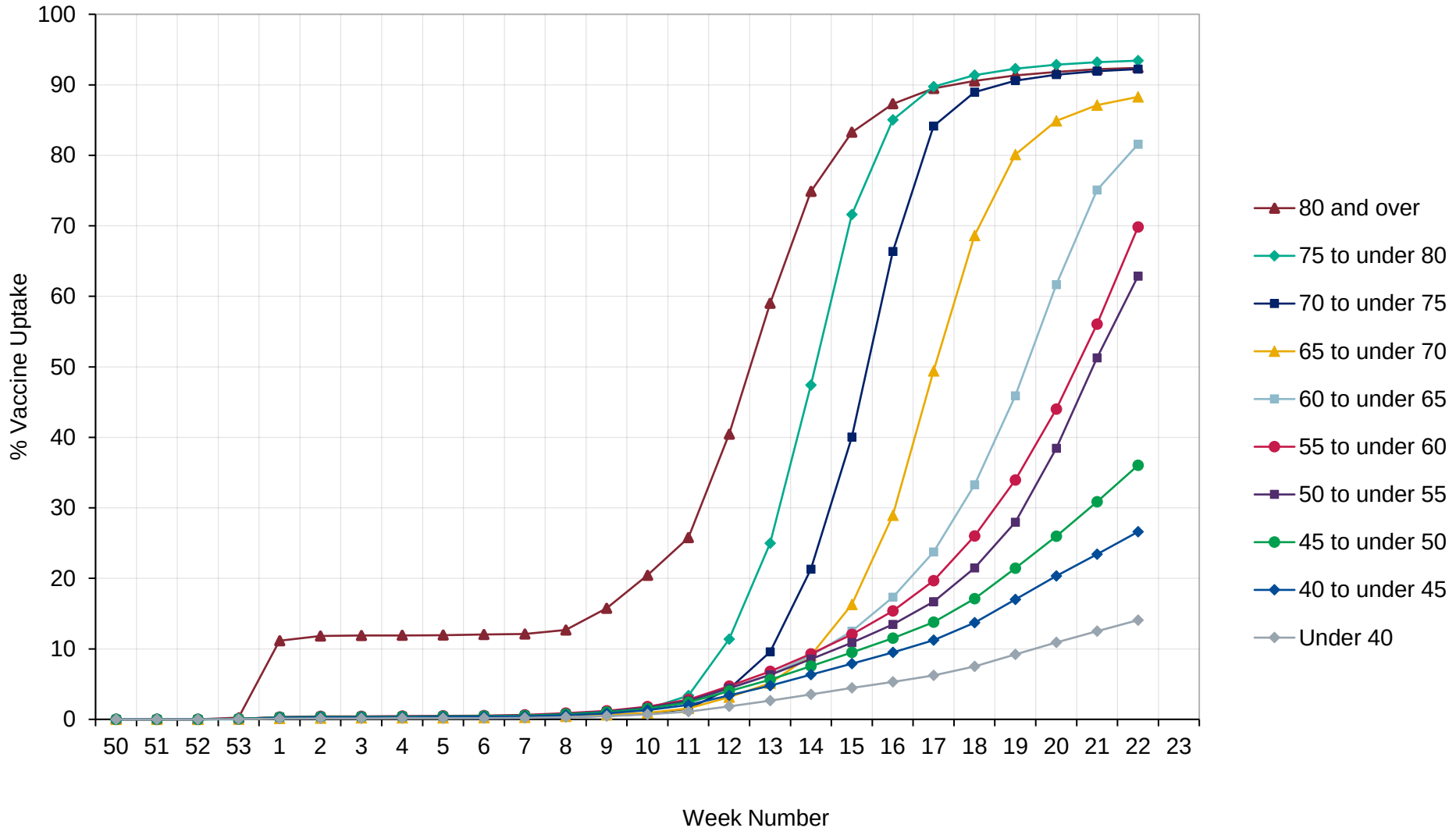
The data in this week's report covers the period from 8 December 2020 to 6 June 2021 (week 22) (Figure 1). It shows the provisional number and percentage of people in England who have had received 1 dose or 2 doses of a COVID-19 vaccination by age group and week since the start of the programme.

Figure 1. Cumulative weekly vaccine uptake by age

a) Dose 1



b) Dose 2


100
90
80
70
60
50
40
30
20
10
0
% Vaccine Uptake
50 51 52 53 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Week Number
80 and over
75 to under 80
70 to under 75
65 to under 70
60 to under 65
55 to under 60
50 to under 55
45 to under 50
40 to under 45
Under 40

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

PHE monitors the proportion of the population with antibodies to COVID-19 by testing samples provided by healthy adult blood donors aged 17 years and older, supplied by the NHS Blood and Transplant (NHS BT collection). This is important in helping to understand the extent of spread of COVID-19 infection (including asymptomatic infection) in the population and the impact of the vaccine programme. 250 samples from every geographic region in England are tested each week using 2 different laboratory tests, the Roche nucleoprotein (N) and Roche spike (S) antibody assays. This dual testing helps to distinguish between antibodies that are produced following natural COVID-19 infection and those that develop after vaccination. 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 the proportion of samples testing positive on the Roche N assay will reflect the effect of natural infection and spread of COVID-19 in the population. Increases in the proportion positive as measured by S antibody will reflect both infection and vaccination. Antibody responses reflect infection or vaccination occurring at least 2 to 3 weeks previously given the time taken to generate an antibody response.

In this report, we present the results using a 4-weekly average, of testing samples up to 30 May 2021, which takes account of the age and geographical distribution of the English population. Overall, the proportion of the population with antibodies using the Roche N and Roche S assays respectively were 15.1% and 77.4% for the period 3 May to 30 May (weeks 18 to 21) (Figure 2). This compares with 16.5% Roche N seropositivity and 70.0% Roche S seropositivity for the period of 8 April 2021 to 2 May 2021 (weeks 14 to 17). During this period seropositivity using the Roche N assay has remained stable suggesting there hasn't been significant ongoing spread of infection in the population and the continuing increase in seropositivity using the Roche S assay reflects the growing proportion of adults who have developed antibodies following vaccination.

Figure 3a and 3b show the proportion of the population with antibodies by age group. Roche N seropositivity has continued to plateau across most age groups and this was first observed in the 70 to 84 age group.

The increase in vaccination especially in the older age groups is seen by the sharp increase in seropositivity using the Roche S assay (Figure 3b). Roche S seropositivity in donors aged 70 to 84 increased and plateaued since week 13, reaching 98.9% in weeks 18 to 21. Seropositivity has now also plateaued since week 16 for those aged 60 to 69 reaching 98.4% in weeks 18 to 21. An increase in Roche S seropositivity has been observed in those aged 50 to 59 from 94.4% in weeks 14 to 17 to 98.2% in weeks 18 to 21. A notable increase is also seen in the 40 to 49 year olds from 56.8% in weeks 14 to

17 to 85.7% in weeks 18 to 21. A small increase is now being observed in the 30 to 39 year olds increasing from 42.0% in weeks 14 to 17 to 51.8% in weeks 18 to 21.

The impact of the vaccination programme is clearly evident from the increases in the proportion of the adult population with antibodies based on Roche S testing. This is particularly evident amongst individuals aged 50 years and above who have been prioritised for vaccination as part phase 1 of the programme and since week 15 in those aged 40 to 49 and 30 to 39 years old as part of phase 2 of the vaccination programme. This is further supported by the earlier plateauing in the proportion testing positive using the Roche N assay, in older age groups and likely reflects the additional role of vaccination is having in reducing infection ahead of reductions seen from national restrictions alone in younger age groups.

Figure 2: Overall population weighted 4-weekly rolling SARS-CoV-2 antibody seroprevalence (% seropositive) in blood donors from the Roche S and Roche N assays.

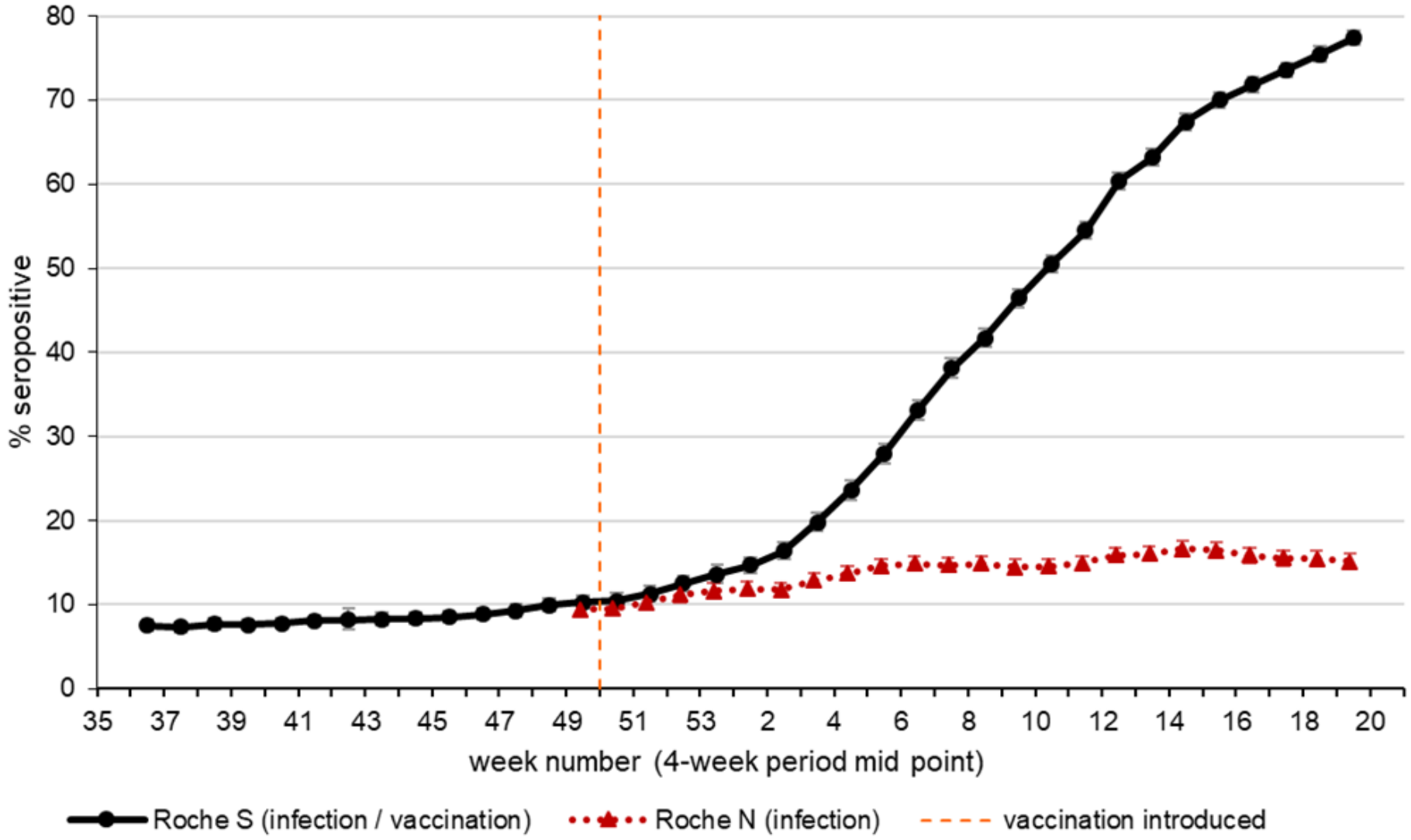
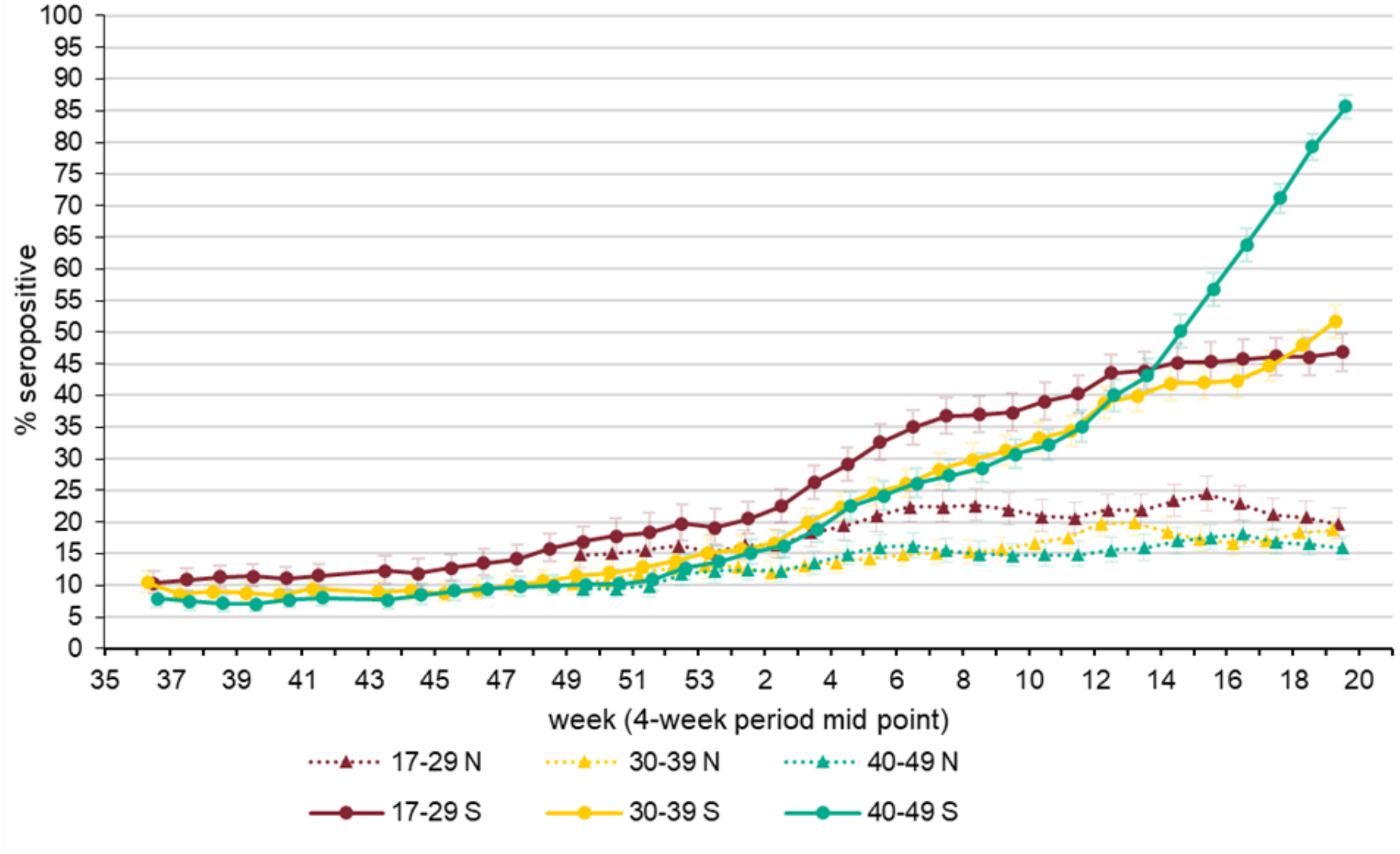
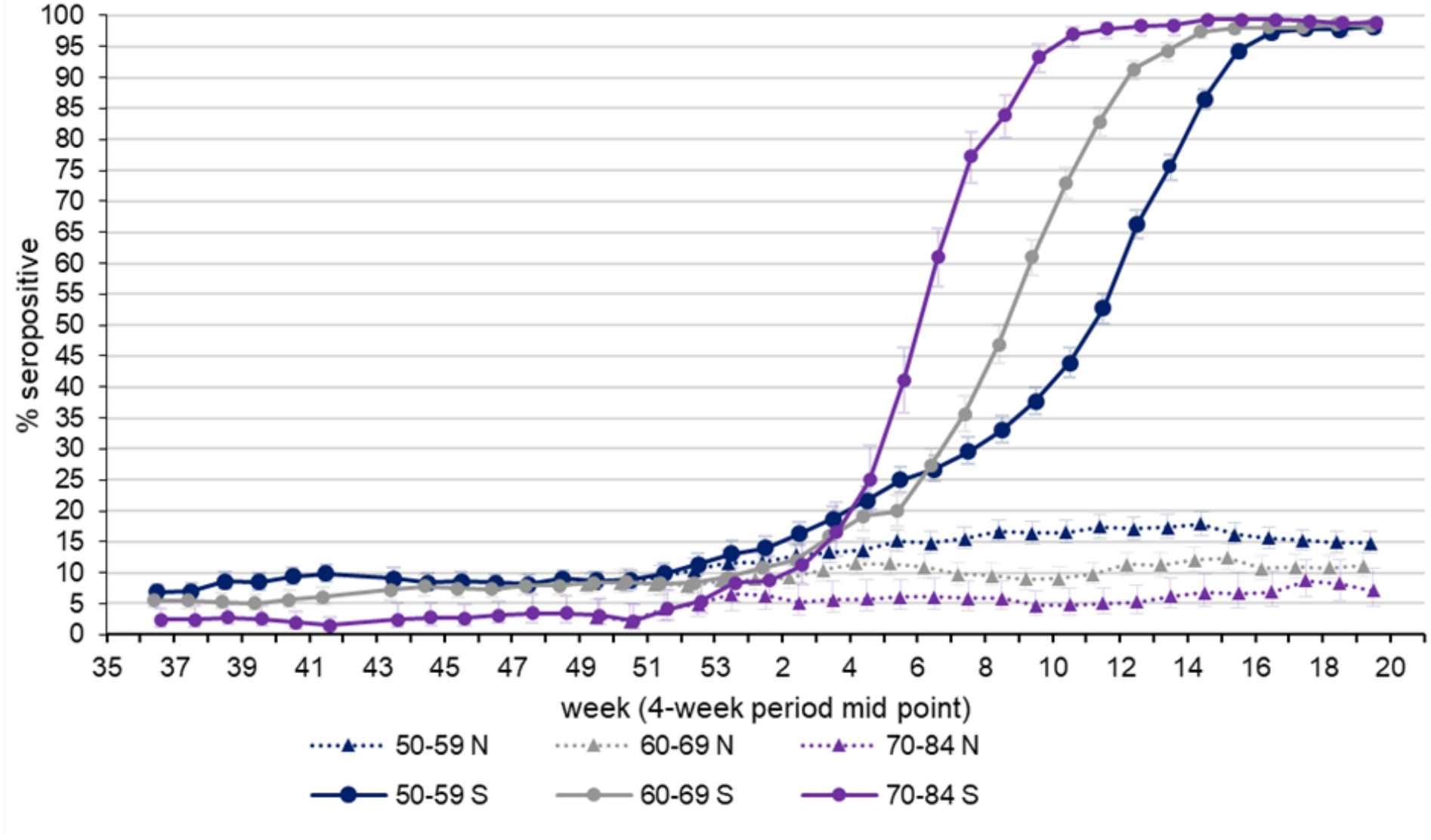


Figure 3: Population weighted 4-weekly rolling SARS-CoV-2 antibody seroprevalence (% seropositive) in blood donors from the Roche S and Roche N assays by a) age groups 17 to 29, 30 to 39 and 40 to 49, b) age group 50 to 59, 60 to 69 and 70 to 84.

a)



b)


% seropositive
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
35
37
39
41
43
45
47
49
51
53
2
4
6
8
10
12
14
16
18
20
week (4-week period mid point)
50-59 N
60-69 N
70-84 N
50-59 S
60-69 S
70-84 S

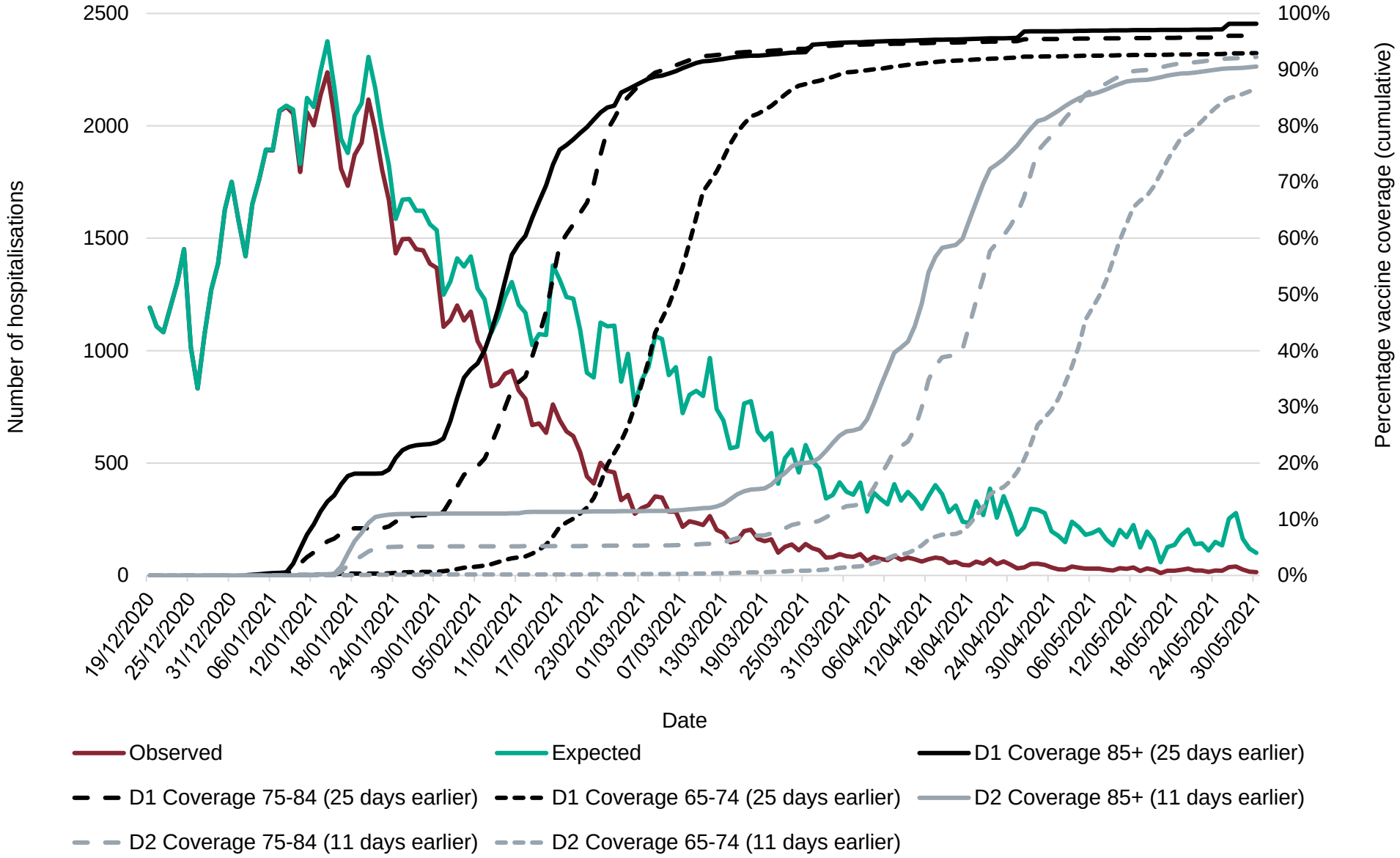
Hospitalisations

The number of hospitalisations averted by vaccination, can be estimated by considering vaccine effectiveness against hospitalisation, vaccine coverage and observed hospitalisations and through modelling using a range of parameters.

PHE estimates to 30 May 2021 based on the direct effect of vaccination and vaccine coverage rates, are that around 42,000 hospitalisations have been prevented in those aged 65 years and over in England (approximately 5,400 admissions in those aged 65 to 74, 16,300 in those aged 75 to 84, and 20,300 in those aged 85 and over) as a result of the vaccination programme (Figure 4). There is increasing evidence that vaccines prevent infection and transmission. The indirect effects of the vaccination programme will not be incorporated in this analysis, therefore the figure of 42,000 hospitalisations averted is likely to be an underestimate.

Please note this analysis will be updated every 2 weeks.

Figure 4. Plot of daily observed and expected COVID-19 hospitalisations in adults aged 65 and over



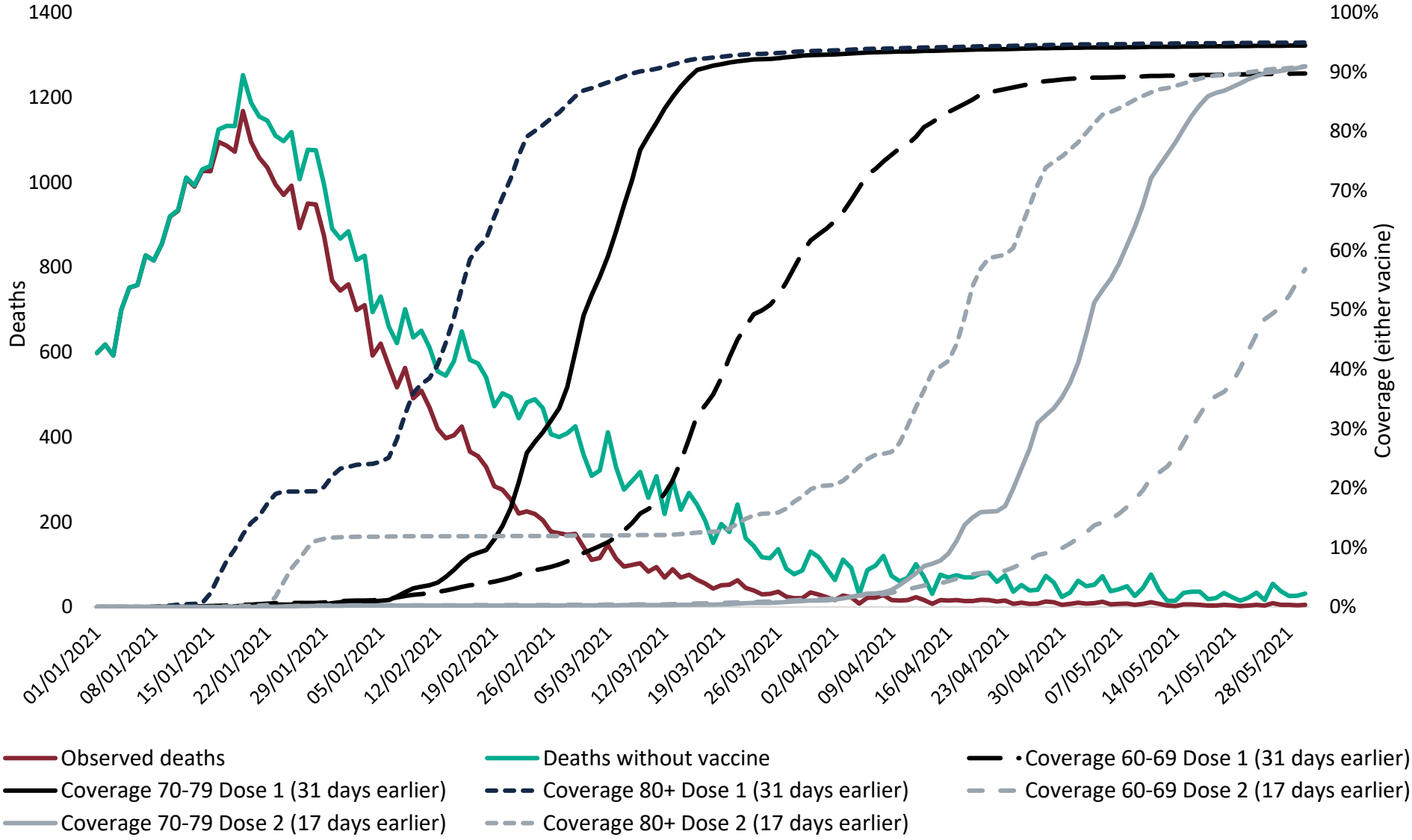
Deaths

The number of deaths averted by vaccination, can be estimated by considering vaccine effectiveness against mortality, vaccine coverage and observed deaths and through modelling using a range of parameters.

PHE estimates to 30 May 2021 based on the direct effect of vaccination and vaccine coverage rates, are that that 11,800 deaths were averted in individuals aged 80 years and older, 1,800 in individuals aged 70 to 79 and 400 in individuals aged 60 to 69 years giving a total of 14,000 deaths averted in individuals aged 60 years or older in England (Figure 5). There is increasing evidence that vaccines prevent infection and transmission. The indirect effects of the vaccination programme will not be incorporated in this analysis, therefore the figure of 14,000 deaths averted is likely to be an underestimate. Details of the methods used in this analysis are available from the PHE monitoring of the effectiveness of COVID-19 vaccination (17).

Please note this analysis will be updated every 2 weeks.

Figure 5: Daily observed COVID-19 deaths aged 60 and over, and expected numbers in the absence of vaccination using the back calculation method



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