UK Health Security Agency

PCR testing in contacts of cases (without release) in England

Study dates: January to July 2021

Contents

1. Executive summary

NHS Test and Trace (T&T)[1] contact tracing was aimed at reducing the spread of coronavirus (COVID-19) by encouraging people who have been in close contact with an infected person to reduce social contact, thereby decreasing the risk of onwards transmission. In March 2021, the eligibility criteria for polymerase chain reaction (PCR) testing in England expanded to include asymptomatic close contacts of confirmed COVID-19 cases in order to improve control measures for those known to be positive. Prior to this, PCR testing was limited to those displaying COVID-19 symptoms.

Why this study was carried out

The purpose of this study was to conduct a descriptive analysis of the testing patterns of close contacts. The analyses focused on the uptake and positivity rates of PCR tests, including breakdowns by demography and vaccination status.

The analyses provide insight into the effectiveness of the policy, with higher uptake and higher positivity being regarded as indicators of successful targeting of those at increased risk of transmission.

The analytical approach

The analysis used data from 2 sources:

- testing data from the National Pathology Exchange (NPEx)
- data on contact tracing from T&T's Contact Tracing and Advisory Service (CTAS)

The analysis was then structured into 2 parts:

- analysis of the testing data alone, with contacts identified through the 'test reason' field during online ordering
- analysis of a dataset created by matching NPEx and CTAS to give PCR tests taken by contacts appearing in CTAS

[1] On 1 October 2021, NHS Test and Trace ceased to exist. Its functions were taken up by the newly established UK Health Security Agency (UKHSA). In this report we will refer to NHS Test and Trace as Test and Trace (T&T)

The key findings

Close contacts identified through testing data alone

Between 1 January and 31 July 2021, 1.35 million PCR tests were taken by people who selected a test reason associated with being an asymptomatic close contact. The rate of testing by contacts (relative to contact numbers held within CTAS) increased from 0.10 tests per contact identified in CTAS in March 2021 to within the range 0.44 to 0.69 tests per contact identified in CTAS for all of June and July 2021.

Over this period, individuals who self-referred as close contacts when ordering their test (that is they identified as a contact despite not having been contacted by T&T or notified by the COVID-19 app) became the biggest group in terms of testing volumes, taking 63.1% of the total tests by close contacts in the last full week of July 2021. This compared with 22.6% taken by those reached by the contact tracing service, with the remaining 14.3% having been notified via the app.

People who reported taking a test after being notified by the COVID-19 app had lower positivity (5.4%) than those who self-referred (9.3%) or reported being reached by contact tracers (9.4%). This could indicate that those notified through the app had less close contact with the original case than self-referrals and those reached by contact tracers.

Close contacts reached by the contact tracing service

Over the period from January to July 2021, 44.7% of contacts reached by the contact tracing service were matched to a PCR test around the time they were contacted (between 5 days prior to contact and 8 days after). The weekly uptake ranged between 29.0% to 46.7%. The proportion of tests taken when asymptomatic increased over time, especially since March 2021.

The overall positivity (symptomatic and asymptomatic) in CTAS identified contacts was high at 44.3%. The oldest and youngest age groups showed higher positivity than other demographic groups (over 80: 57.9%; and 20 and under: 50.2%).

The proportion of close contacts who were vaccinated increased over the time period, reflecting the progress of the vaccination programme. There was no link observed between the uptake of PCR tests and vaccination coverage. In terms of positivity, contacts who were fully vaccinated showed a positivity of 23.4%, compared with 36.5% in those who had one dose of vaccination and 49.6% in those who were not vaccinated.

Multivariate analysis

Even when controlling for vaccination status, the demographic factors of older age, Asian and Black ethnicities and living in North region were associated with increased likelihood of a positive PCR test in contacts. The risk was greater in symptomatic and not vaccinated contacts and in those who described their contact type as household or accommodation. Positivity

changed over time (January to July 2021) with symptom status showing the largest impact on the odds of being COVID-19 positive.

What these findings mean

The findings of the analysis by demographic subgroup and the multivariate analysis reinforce the known impact of factors influencing COVID-19 positivity.

The positivity rate of contacts who self-referred was very similar to that for those reached by contact tracers (9.3% and 9.4% respectively). This could indicate that people had a good judgment about whether they had been exposed to a case and were therefore likely to be infectious.

Different sources of data would be necessary to establish with greater confidence whether the positivity rates of the different groups of contacts (notified by app, self-referred and reached by contact tracers) reflect the true picture or are effects of how the data was collected.

The high positivity rate of the contacts tested indicated that this was a population that it was worthwhile to target with increased testing. At the time of the study, compliance with isolation rules was high for both cases (79%) and contacts (89%) [1,2]. A positive test would have reduced onwards transmission because it would lead to the secondary contacts of the contacts being alerted earlier than otherwise. It would also reset the self-isolation period for contacts who become cases so that it aligns better with their infection.

However, there was scope to increase uptake further amongst this population: at no point between January and July did we identify an uptake of PCR testing of greater than 50% by contacts reached by the contact tracing service.

2. Introduction

2.1 Background

Since the start of the COVID-19 pandemic, control approaches across the world have focused on the isolation of both positive cases and close contacts of cases in order to break the chains of transmission of the disease [3]. In England the self-isolation period for COVID-19 cases and contacts was originally set at 14 days, and was then reduced to 10 days in December 2020. From then, anyone testing positive was required to self-isolate for a period of 10 days from the date of their positive test. Similarly close contacts of cases were required to self-isolate for 10 days from the last date of their contact with a confirmed positive case. Figure 1 presents a timeline of relevant policy changes.

Test and Trace (T&T) had 2 main mechanisms for identifying and notifying contacts[2] of confirmed COVID-19 cases. The primary mechanism was through the Contact Tracing and Advisory Service (CTAS), whereby confirmed cases were asked to provide contact details of those they have been in contact within the period within which they may have been infectious. T&T then contacted these people to inform and advise on the appropriate action (typically to self-isolate).

Contacts were also notified by the COVID-19 app, which informed users if they had been in close proximity with someone who has tested positive. For the time period covered by this report, contacts identified by the app were advised to self-isolate, but this was not mandatory. T&T also provided more general advice for those that may consider themselves to be at risk of infection through a close contact but have not received a formal notification.

In England, from 30 March 2021, close contacts of confirmed cases of COVID-19 were eligible to take a PCR test, whether they had symptoms or not. Prior to this, PCR tests were only available to the general public if they had symptoms of COVID-19. At the time of the study, compliance with isolation rules was high for both cases (79%) and contacts (89%) [1,2]. The change to the policy was intended to reduce onwards transmission by alerting secondary contacts of the contacts earlier than otherwise so they would then self-isolate. It would also reset the self-isolation period for contacts who become cases so to align better with their infection.

[2] Guidance on gov.uk described close contacts as people who have been close (less than 1 metre away, spending more than 15 minutes within 2 metres of someone, travelling in a car or other small vehicle with someone or close to them on a plane) to a confirmed COVID-19 case, any time from 2 days before the case developed their symptoms (or, if they did not have any symptoms, from 2 days before the date of their positive test result), and up to 10 days after

Figure 1: PCR testing in close contacts policy changes and national lockdown timelines, England

PCR testing of close contacts policy change timeline, England to August 2021				
Until 30 March 2021	30 March 2021 until 15 August 2021	16 August 2021 onwards		
Contacts advised to self-isolate; individuals with symptoms encouraged to take PCR test	Contacts advised to take PCR test, even if they do not have symptoms and continue to self-isolate	Exemptions from self-isolation for contacts introduced		
National lockdown timeline, England, January to July 2021				
6 January	8 March, 29 March	12 April	17 May	19 July
England enters third lockdown	Step 1. Easing of lockdown: schools reopen, stay-at-home order ends	Step 2. Non-essential services open	Step 3. Limit of 30 people allowed to mix outdoors	Step 4. All legal limits on social contact removed

The T&T guidance changed from 16 August 2021. Contacts of COVID-19 cases were still encouraged to take a PCR test whether symptomatic or not, but were no longer required to self-isolate if they did not have any symptoms of COVID-19 and they:

- were fully vaccinated
- were below the age of 18 years 6 months
- had taken part in or were currently part of an approved COVID-19 vaccine trial or
- were not able to get vaccinated for medical reasons [4,5]

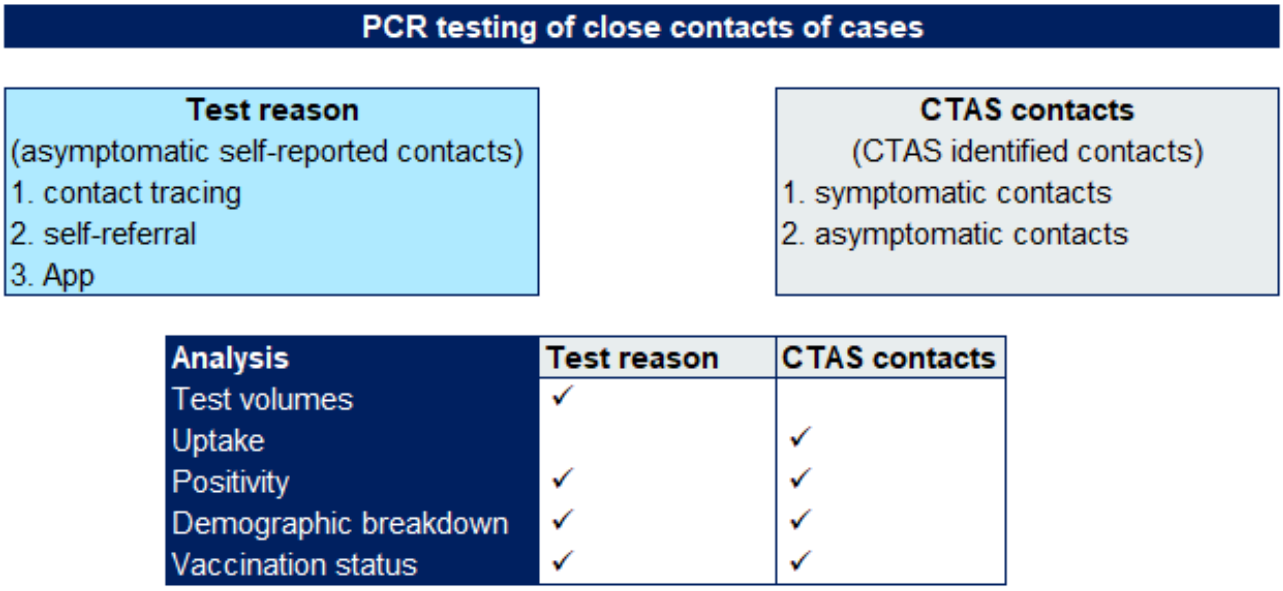
This analysis includes PCR tests taken by contacts between 1 January 2021 and 30 July 2021. Changes to the policy in August 2021 and later were therefore not taken into account in this analysis. We have selected these dates to cover a period of time before and after the policy change for testing of close contacts (30 March 2021), to investigate both the impact of the policy change and other changes in lockdown restrictions throughout the year. This also includes the time when Delta was classified as a variant of concern (May 2021) in the UK.

2.2 Aims

The aim of this study was to understand the PCR testing patterns of close contacts of COVID-19 cases. We use 2 main metrics to assess this, which we consider to be most important in policy development and understanding. They are:

- the uptake of PCR tests; that is the usage of the testing offer within the close contact population (both volume and uptake rate/percentage), disaggregated by sub-groups (including age, ethnicity and sex) – this gives an indication of how successful the policy has been in reaching its intended audience
- the positivity rate of PCR tests taken, also disaggregated by sub-groups – this gives an indication as to how prevalent COVID-19 was within the groups reached, and whether the policy was targeted at the right population, and thus can provide valuable insight for future policy development as to where best to target testing

Figure 2: Report and analysis structure



Analysis	Test reason	CTAS contacts
Test volumes	✓	
Uptake		✓
Positivity	✓	✓
Demographic breakdown	✓	✓
Vaccination status	✓	✓

Text version of Figure 2

PCR testing of close contacts of cases

Test reason (asymptomatic self-reported contacts):

1. Contact tracing
2. Self-referral
3. App

CTAS contacts (CTAS identified contacts):

1. Symptomatic contacts
2. Asymptomatic contacts

Analysis	Test reason	CTAS contacts
Test volumes	Yes	
Uptake		Yes
Positivity	Yes	Yes
Demographic breakdown	Yes	Yes
Vaccination status	Yes	Yes

Figure 2 illustrates the structure of the report and summarises which analyses are in which chapter. Chapters 3 and 4 cover the analysis of these metrics, considering both the whole testing population, and any differences in the uptake and positivity rate of tests when disaggregated by symptom status, demographics (sex, age groups, ethnicity and region), vaccination status and contact type.

Chapter 5 presents a quantitative evaluation of positivity in contacts using the data sets generated in chapter 4 considering the interactions between various factors impacting positivity using statistical modelling.

This analysis focuses specifically on PCR testing, and as such any tests taken using a lateral flow device (LFD) were excluded.

2.3 Identifying close contacts in testing data

It is difficult to identify and analyse tests taken by individuals as close contacts within the T&T data systems. Many data points are collected during the testing journey, and being a close contact is not mutually exclusive from being eligible for tests for other reasons. Within this report we have considered 2 different mechanisms for identifying close contact PCR tests, and present these as separate analyses in chapters 3 and 4:

1. Test reason

Within the digital journey for PCR test ordering, users can select a test reason that identifies them as someone who is testing as they believe they are a close contact. This approach most closely aligns to the extended eligibility criteria for contact testing introduced in March 2021, and has the benefit that it covers all methods by which people can be notified they are a contact. However, it is limited in that it relies on self-reported contact status, and also that it does not capture people who have been identified as close contacts but have tested for another reason. For example if someone had developed symptoms they may have been more likely to enter this

is their test reason rather than the contact tracing reasons. Analysis using this group of contacts is presented in chapter 3.

2. Data matching

T&T ran the Contact Tracing and Advisory Service (CTAS). The service aimed to contact every individual who tested positive for COVID-19, collect details of their close contacts and notify these people of their contact status. This provides a group of people we can be confident are close contacts of a positive case. We can perform data matching on this group to identify if they have taken a PCR test. The approach has the benefit that it produces a data set of tests we can be confident pertain to close contacts. However, it cannot include contacts notified through other routes (such as self-referral or the COVID-19 app). There is also a risk of inaccuracies in the data matching process. Analysis using this group of contacts is presented in Chapter 4.

2.4 Demographic groups

In this analysis, we considered age, sex, ethnicity and regions as the demographic groups. This demographic data was available in both NPEx and CTAS databases. We considered NPEx as our primary source for demographic data to calculate metrics (such as test volumes, positivity), considering its completeness compared with CTAS data. However, to calculate uptake (proportion of contacts in CTAS who took PCR tests) we needed to use CTAS data, which was poorly completed. We were therefore unable to provide uptake by all demographic groups.

3. Close contacts identified through testing data alone

3.1 Introduction

This chapter presents the analysis of the testing data alone, with contacts identified through the 'test reason' field during online ordering for PCR tests. The underlying data is drawn from the National Pathology Exchange (NPEx).

3.2 Methodology

3.2.1 Identifying close contacts

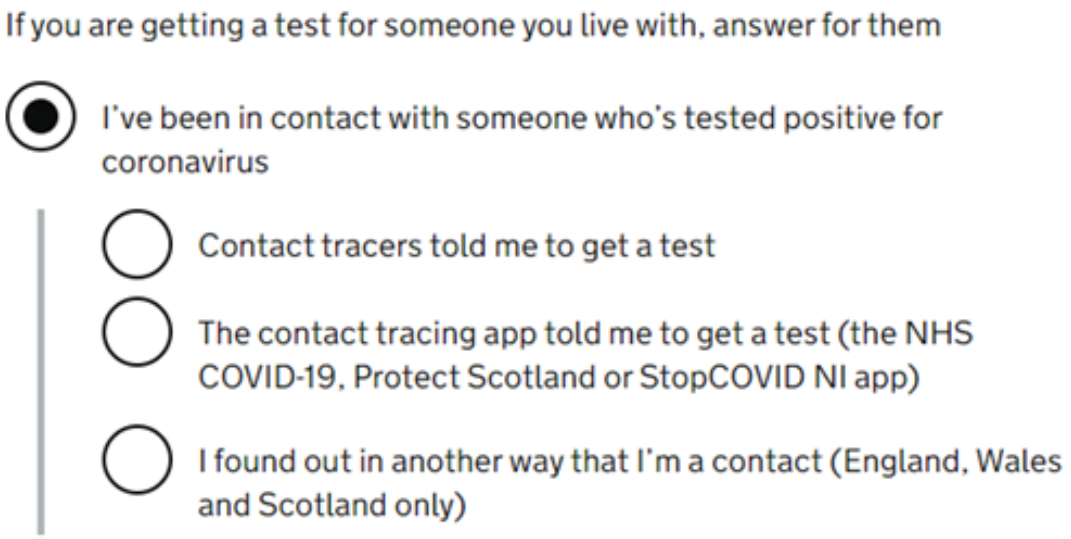
When ordering a PCR test, a user provides information to determine their eligibility (Figure 3). This includes their personal details, symptom status, and their reason for wanting a test. One option available for the reason for wanting a test is "Contact tracers told me to get a test". This test reason first became available in February 2021.

As of May 2021, 2 further close contact related test reasons also became available: "The contact tracing app told me to get a test" and "I found out in another way that I'm a contact". Users can only select one test reason. In this chapter, the analysis includes all PCR tests that have been ordered in which any one of these reasons were selected:

- "Contact tracers told me to get a test", which we refer to as "reached by contact tracers"
- "The contact tracing app told me to get a test", which we refer to as "notified by the app"
- "I found out in another way that I'm a contact", which we refer to as "self-referred"

The "contact tracing" test reason was only available to users who had declared previously in the test ordering process that they were asymptomatic. Therefore, this method of identifying close contacts would not be expected to capture all PCR tests taken by individuals who had been in close contact with a known COVID-19 case. Principally, the contact may have developed symptoms of COVID-19 and therefore would have been likely to declare they were testing for that reason. Chapter 5 gives an analysis of all PCR tests taken by close contacts, regardless of symptom status.

Figure 3: PCR test ordering digital journey test reasons for asymptomatic people



Text version of Figure 3

If you are getting a test for someone you live with, answer for them.

I've been in contact with someone who's tested positive for coronavirus	Yes
Contact tracers told me to get a test	Yes/no
The contact tracing app told me to get a test (the NHS COVID-19, Protect Scotland or StopCOVID NI app)	Yes/no
I found out in another way that I'm a contact (England, Wales and Scotland only)	Yes/no

3.3 Limitations

The analysis in this chapter is based on data for which the reasons available to determine eligibility for a test were self-reported by users of the testing service when they ordered a test. There was limited quality control within the system to check that these users were actually close contacts and were selecting the correct reason for their test. It is possible that people gave an incorrect test reason in error or to receive a test despite not meeting the eligibility criteria. Furthermore, users could only select one primary reason for taking a test but, in reality, there may have been more that were applicable.

By matching between the test records and the contact tracing database, we have attempted to assess the quality of information provided by users as they ordered their tests.

We might have expected a high proportion of users providing the test reason "Contact tracers told me to get a test" to be present within the CTAS databases. However, we were only able to

match 47.9% of tests taken using this test reason to entries in CTAS. This could be due to people not giving consistent information during the contact tracing and testing processes (leading to mismatching). It could also be due to people giving the wrong test reason, for example if they did not understand the distinction between the app and contact tracing services. Prior to May 2021 only one test reason was available in the digital journey, which could have exacerbated this effect.

It is also possible that people may have knowingly entered incorrect information to order a PCR test through this route when they were not eligible according to the official policy. They could have been, for example, testing before or after international travel, or seeking reassurance having been in a situation that fell outside of the eligibility criteria.

Where users provided self-referral or notified by the app as the reasons for testing, they may have had some reason to consider this the primary reason for ordering their test – perhaps because it came first. However, it is not unreasonable to expect that a proportion of these people may also be present within CTAS. For example, if a user had close contact with a case, their app may have notified them of the contact and prompted them to book a test more quickly than the contact tracing service was able to reach them.

This was illustrated in the data: we were able to identify in CTAS 25.9% of those that selected notified by the app as the reason for testing and 16.7% of those that selected self-referral. This supports the hypothesis that there was substantial cross-over between the routes by which people became aware that they are contacts.

In chapter 4 we use this matching mechanism to investigate the testing patterns of a known group of close contacts held within the CTAS databases.

3.4 Findings

3.4.1 Test volumes

Figure 4: All individuals who took a test with one of the 3 test reasons corresponding to contact tracing – the red line indicates the date at which the policy went live in England

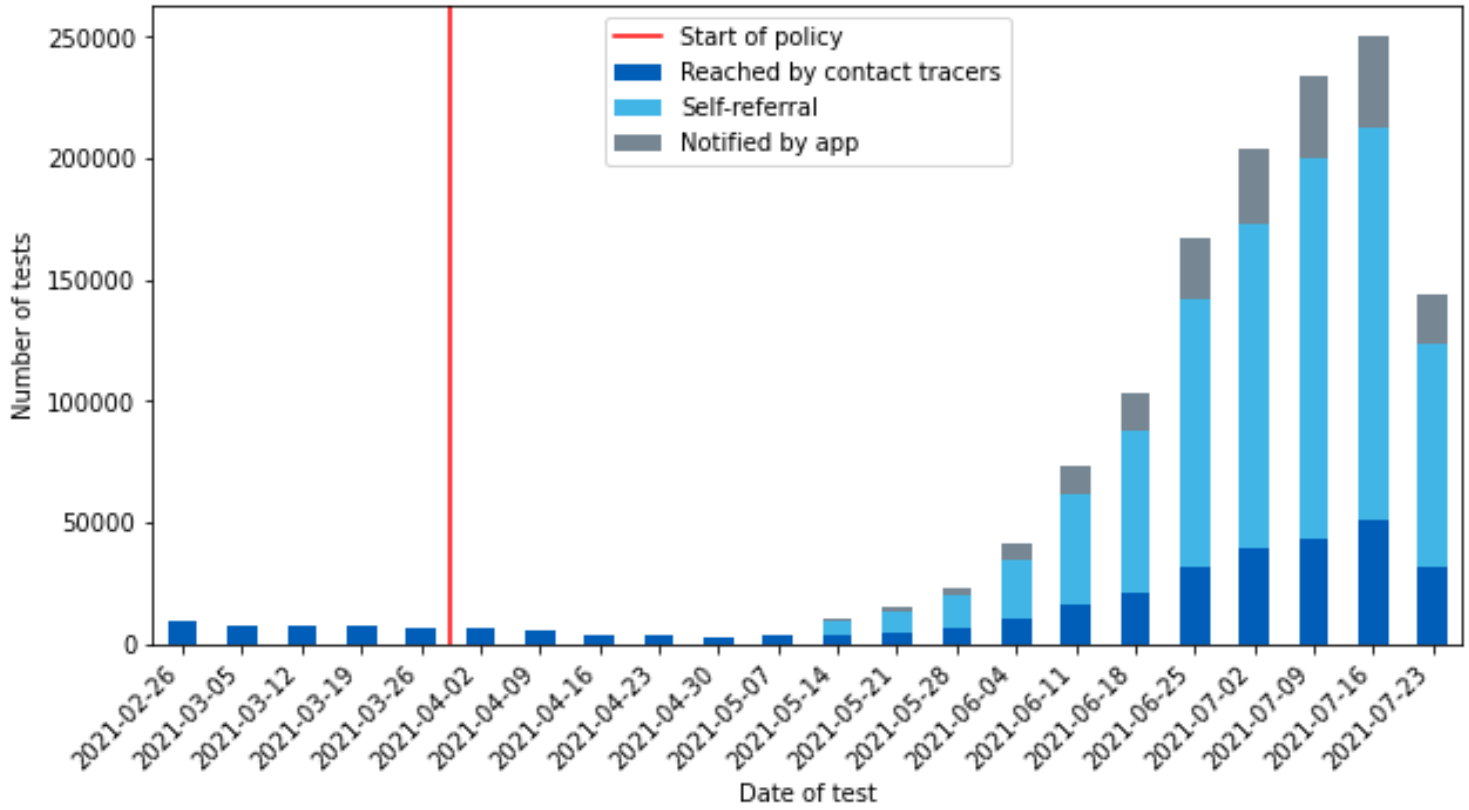


Figure 4 shows the total number of tests taken by people that recorded one of the 3 test reasons related to contact tracing up to the end of July 2021. In total, 1,344,688 PCR tests were taken. “Contact tracers told me to get a test” first became available as a test reason in late

February 2021, while the test reasons for app contacts and self-referral were introduced in May 2021. The number of tests taken rose substantially in the following weeks, and self-referral became the most frequently given of the 3 test reasons. In the last full week in July 2021, 63.1% of the tests taken by individuals identifying as close contacts were by people who had self-referred. A further 22.6% of the tests were taken following contact with the tracing service, with the remaining 14.3% taken by people who had been notified via the app.

Figure 5: People taking a test with one of 3 test reasons corresponding to the policy, relative to the number of contacts in CTAS – the red line indicates the date at which the policy went live in England

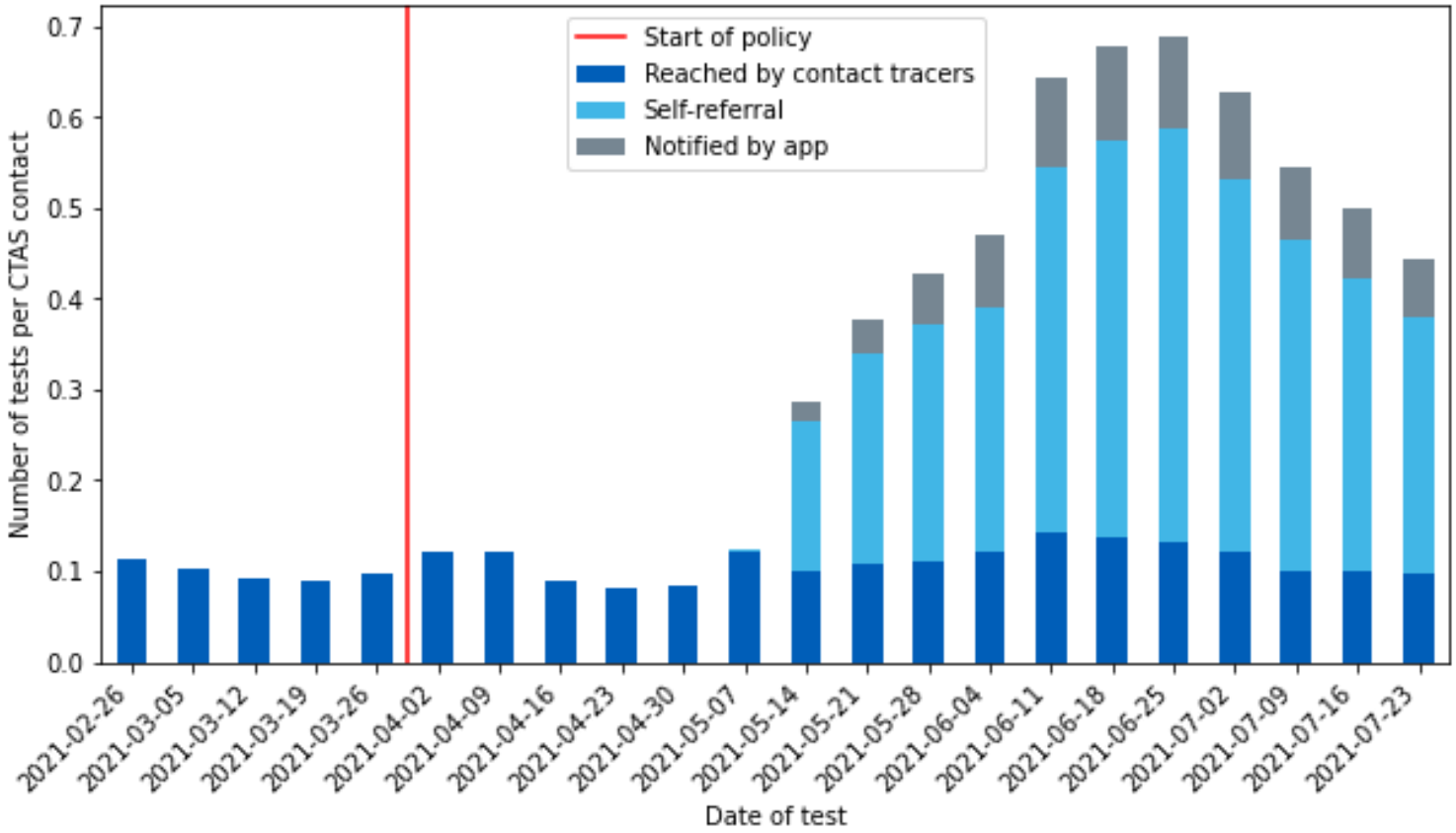


Figure 5 shows the same set of tests in which one of the relevant test reasons was given, but relative to the number of contacts identified in CTAS. Those giving the primary test reason "Contact tracers told me to get a test" has remained relatively constant as a proportion, whereas the introduction of the 2 newer reasons has led to an increase in the number of PCR close contact tests relative to the population in CTAS.

Whilst it was not possible to include the population of app contacts and eligible self-referrals in the denominator (that is to produce a 'true' number of eligible contacts), this analysis demonstrates that changes in the policy to make PCR testing of close contacts more widely available led to an increase in the proportion of contacts taking tests.

3.4.2 Test positivity

3.4.2.1 Overall positivity

Figure 6: Positivity of testing as a 7-day rolling average for the 3 testing reasons corresponding to the policy – positivity rate is shown for the whole period over which each testing reason was available in the digital journey

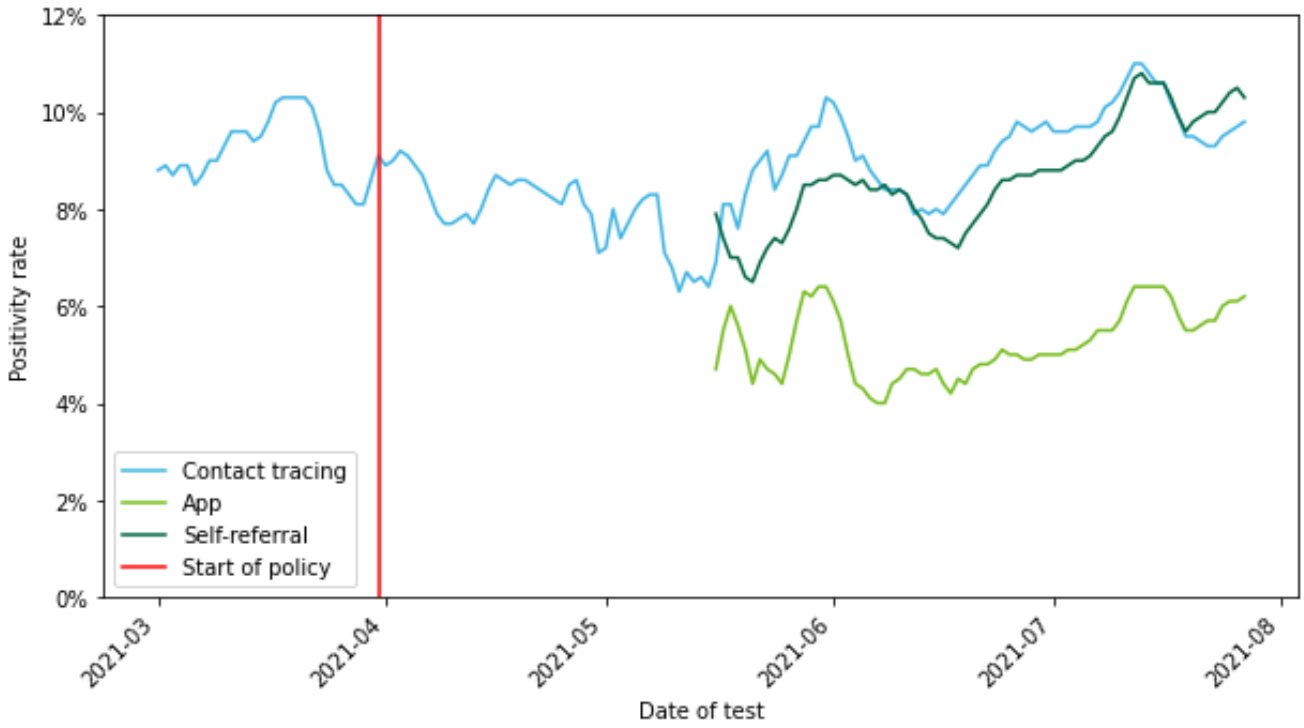


Figure 6 shows the positivity for the 3 contact tracing test reasons offered by the PCR test ordering journey. For most of the period, the positivity of tests taken following contact by trace agents was higher than the other reasons. The self-referral positivity was slightly lower, although toward the end of July the self-referral positivity did overtake that of trace contacted people. In the last full week in July, the positivity rates following contact tracing and self-referral were 10.1% and 10.4% respectively. Positivity amongst app notified contacts was lower at 6.1%.

A possible explanation for the lower positivity seen for app contacts could be that app notification works on the proximity of mobile devices alone. There is no account taken of the context of contact, such as ventilation or whether the device owner is with the device.

The fact that people taking tests after self-referring have similar positivity rates to those taking after contact tracing could suggest that this group of people are conducting effective self-managed contact tracing. (Part of the self-managed contact tracing could possibly include taking a LFD before deciding whether to take a PCR test, which would increase the positivity rate of the PCR tests.) It is therefore important to consider the demographics of this group to determine who these people are, and what this may mean for future use of contact tracing. A key limitation in drawing conclusions from this data is that a user can only select one test reason when they book or order their test. It would not be unreasonable to expect that many contacts may be contacted by contact tracers and notified by the app about the same contact event. However, when ordering a test a user is forced to choose only one reason, and it may be that people are more likely to choose the contact tracing option, as this is more likely to have been a stronger steer for them to get a test. That would mean that those people falling in the notified by the app group as those whose contact was not detectable by contact tracers, for example on public transport. These are potentially less risky contacts, which may be a contributing factor to why positivity in the app contacts is lower.

3.4.2.1 Positivity by demographics

Table 1:Number of PCR test results in contacts by test reason, contacts and demographics, 1 January to 31 July 2021, England

	Negative number	Negative percent	Positive number	Positive percent	Void number	Void percent	Total
Total	1,204,576	89.6%	118,253	8.8%	21,859	1.6%	1,344,688
Test reason							
Self-referral	740,824	89.1%	77,573	9.3%	13,397	1.6%	831,794
App	176,498	93.2%	10,279	5.4%	2,687	1.4%	189,464
Trace	287,254	88.8%	30,401	9.4%	5,775	1.8%	323,430
Sex							
Female	651,401	90.2%	59,067	8.2%	11,529	1.6%	721,997
Male	550,931	88.8%	58,957	9.5%	10,282	1.7%	620,170
Unknown	2,246	89.1%	230	9.1%	45	1.8%	2,521
Age group							
20 and under	335,130	86.9%	43,607	11.3%	6,764	1.8%	385,501
21 to 40 years	510,595	89.5%	50,519	8.9%	9,263	1.6%	570,377

	Negative number	Negative percent	Positive number	Positive percent	Void number	Void percent	Total
41 to 60 years	287,714	92.1%	19,995	6.4%	4,645	1.5%	312,354
61 to 80 years	67,617	93.1%	3,885	5.4%	1,109	1.5%	72,611
Over 80	3,503	91.6%	248	6.5%	74	1.9%	3,825
Ethnicity							
White	1,022,657	89.8%	98,757	8.7%	17,856	1.6%	1,139,270
Asian	78,488	88.4%	8,469	9.5%	1,790	2%	88,747
Black	23,860	87.8%	2,690	9.9%	613	2.3%	27,163
Mixed	34,534	88.9%	3,642	9.4%	659	1.7%	38,835
Other	12,382	88.9%	1,288	9.2%	257	1.8%	13,927
Unknown	32,657	88.9%	3,408	9.3%	681	1.9%	36,746
Region							
London	198,828	91%	15,219	7%	4,470	2%	218,517
Midlands and East	294,416	89.2%	29,650	9%	6,119	1.9%	330,185
North	367,334	88.3%	42,474	10.2%	6,068	1.5%	415,876
South East	187,420	90.4%	16,292	7.9%	3,590	1.7%	207,302
South West	146,781	90.7%	13,643	8.4%	1,446	0.9%	161,870
Other	9,797	89.6%	975	8.9%	166	1.5%	10,938

When users of the testing service ordered a PCR test, they provided their demographic information. This enables us to investigate how testing patterns varied according to these different characteristics.

Table 1 shows the number of positive, negative, and void PCR test results in contacts by test reasons offered by the PCR test ordering journey between January 2021 and July 2021, and the breakdown by demographic subgroups. There were a total of 1,344,688 PCR test results, of which 8.8% were positive, 89.6% were negative and 1.6% were void.

Positivity was slightly higher in males (9.5%) than females (8.2%). For age groups, positivity was highest in the youngest age group (20 years and under) at 11.3% and lower in middle and older age groups: 41 to 60 years was 6.4%, 61 to 80 years was 5.4% and over 80 years was 6.5%.

Positivity was lowest in the White ethnic group (8.7%), with all other ethnic groups being at least half a percentage point higher. For regions, test reason contacts in North region showed the highest positivity (10.2%) than the other regions.

The relationship between demographic factors and positivity is explored in more depth in the multivariate analysis described in chapter 5.

3.4.3. Test reason

When considering users who have ordered a PCR test as a contact, we can investigate the demographic differences in 2 ways. Firstly, we can look at the proportion of people who test using the different contact identification options (contact tracing, self-referral, app) to see if certain groups are testing for different reasons. Secondly, we can compare the distribution of users of the PCR testing system by demographics with the latest census data to see if certain groups are under- or over-represented.

3.4.3.1 Test reason by demographics

Table 2: Distribution of PCR tests taken by close contacts by test reason and demographics, 1 January to 31 July 2021, England

	Self-referral number	Self-referral percent	App number	App percent	Trace number	Trace percent	Total number
Total	831,794	61.9%	189,464	14.1%	323,430	24.1%	1,344,688
Sex							
Female	448,194	62.1%	102,623	14.2%	171,180	23.7%	721,997
Male	381,901	61.6%	86,584	14%	151,685	24.5%	620,170
Unknown	1,699	67.4%	257	10.2%	565	22.4%	2,521
Age group							
20 and under	270,712	70.2%	27,924	7.2%	86,865	22.5%	385,501
21 to 40 years	352,741	61.8%	97,668	17.1%	119,968	21%	570,377
41 to 60 years	169,259	54.2%	50,250	16.1%	92,845	29.7%	312,354
61 to 80 years	36,799	50.7%	13,211	18.2%	22,601	31.1%	72,611
Over 80	2,270	59.3%	408	10.7%	1,147	30%	3,825
Ethnicity							
White	707,012	62.1%	167,635	14.7%	264,623	23.2%	1,139,270
Asian	52,333	59%	9,891	11.1%	26,523	29.9%	88,747
Black	14,944	55%	2,644	9.7%	9.575	35.3%	27,163
Mixed	26,545	68.4%	4,547	11.7%	7,743	19.9%	38,835
Other	8,066	57.9%	1,461	10.5%	4,400	31.6%	13,927

	Self-referral number	Self-referral percent	App number	App percent	Trace number	Trace percent	Total number
Unknown	22,894	62.3%	3,286	8.9%	10,566	28.8%	36,746
Region							
London	137,758	63%	33,339	15.3%	47,420	21.7%	218,517
Midlands and East	200,513	60.7%	47,250	14.3%	82,422	25%	330,185
North	250,450	60.2%	52,803	12.7%	112,623	27.1%	415,876
South East	133,168	64.2%	30,906	14.9%	43,228	20.9%	207,302
South West	104,280	64.4%	23,996	14.8%	33,594	20.8%	161,870
Other	5,625	51.4%	1,170	10.7%	4,143	37.9%	10,938

As shown in Table 2, self-referral was the most frequent reason given for users ordering a PCR test as a contact between January and July 2021, accounting for 61.9% of the tests. For different age groups the proportion of tests taken as self-referral ranged from 50.7% for those aged 61 to 80 years to 70.2% in those aged 20 years and under. Being notified by the app consistently accounted for the lowest proportion across all demographic groups, but, was noticeably lower for Black and Unknown ethnic groups (9.7%, 8.9%).

The youngest age group (20 and under) had the lowest proportion of tests taken as app identified contacts (7.2%) probably because the COVID-19 app is only recommended for those aged 16 and over [5] and because of restrictions on mobile phone usage in educational settings. The oldest age group (over 80 years) also showed a lower proportion of tests taken as app identified contacts (10.7%).

The proportion of tests taken after being reached by contact tracers was highest for the Black ethnic group (35.3%) than for any other group. The proportion was also high for the Asian ethnic group (29.9%) and those describing their ethnicity as Other (31.6%) or Unknown (28.8%), compared to that of the total population (24.1%).

The proportion of tests were similarly distributed across all regions (self-referral was the most common test reason followed by contact tracing and app). ‘Other’ group showed higher proportion of contacts with trace test reason (37.9%) and lower proportions of self-referral (51.4%) and app test reason (10.7%).

3.4.3.2 Demographics compared with census

Table 3: Number and proportions of PCR tests taken by close contacts by demographics in comparison with population estimates, 1 January to 31 July 2021, England

	Self-referral number	Self-referral percent	App number	App percent	Trace number	Trace percent	Total number	Census percent
Sex								
Female	448,194	54%	102,623	54.2%	171,180	54%	721,997	50.5%
Male	381,901	46%	86,584	45.8%	151,685	46%	620,170	49.5%
Unknown	1,699	–	257	–	565	–	2,521	n/a
Age group								
20 and under	270,712	32.5%	27,924	14.7%	86,865	26.9%	385,501	23.6%
21 to 40 years	352,741	42.4%	97,668	51.6%	119,968	37.1%	570,377	26.2%
41 to 60 years	169,259	20.3%	50,250	26.5%	92,845	28.7%	312,354	26.1%
61 to 80 years	36,799	4.4%	13,211	7%	22,601	7%	72,611	19.1%
Over 80	2,270	0.3%	408	0.2%	1,147	0.4%	3,825	5%
Ethnicity								
White	707,012	87.4%	167,635	90%	264,623	86.4%	1,139,270	86%
Asian	52,333	6.5%	9,891	5.3%	26,523	8.5%	88,747	7.5%
Black	14,944	1.8%	2,644	1.4%	9.575	3.1%	27,163	3.3%
Mixed	26,545	3.3%	4,547	2.4%	7,743	2.5%	38,835	2.2%
Other	8,066	1%	1,461	0.8%	4,400	1.4%	13,927	1%
Unknown	22,894	–	3,286	–	10,566	–	36,746	n/a
Region								
London	137,758	16.7%	33,339	17.7%	47,420	14.9%	218,517	15.9%
Midlands and East	200,513	24.3%	47,250	25.1%	82,422	25.8%	330,185	30.2%
North	250,450	30.3%	52,803	28%	112,623	35.3%	415,876	27.5%
South East	133,168	16.1%	30,906	16.4%	43,228	13.5%	207,302	16.3%
South West	104,280	12.6%	23,996	12.7%	33,594	10.5%	161,870	10%
Other	5,625	–	1,170	–	4,143	–	10,938	n/a

The census population estimates for sex, age group and region are for 2020 [6]. The estimates for ethnicity are older, last available for the year 2011 [7].

Table 3 shows the demographic breakdown of users who have taken a PCR test and selected one of the test reasons relating to testing of close contacts compared with population estimates. For all 3 test reasons, a greater proportion of tests were taken by females (54.0%) when compared with population estimates (50.5%).

When considering age groups, the proportion of tests for all 3 test reasons were higher in 21 to 40 years than the population estimate (population estimate: 26.2%; self-referral: 42.4%; app: 51.6%; contact tracing: 37.1%).

For ethnic groups, White and Mixed populations took a slightly larger proportion of tests compared with their population estimates [5] (White: 87.0% of tests, 86.0% of population and Mixed: 3.0% of tests, 2.2% of population). The pattern was the same across all test reasons, with the exception of the White group reporting having tested after being contacted via the tracing system, where the proportion was lower than the population estimate.

3.4.5. Vaccination status

3.4.5.1 Proportion of tests by vaccination status

Figure 7: All individuals who took a test with one of the 3 test reasons corresponding to contact tracing, split by vaccination status – the red line indicates the date at which the policy went live in England

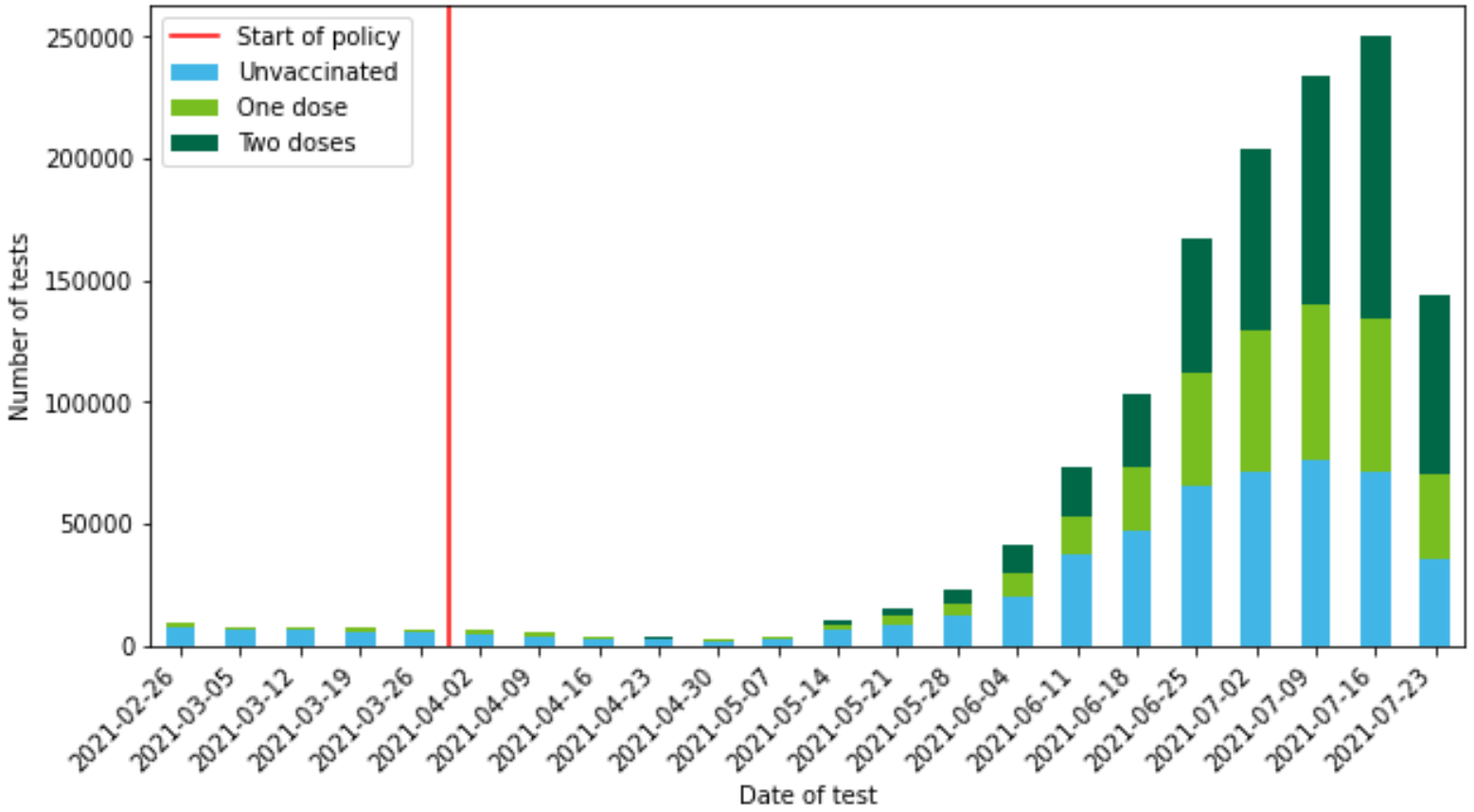


Figure 7 shows the total number of tests taken by individuals giving one of the 3 test reasons corresponding to contact tracing divided by the vaccination status of the individual. Until mid-April 2021 this is dominated by those who are unvaccinated, with individuals with first one dose,

and then 2 doses, rising quickly as the vaccination rollout continued. On the week starting 16 July 2021 (the peak week in terms of tests taken), the breakdown of vaccination status was: 28.5% unvaccinated, 25.1% one dose vaccinated, 46.5% vaccinated with 2 doses.

3.4.5.2 Positivity by vaccination status

Figure 8: Positivity of testing as a 7-day rolling average for the 3 testing reasons corresponding to the policy, split by vaccination status – the red line marks the start of the policy

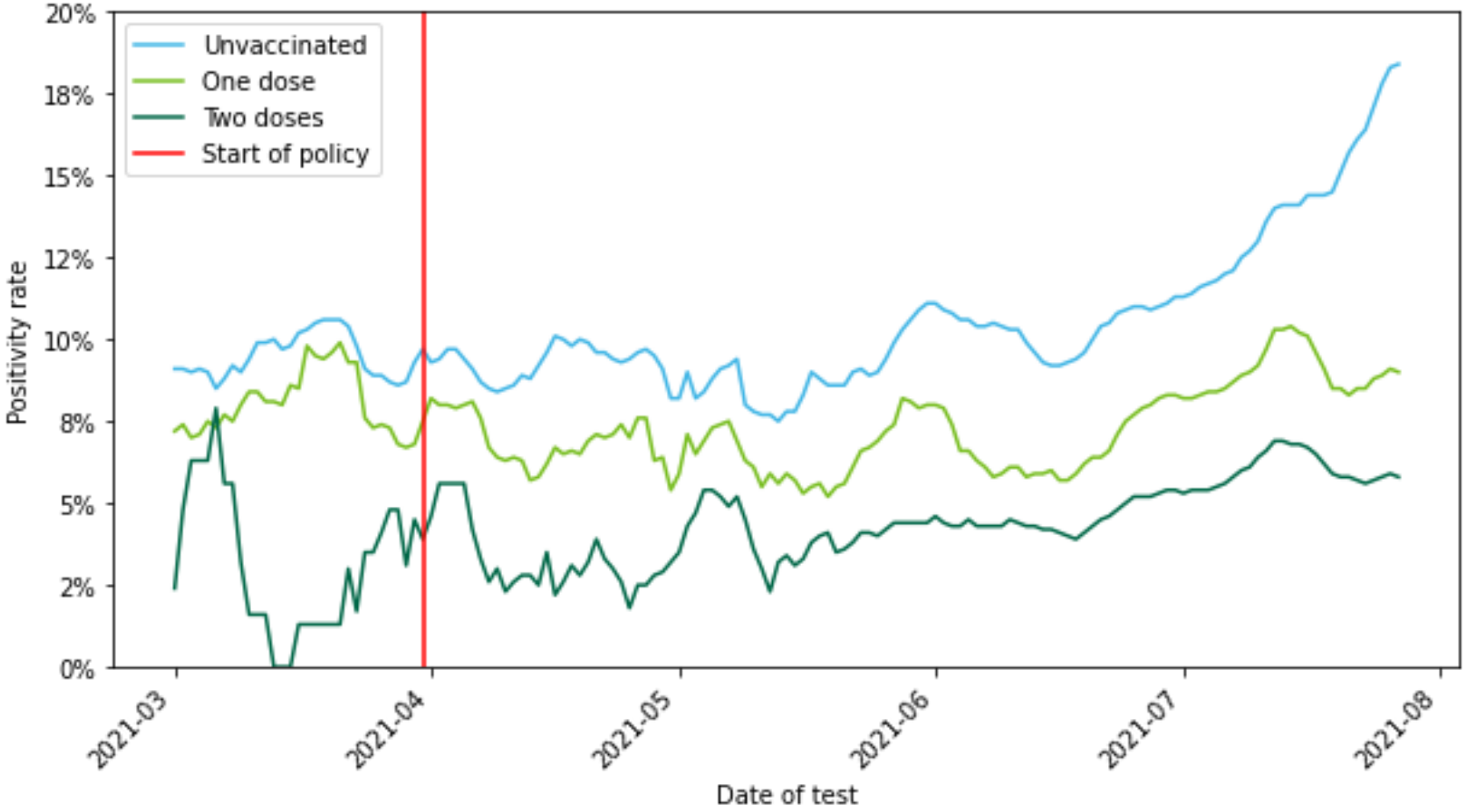


Figure 8 shows the positivity of those taking tests giving a test reason corresponding to the policy. This is split into those who have had one dose, 2 doses, or no doses of vaccine. As illustrated in Figure 5, the absolute numbers for those vaccinated, particularly those having 2 doses, are very low for the earlier periods of the plot, causing larger fluctuation in the positivity rate in this region.

Outside this early period, positivity remains higher for those unvaccinated than those who have had one dose, and higher for those who have had one dose than those who have had 2 throughout.

3.4.6 Summary

In summary, the analysis of PCR testing of self-reported asymptomatic close contacts found that:

- the number of PCR tests taken by self-reported asymptomatic contacts increased substantially from mid-May 2021 until July 2021, around the time the test reasons for app contacts and self-referral were introduced
- over the analysis period, self-referral became the most common test reason for close contacts ordering a PCR test
- for most of the period, the positivity of tests taken following contact by trace agents was higher than the other reasons – however, by end of the period (July 2021), the positivity rate for those that self-referred was higher than for those reached by contact tracers
- in terms of demographics, the proportion of tests taken by females was higher their population estimate – this was also true for younger age groups (≤40 years) and White and Mixed ethnic groups

4. Close contacts reached by the contact tracing service

4.1 Introduction

In this chapter, we present an analysis of tests taken by known close contacts of COVID-19 cases that were identified by data matching between data collected during the contact tracing process (held in the Contact Tracing and Advisory Service (CTAS) system) and data collected as part of the ordering system for PCR tests (held in the National Pathology Exchange (NPEx) system).

This has advantages over the approach presented in Chapter 4 in that it allows us to:

- consider all tests (not just those identified by the user as contact tests), and thus consider all possibilities for why someone identified as a close contact might order a PCR test
- consider a known population of contacts, and therefore calculate more informative metrics – for example, we can calculate the proportion of people eligible for a test who went on to take one

However, we can only do this for contacts identified through the contact tracing process and therefore appear in CTAS. We cannot include those contacted via the app or those who self-referred because no data is held in CTAS on these groups. This means that we can only consider a subset of the close contacts who were eligible for PCR testing.

The analysis considers all PCR tests regardless of test reason, test location or symptom status. This is wider than the policy introduced on 30 March 2021 (which extended PCR testing to asymptomatic close contacts). We have extended the criteria for testing to give the most complete picture of how many contacts were tested and the extent to which subsets of the population were taking up the PCR testing offer. The resultant analyses can then inform future policy decisions with regards eligibility for PCR testing and also where tests can be targeted to be most effective in term of public health benefits.

For the purposes of this chapter we will refer to the group of contacts whose tests we are analysing as ‘CTAS contacts’.

4.2 Methodology

4.2.1 Identifying close contacts

As part of the contact tracing process, T&T contacts confirmed COVID-19 cases to identify their close contacts so that they in turn can be given the appropriate public health advice. The data relating to these close contacts is held within the CTAS database, along with the date on which they were contacted, and personal identifiable information (PII). In this chapter we include any close contact who was identified by the tracing service and successfully reached by contact tracers during the period of the analysis.

All use of the COVID-19 app is anonymised, and therefore we are not able to include close contacts who were notified by the app in this analysis. Similarly, individuals who self-refer are by definition not known to T&T and also cannot be included here.

4.2.2 Identifying PCR tests

All PCR tests that were booked through the T&T systems and subsequently returned to T&T were eligible for inclusion in this analysis. The data relating to these tests is stored within the NPEx database. See Chapter 2 for further information on the process by which PCR tests can be ordered by close contacts.

4.2.3 Matching CTAS contacts and tests

The aim of this analysis was to identify PCR tests taken by close contacts whose details were held in the CTAS system. Tests in NPEx corresponding to people in CTAS were linked by looking for an exact match on their PII (surname, postcode and date of birth) excluding white space and case sensitivity. A matching process such as this is required because there is no systematic linkage of people within the Test and Trace systems.

Our approach balanced overmatching, where different people were linked as the same person, and undermatching, where the same person within CTAS and NPEx was judged to be 2 separate people. Including exact matches on fields such as first name in the matching requirements would have led to significant undermatching, because people use abbreviations inconsistently. By contrast, allowing for fuzzy matching on multiple fields would have led to a high rate of overmatching.

We acknowledge that there is still potential for both overmatching and undermatching in our adopted approach. For example, overmatching might have occurred if there were twins living at the same address: they might have the same surname, postcode and date of birth. Undermatching may occur if someone with a double-barrelled surname entered it with a hyphen between the names in one database, and a space between the names in the other. We judge the impact of these effects to be small.

4.2.4 Matching window

In this analysis we wanted to capture all the tests that were taken by close contacts, regardless of the reason for taking the test. Primarily, we wanted to include symptomatic as well as asymptomatic contacts, who are likely to have selected being symptomatic as their reason for being tested (rather than being a close contact).

Individuals may have become symptomatic and been tested prior to being contacted by CTAS. Therefore, the window for matching individuals within the CTAS database to PCR tests needs to cover the period before and after that person was reached by contact tracers.

All matched PCR tests that were taken up to 5 days prior to or 8 days following being reached by contact tracers were included[3]. This window was based on the expectation that tests outside this window were not relevant to the contact event.

For people that were reached by contact tracers multiple times in a single week, only the first contact that week was counted. This was to provide a meaningful comparison with the number of tests taken: if an individual were to have been exposed to multiple contacts over the space of a week, we assumed that they would take just one PCR test.

4.3 Limitations

The matching process is dependent on the quality of the data provided. If personally identifying information was not provided or provided incorrectly, matching an individual reached by T&T with a test is not possible.

Some individuals test in the days prior to being reached entirely independently of the contact event in question (for example if they were not aware of being in contact). These individuals would have been included in the analysis.

Deduplication occurs for multiple instances of the same individual being reached by T&T within 7 days.

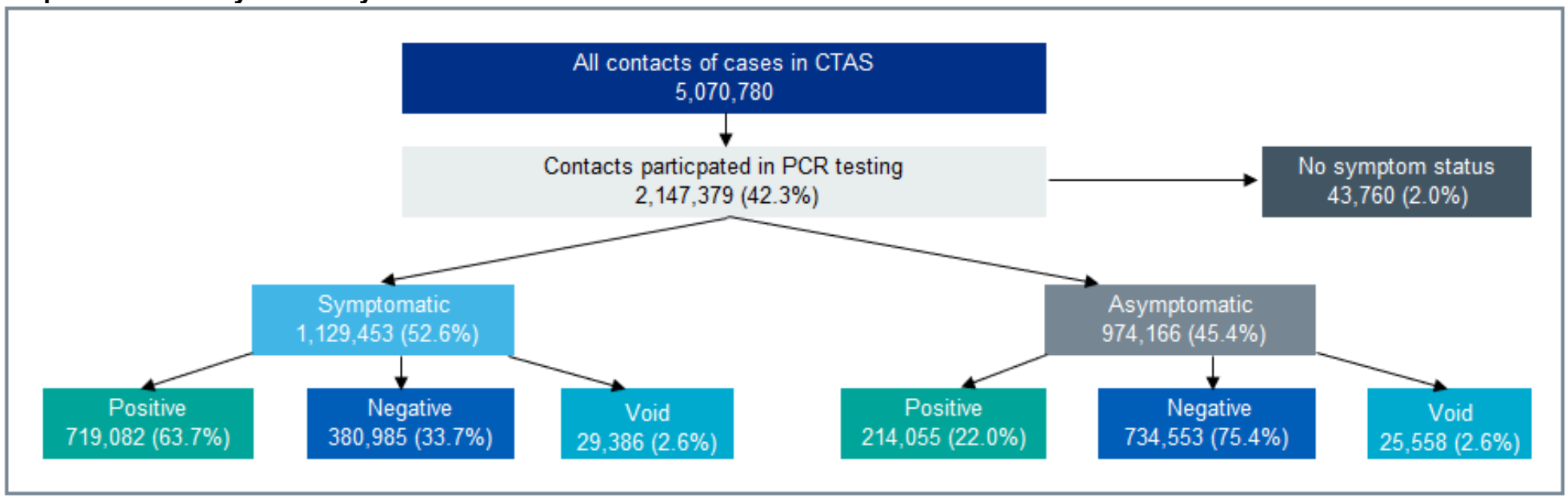
[3] Those contacted from 1 January to 31 July 2021 were included in the analysis, and therefore PCR tests taken between 27 December 2020 and 8 August 2021 were considered for matching.

4.4 Findings

4.4.1 Uptake of testing by CTAS contacts

4.4.1.1 Overall uptake

Figure 9: The flowchart presents the uptake of PCR tests and breakdown of the test results of traced close contacts (in CTAS) for the period 1 January to 31 July 2021



Text equivalent of Figure 9

All contacts of cases in CTAS 5,070,780.

Of which contacts participated in PCR testing 2,147,379 (42.3%).

Of which:

- symptomatic 1,129,453 (52.6%) of which
  - positive 719,082 (63.7%)
  - negative 380,985 (33.7%)
  - void 29,386 (2.6%)
- asymptomatic 974,166 (45.4%) of which
  - positive 214,055 (22%)
  - negative 734,553 (75.4%)
  - void 25,558 (2.6%)
- no symptom status 43,760 (2%)

Unlike the approach used in chapter 3, the matching approach used in this chapter gives us the numerator and denominator for a measure of uptake.

Figure 9 shows that there were 5,070,780 unique occurrences of contacts of confirmed COVID-19 cases being reached by contact tracers between 1 January and 31 July 2021 in England. By matching between contact tracing and test records we were able to identify that 2,147,379 of these close contacts took a PCR test between 5 days prior to and 8 days after having been first contacted, giving an overall uptake rate of testing of 42.3%. This suggests that over half of the close contacts reached by the contact tracing service did not take up the testing that was offered to them.

Among all those who were contacted between 1 January and 31 July 2021 who took a PCR test, 52.6% were symptomatic and 45.4% were asymptomatic. Test positivity was higher in the symptomatic group of tested close contacts, but a substantial number of asymptomatic close contacts were positive: 63.7% of symptomatic contacts and 22.0% of asymptomatic contacts were positive for COVID-19.

Figure 10: CTAS contacts who took and did not take a PCR test, by week, 1 January to 31 July 2021, England – the red line indicates the date at which the policy went live in England

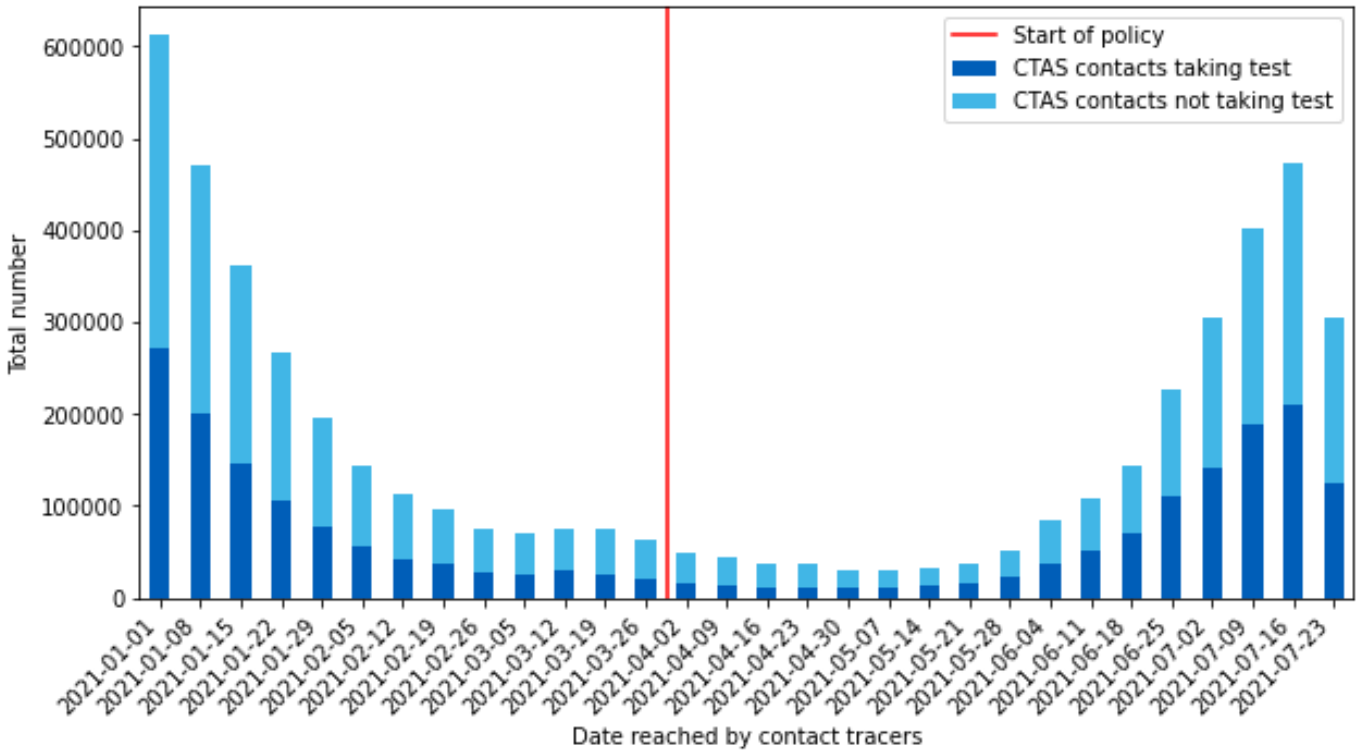
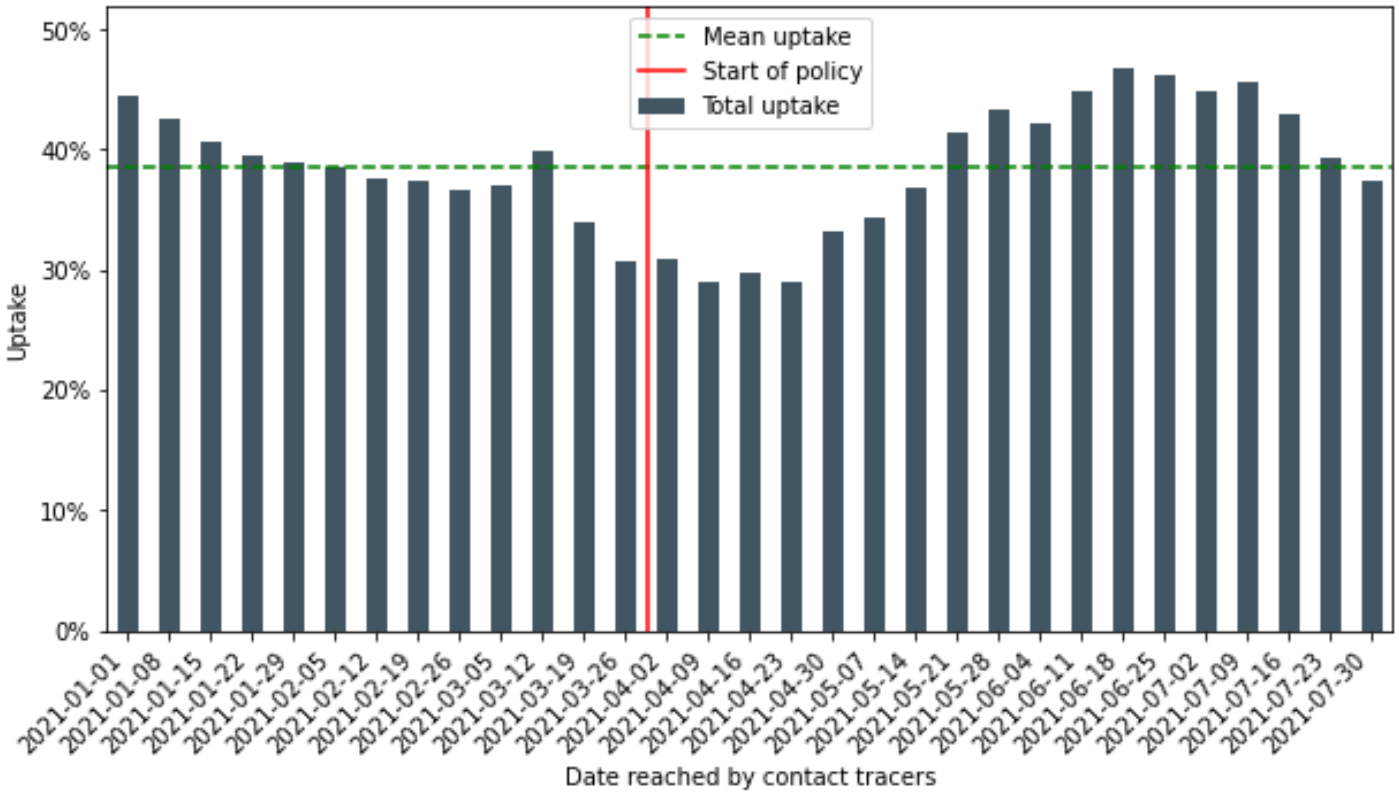


Figure 10 shows the total number of CTAS contacts who took a PCR test and those who did not over time. The trend in the total number of cases identified by CTAS over the period followed that for the total number of COVID-19 cases reported in England, during the same time period [8].

At the start of the year, as England entered its third lockdown, the weekly number of CTAS contacts reached were at its highest. From then, the numbers reduced until late spring and early summer. Numbers then rose again as the Delta variant became established and social restrictions were relaxed.

Figure 11: Uptake of PCR tests, by week, 1 January to 31 July 2021, England



The red line indicates the date at which the policy went live in England (between 26 March and 2 April 2021)

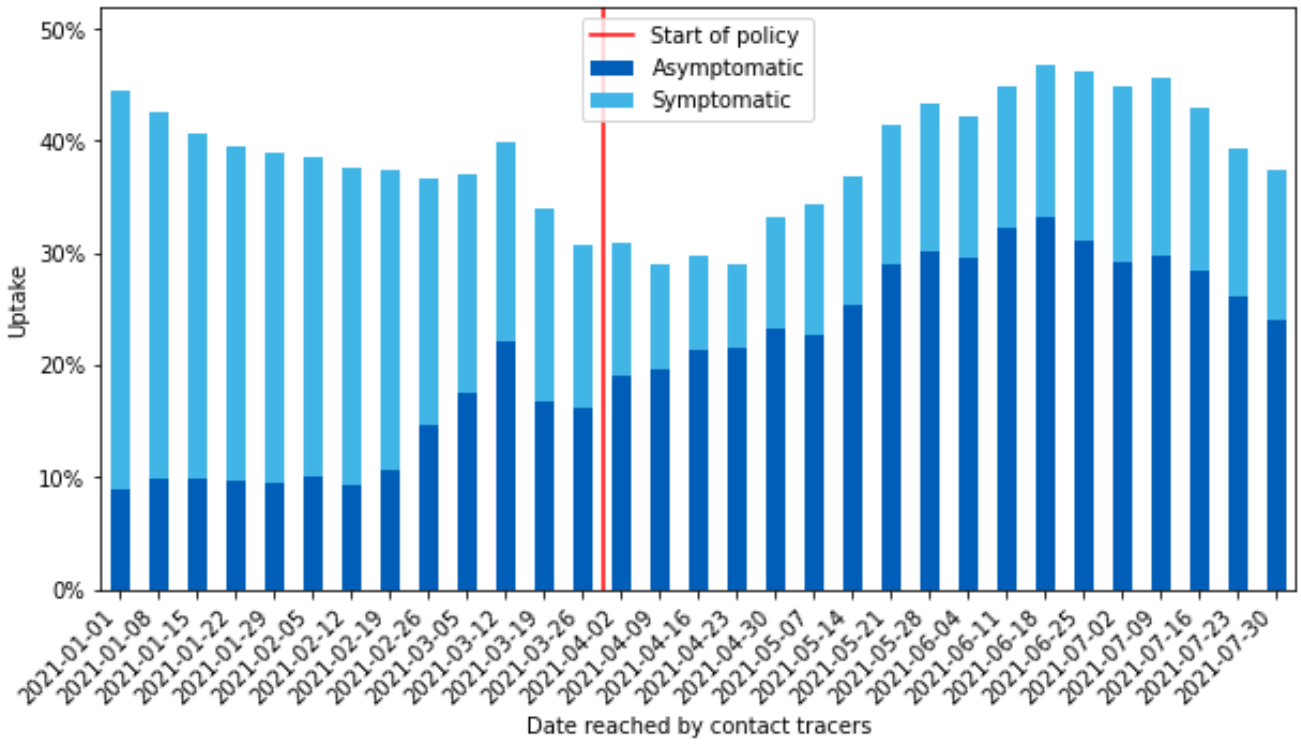
Figure 11 shows the PCR tests taken by CTAS contacts as a proportion of the total number of CTAS contacts reached by contact tracers – the uptake rate of testing. The uptake rate has fluctuated over time, broadly decreasing between January and April 2021, before rising again between May and July 2021. The highest weekly uptake of 46.8% was in the week commencing 18 June 2021. The lowest weekly uptake (29.0%) was seen in the week commencing 9 April, after which the weekly uptake rose to above 40% for most of the remainder of the time period.

These results suggest that the change in testing policy did not lead to a substantial increase in the uptake rate of PCR testing for close contacts. While the subset of CTAS contacts are self-selecting (that is they chose to test so may be the ones who considered themselves most likely to have been infected by the case to which they are linked), these results suggest there was scope to increase the testing within the close contact population.

4.4.1.2 Uptake by symptom status

In Chapter 3, contacts were determined by user-supplied test reasons that were only available in the digital journey after an individual had described themselves as asymptomatic. In contrast, using the method of matching contacts with tests described in section 4.2, it is possible to examine the data broken down by symptom status.

Figure 12: Uptake of PCR tests split by symptom status, by week, 1 January to 31 July 2021, England



The red line indicates the date at which the policy went live in England (between 26 March and 2 April 2021)

Figure 12 shows the same data on uptake of PCR tests by CTAS contacts but split by symptom status. At the start of the year, the large majority (91.2%) of CTAS contacts were symptomatic. This proportion rose between January and July 2021 and in May, June, and July the proportion of CTAS contacts who tested and identified as asymptomatic was between 64.2% and 72.1%.

This increase over time in the proportion of tests taken by CTAS contacts when asymptomatic is likely to be due to the policy change at the end of March 2021, when all contacts were advised to take PCR test irrespective of their symptom status (The options available for booking PCR tests changed to reflect the policy, making it possible for asymptomatic contacts to identify themselves as such in the digital journey.) However, it appears that this trend started before the policy change, and could also be linked to the increase in vaccination coverage [9] over time. COVID-19 cases that arise among fully or partially vaccinated people are more likely to be asymptomatic or with milder symptoms compared to those who are unvaccinated [10].

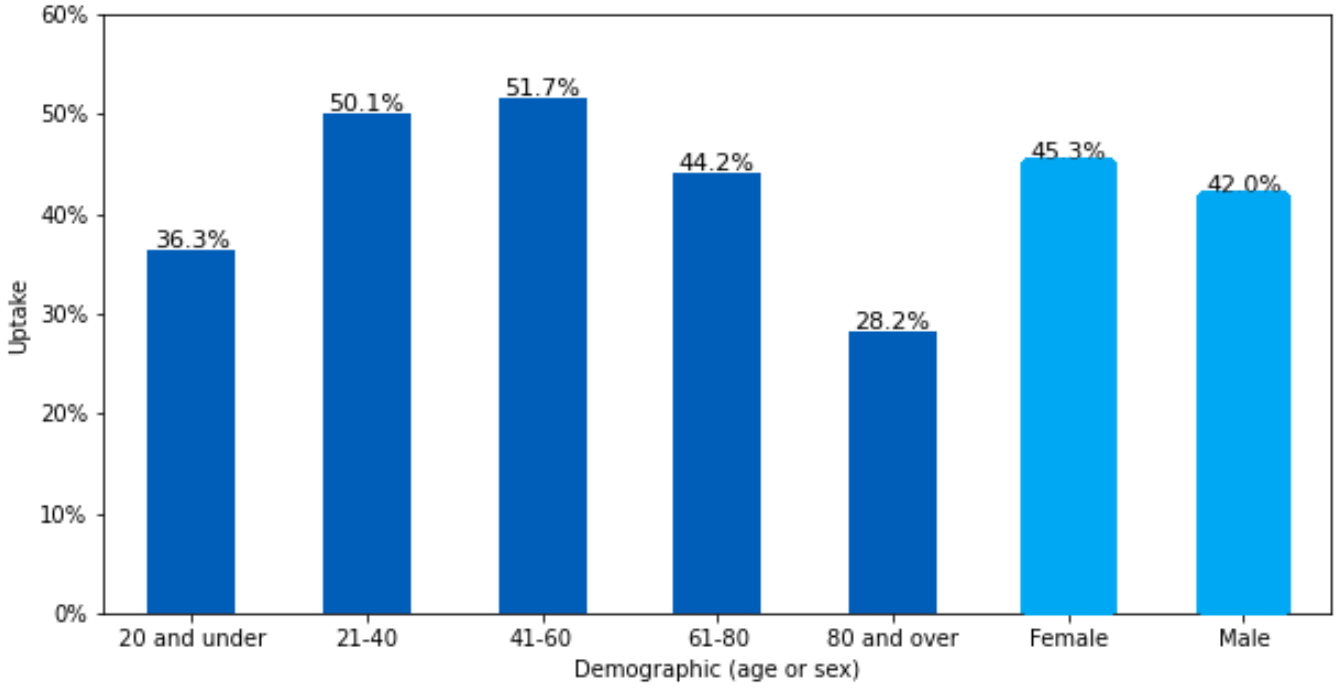
4.4.1.3 Uptake by demographics

Demographic breakdown of the uptake is dependent on demographic data within CTAS rather than NPEx, because the denominator covers those who have not tested (and therefore do not appear in NPEx) as well as those who have.

Within the CTAS data system, there is a high level of completeness for the data on sex and age of contacts (>93% completion). In contrast, ethnicity data was more sparsely completed, with information on ethnicity provided for just over half of contacts. Consequently, we have been

unable to calculate the uptake rate by ethnicity and have restricted the analysis here to age and sex.

Figure 13: Uptake of PCR tests by sex and age, 1 January to 31 July 2021, England



As shown in Figure 13, the uptake of PCR testing by female close contacts was higher than that of males (47.7% compared to 44.0%). When considering different age groups, uptake was highest amongst those aged 21 to 40 years and 41 to 60 years (50.1% and 51.7% respectively), with much lower uptake in the 80 years and over and 20 years and under groups.

4.4.2 Test positivity

4.4.2.1 Overall positivity

Figure 14: Positivity of asymptomatic and symptomatic contacts, as a 7-day rolling average, 1 January to 31 July 2021, England

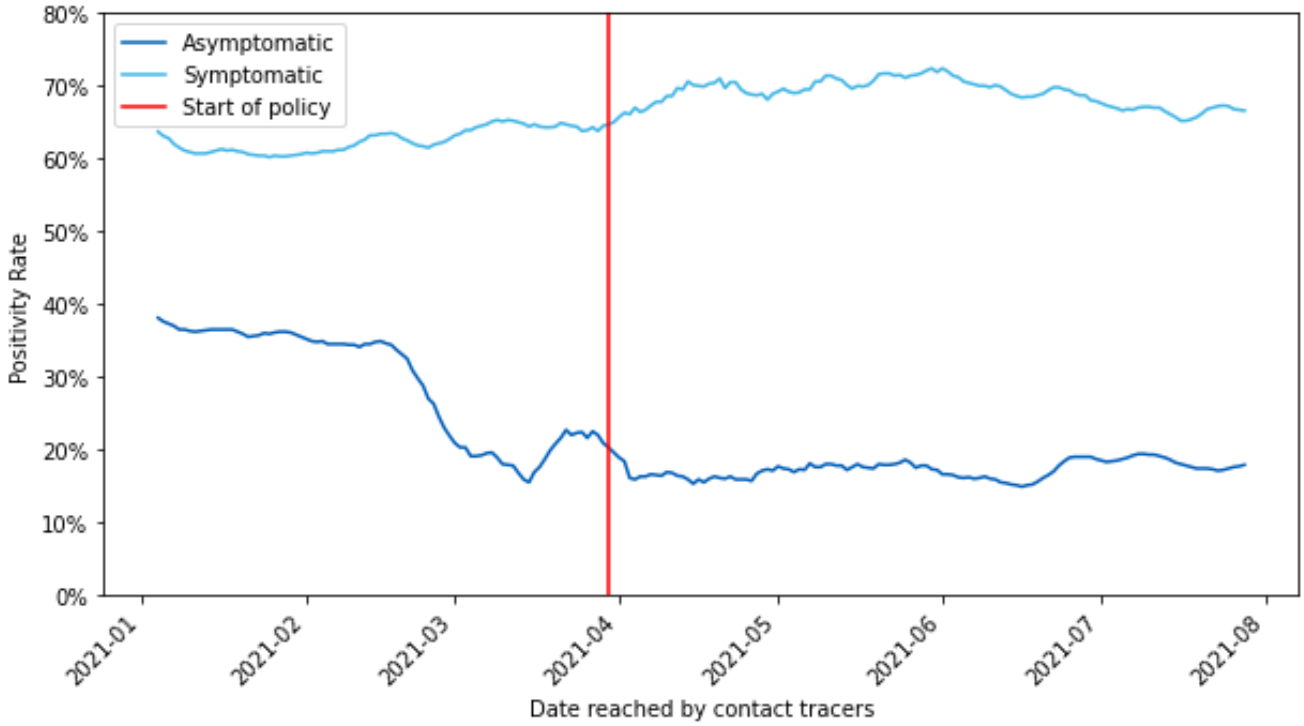


Figure 14 shows the proportion of positive PCR test results by symptom status over a 7-day rolling average between January and July 2021. The positivity was consistently much higher amongst CTAS contacts who were symptomatic, which is in line with expectations. Interestingly, the asymptomatic positivity was very high early in the year until mid-late February 2021, after which asymptomatic positivity dropped and has since remained relatively steady. Although, it is not clear how asymptomatic contacts were able to book a PCR test prior to policy change (30 March 2021), it could be linked to confirmatory PCR testing which was accessible for everyone (even those without symptoms) and care home testing, where asymptomatic staff and residents took PCR tests as part of the dual testing regime. At the end of July 2021, positivity rates in CTAS contacts were 66.6% and 17.9% for symptomatic and asymptomatic contacts respectively.

4.4.2.2 Positivity by demographics

This section shows how positivity varied by demographics in CTAS contacts taking a PCR test. It provides a comparison to the analysis in 3.4.2, which showed positivity by demographics for the 3 different test reasons offered by the PCR test ordering journey.

The demographic data in this analysis is taken from NPEx because the denominator only covers those who have been tested and because demographic data in NPEx is more complete than that in CTAS.

Table 4: Number of PCR test results in contacts by demographics, 1 January to 31 July 2021, England

	Negative number	Negative percent	Positive number	Positive percent	Void number	Void percent
Total	1,139,983	53.1%	951,627	44.3%	55,769	2.6%
Sex						
Female	624,382	54.3%	495,891	43.1%	29,883	2.6%
Male	514,572	51.7%	455,262	45.7%	25,847	2.6%
Unknown	1,029	66.7%	474	30.7%	39	2.5%
Age group						
20 and under	267,014	46.6%	287,374	50.2%	18,350	3.2%
21 to 40 years	419,014	55.2%	320,832	42.3%	18,881	2.5%
41 to 60 years	376,947	56.9%	270,143	40.8%	14,873	2.2%
61 to 80 years	73,483	50.7%	68,072	47%	3,407	2.4%
Over 80	3,525	39.2%	5,206	57.9%	258	2.9%
Ethnicity						
White	903,564	54%	727,894	43.5%	40,662	2.4%
Asian	129,166	49.4%	124,501	47.6%	7,984	3.1%
Black	29,535	50.7%	26,544	45.6%	2,123	3.6%
Mixed	24,381	49.9%	22,934	47%	1,501	3.1%
Other	13,378	48.4%	13,350	48.3%	937	3.4%
Unknown	39,959	50.6%	36,404	46.1%	2,562	3.2%
Region						
London	176,949	53.2%	143,021	43%	12,339	3.7%
Midlands and East	329,688	51.5%	292,930	45.8%	17,171	2.7%
North	360,100	51.8%	320,097	46.1%	14,531	2.1%
South East	164,963	54.4%	129,368	42.6%	9,094	3%
South West	107,356	61.2%	65,618	37.4%	2,564	1.5%
Other	927	58.3%	593	37.3%	70	4.4%

Table 4 shows the number of positive, negative, and void PCR test results from CTAS contacts between January 2021 and July 2021, and the breakdown by demographic subgroups. There was a total of 1,139,983 PCR test results, of which 44.3% were positive, 53.1% were negative and 2.5% were void. The overall positivity was high and can be attributed to the fact that the test results analysed were in close contacts of cases.

The demographic group with the greatest variation in positivity was age. Positivity was highest in the oldest age group (over 80 years) at 57.9% and the youngest age group (20 years and under) at 50.2%, and was lowest in 41 to 60 year olds.

Positivity was slightly higher in males (45.7%) than females (43.1%). It was highest in the Asian (47.6%) and Other (48.3%) ethnic groups, and lowest in the White group (43.5%). Positivity rates amongst CTAS contacts in the South West of England were 37.4%, much lower than the other regions. The highest positivity was in the North (46.1%) and Midlands and East (45.8%).

4.4.2.3 Positivity by symptom status

Table 5: Asymptomatic and symptomatic positivity in contacts who took a PCR test by demographics, 1 January to 31 July 2021, England

	Asymptomatic number	Asymptomatic positivity	Symptomatic number	Symptomatic positivity
Sex				
Female	111,826	21.3%	374,665	62.4%
Male	102,071	22.8%	344,121	65.1%
Age group				
20 and under	83,430	32.7%	196,334	64.5%
21 to 40 years	63,883	19.1%	252,257	61.2%
41 to 60 years	52,749	16.7%	212,894	64%
61 to 80 years	12,862	19.9%	53,643	71.2%
Over 80	1,131	30.4%	3,954	80%
Ethnicity				
White	162,219	21.5%	551,625	62.5%
Asian	26,992	22.4%	95,227	69.7%
Black	6,823	24.4%	19,041	66.2%
Mixed	5,874	27.1%	16,638	63.3%
Other	2,839	23%	10,235	69.1%
Unknown	9,308	25.7%	26,316	64.9%

	Asymptomatic number	Asymptomatic positivity	Symptomatic number	Symptomatic positivity
Region				
London	32,374	20.7%	109,053	63.6%
Midlands and East	64,233	23.3%	223,844	63.4%
North	73,632	23.3%	237,575	66.3%
South East	27,684	20.3%	99,923	61.4%
South West	16,012	18.1%	48,239	57.8%
Other	120	14.2%	448	63.2%

Table 5 shows the number of positive tests and proportions in asymptomatic and symptomatic contacts who took a PCR test by demographics. As would be expected, positivity was consistently higher for those identifying as symptomatic.

Symptomatic positivity was the highest in older age groups, 61 to 80 years (71.2%) and over 80 years (80.0%). For Asian contacts and where the ethnic group was not identified (Other), the symptomatic positivity was higher than other ethnic groups at 69.7% and 69.1% respectively. The proportions were lowest amongst contacts in South West region at 57.8%.

Asymptomatic positivity was the highest in 20 years and under (32.7%). This was followed by the over 80 years age group where the asymptomatic positivity was 30.4%. This may be associated with children being less susceptible to infection and having no or fewer symptoms than adults [11] and higher vaccination rates in the oldest age group. For the other demographic subgroups, asymptomatic positivity ranged between 16.7% (41 to 60 years) to 27.1% (Mixed ethnic group).

The contrast between the high asymptomatic positivity in both youngest and oldest and the high symptomatic in just the oldest (but not the youngest) is consistent with the youngest being least susceptible to severe disease from COVID-19.

4.4.2.4 Demographics compared with census

Table 6: Total number of PCR test results in contacts and census data by demographics, 1 January to 31 July 2021, England

	Total number	Total percent	Census percent
Total	2,147,379	100%	n/a
Sex			
Female	1,150,156	53.6%	50.5%
Male	995,681	46.4%	49.5%
Unknown	1,542	n/a	n/a
Age group			
20 and under	573,738	26.7%	23.6%
21 to 40 years	758,727	35.3%	26.2%
41 to 60 years	661,963	30.8%	26.1%
61 to 80 years	144,962	6.8%	19.1%
Over 80	8,989	0.4%	5%
Ethnicity			
White	1,672,120	80.8%	86%
Asian	261,651	12.6%	7.5%
Black	58,202	2.8%	3.3%
Mixed	48,816	2.4%	2.2%
Other	27,665	1.3%	1%
Unknown	78,925	–	–
Region			
London	332,309	15.5%	15.9%
Midlands and East	639,789	29.8%	30.2%
North	694,728	32.4%	27.5%
South East	303,425	14.1%	16.3%
South West	175,538	8.2%	10%
Other	1,590	–	–

The census population estimates for sex, age group and region are for 2020 [6]. The estimates for ethnicity were older, last available for 2011 [7].

During the period, there were more tests taken by female contacts (53.6%) than male contacts (46.4%). The proportion of tests taken by females were slightly higher when compared with their population estimates by sex [7] (50.5%).

In terms of the proportion of tests taken by age, contacts in the age groups 21 to 40 and 41 to 60 years took most tests (35.3% and 30.8% respectively). When compared to population estimates, older age groups (over 60 years) took a lesser proportion of tests and middle and younger age groups (less than or equal to 60 years) took a larger proportion [6].

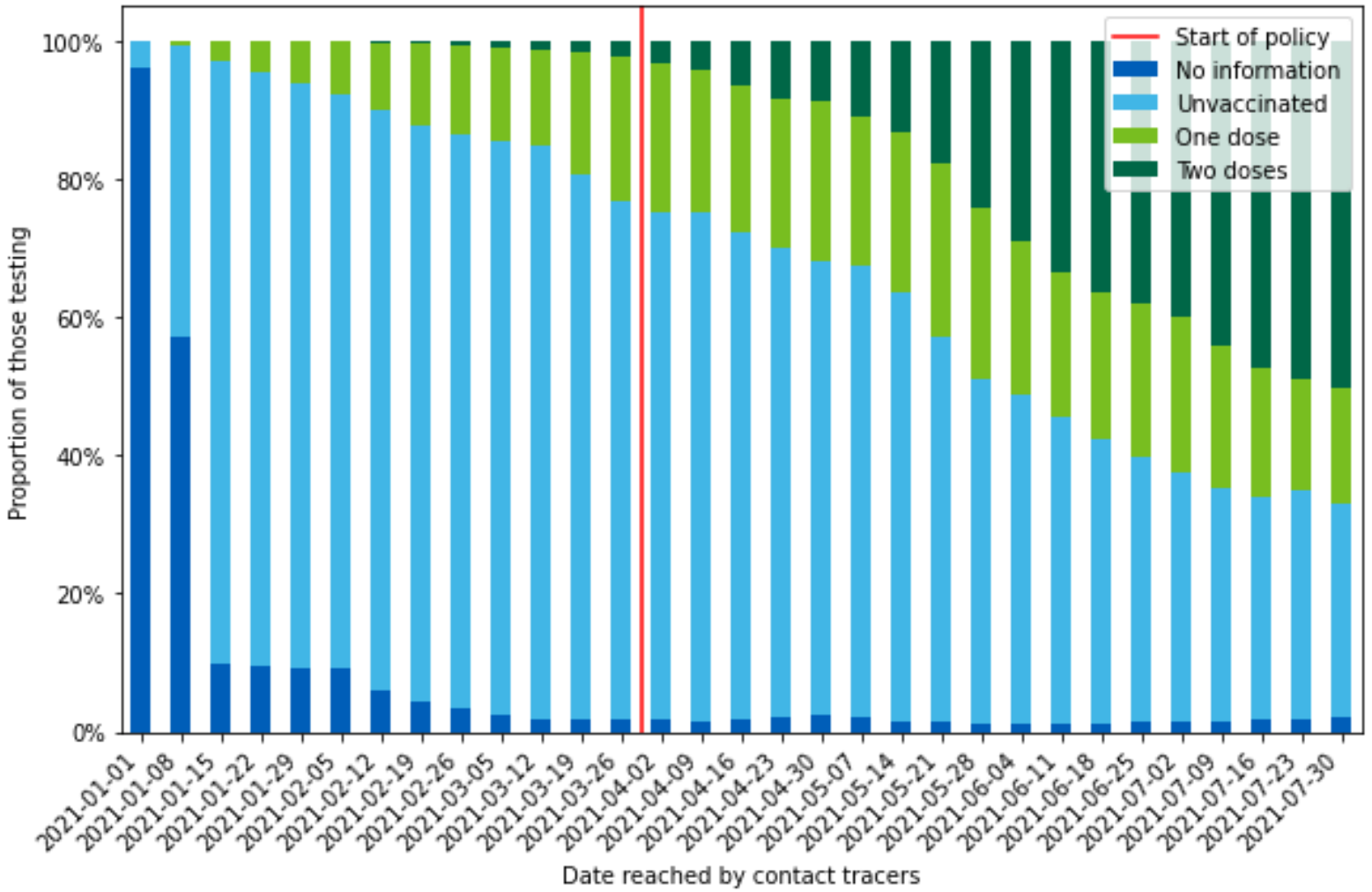
Contacts who identified as White took the majority of the PCR tests (80.8%), but this is lower than the population estimate for the white group (86.0%). When compared to the population estimates, the Asians group took a larger share of tests (7.5% of the population compared to 12.6% of the tests). For all other ethnic groups, the proportion of tests were lower when compared with their population estimates [7].

Contacts in the North region followed closely by those in Midlands and East took the largest share of PCR tests (32.4% and 29.8% respectively). The proportion of tests taken were in line with their population estimates for all the regions except North which showed higher proportion of tests (32.4%) than population estimates (27.5%)[6].

4.4.3 Vaccination status

4.4.3.1 Proportion of tests by vaccination status

Figure 15: Proportion of tests by vaccination in contacts who took a PCR test, by week, January to July 2021, England



This analysis covers the period from 1 January to 31 July 2021, which coincides with the rollout of the COVID-19 vaccination programme. Figure 15 shows that over this period the proportion of contacts (who took PCR tests) who were vaccinated increased in line with vaccine coverage in the general population [9].

4.4.3.2 Positivity by vaccination status

Figure 16: Positivity in contacts who took a PCR test by vaccination status, as a 7-day rolling average, 1 January to July 2021, England

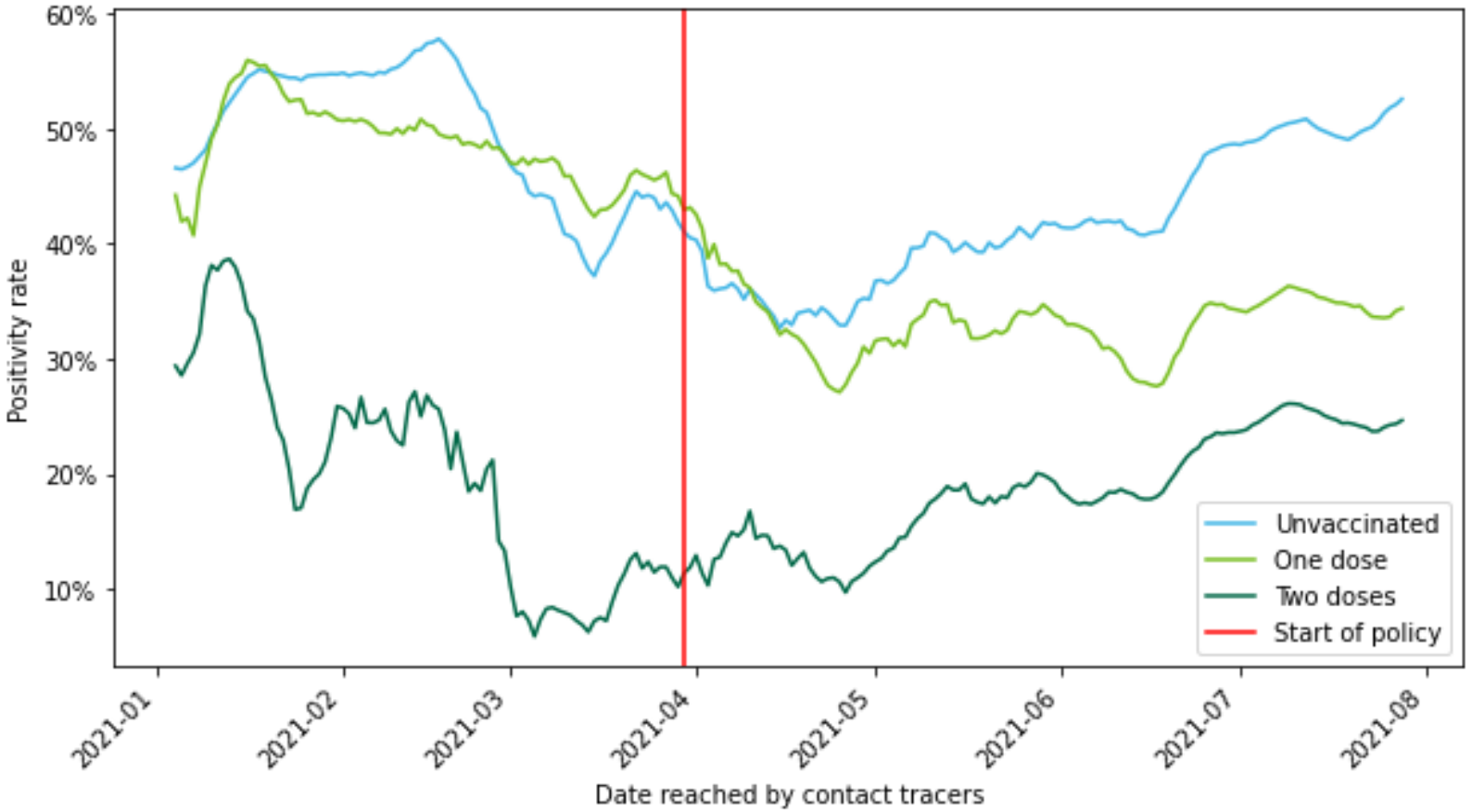


Figure 16 shows the positivity over time of contacts who took a PCR test by their vaccination status[4,5]. The positivity was the highest amongst contacts who were unvaccinated for most of the time-period. Contacts who had a single dose showed higher positivity than unvaccinated contacts in mid-January 2021 and between March to mid-April 2021. This should not be taken as an indication of vaccine efficacy, and probably reflects changes to the underlying contact population (for example, as a result of social restrictions in place).

4.4.3.3 Vaccine and symptom status

Table 7: Symptomatic and asymptomatic positivity in contacts who took a PCR test by vaccination status, 1 January to 31 July 2021, England

Symptomatic contacts who took a PCR test						Asymptomatic contacts who took a PCR test				
Vaccination	**Negative**	**Positive**	**Void**	**Total**	**Positive (%)**	**Negative**	**Positive**	**Void**	**Total**	**Positive (%)**
No dose	200,350	380,654	14,272	595,276	63.9%	276,538	115,075	12,174	403,787	28.5%
One dose	35,640	69,055	2,090	106,785	64.7%	125,723	26,709	3,376	155,808	17.1%
Two doses	42,523	60,498	1,972	104,993	57.6%	263,702	35,402	5,870	304,974	11.6%

Amongst all the contacts who took a PCR test and reported their vaccination status, 47.5% were not vaccinated at the time of taking their test, 12.5% had one dose and 19.5% had 2 doses of vaccination. The contacts of cases who had 2 doses showed lower overall positivity (23.4%) compared with those who had one dose of vaccination (36.5%), and those who did not have vaccination (49.6%). This appears to be evidence that vaccination reduces the risk of infection for contacts of cases.

[4] Two doses refers to all those who have had 2 doses with no restriction on how recent the second dose was

[5] This plot does not include a line for those who did not provide their vaccination status. As seen in figure 9, this was a particularly large proportion at the start of the year

4.4.4 Contact type

4.4.4.1 Proportion of tests by contact type

Figure 17: Proportion of PCR tests by contact type, by week,1 January to 31 July 2021, England

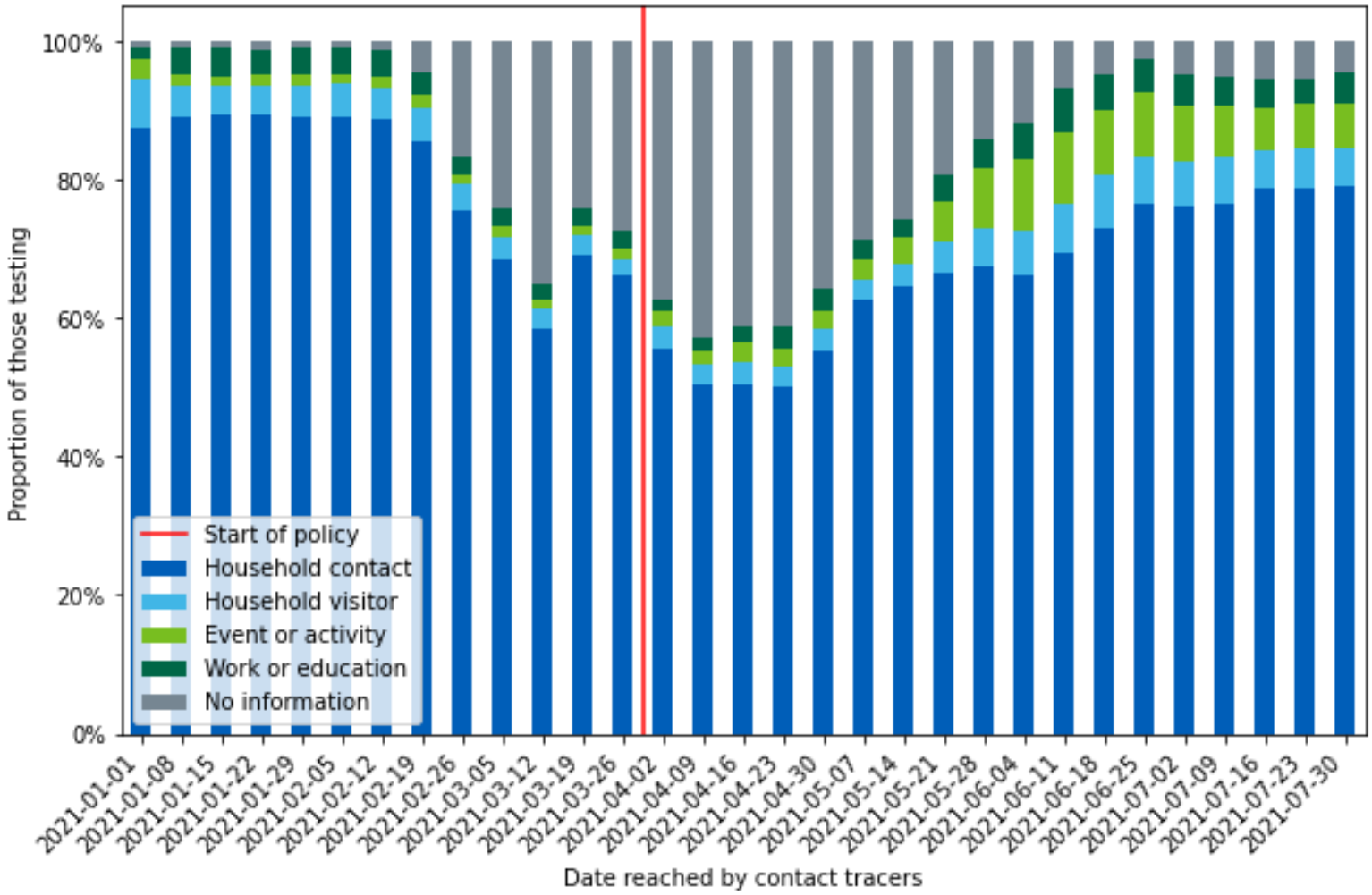


Figure 17 shows the PCR tests taken by contacts split by the type of contact. The majority of CTAS contacts who took a test were household contacts, with a substantial proportion of the remainder being household visitors. The proportion of contacts from "Event or Activity" increased in the summer (June 2021 onwards) in line with reduced restrictions.

Work or education contacts increased in proportion during March 2021 which can be linked to opening of schools. Also, between April and May 2021, there was a rise in household visitor contacts most likely due to further easing of restrictions (opening of non-essentials services and mixing of households). Additionally, there was also slight increase in ‘No information’ between March and May 2021.

4.4.4.2 Positivity by contact type

Figure 18: Positivity by contact type, as a 7-day rolling average, 1 January to 31 July 2021, England

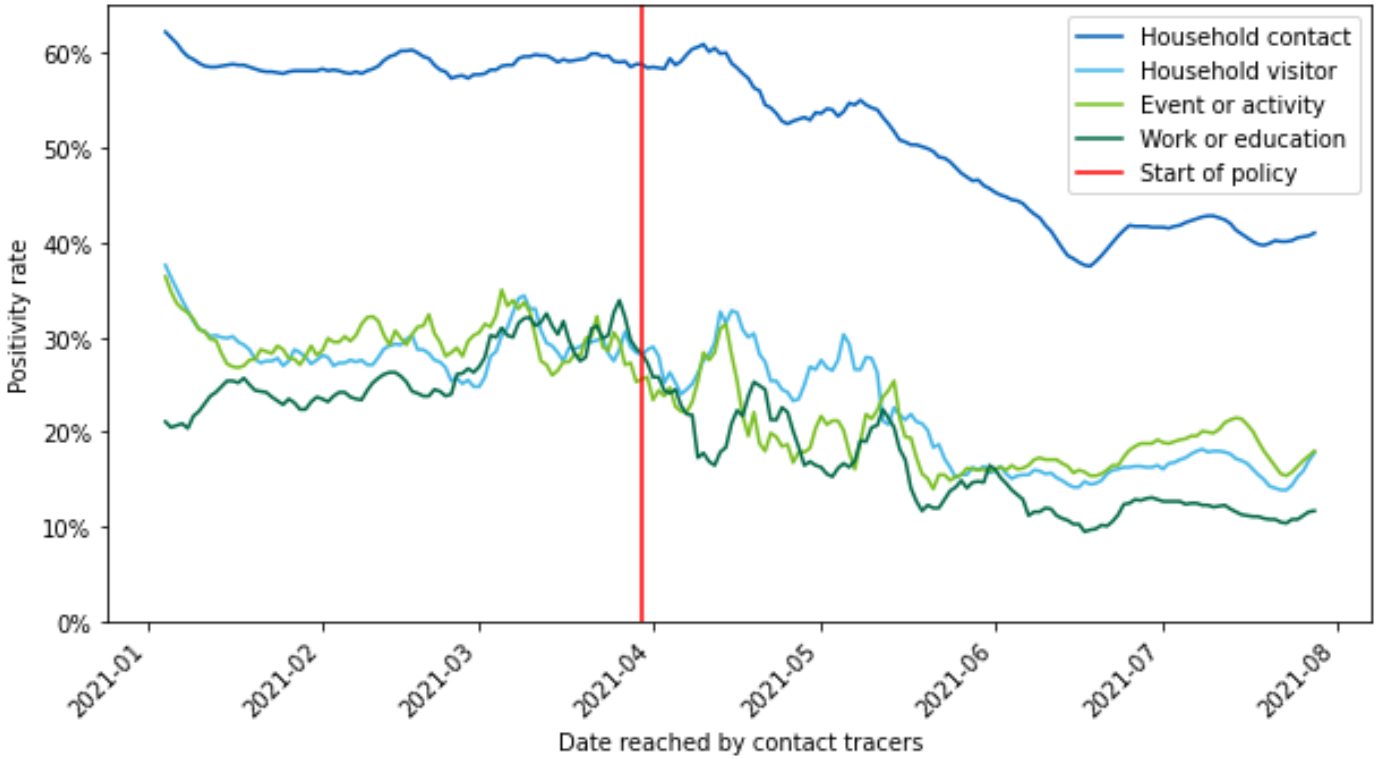


Figure 18 shows that positivity was consistently much higher amongst household contacts than other contact types. The differences between other contact types were smaller, and through June and July 2021 the positivity for work or education contacts was consistently lower than that of household visitors and event or activity contacts.[7]

4.4.5 When contacts tested (relative to being reached by contact tracing)

Figure 19: The day PCR tests were taken among CTAS contacts, relative to being reached by contact tracers, 1 January to 31 July 2021, England

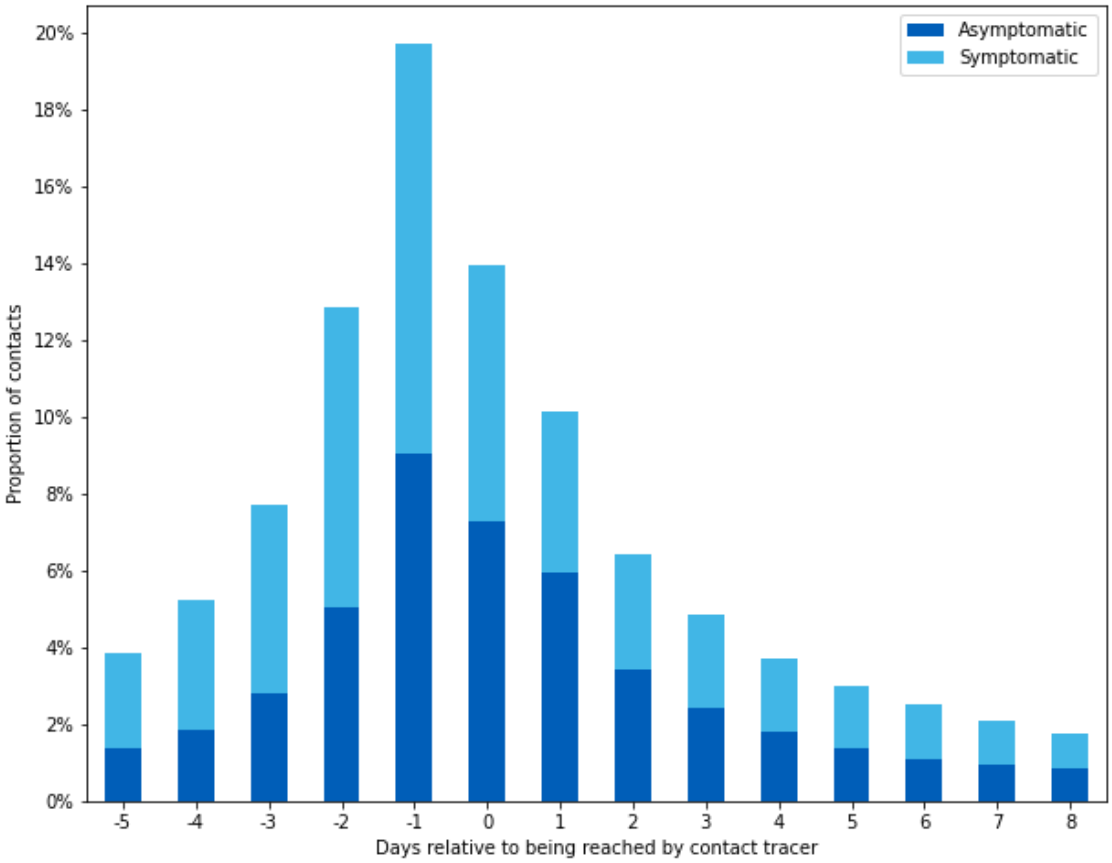
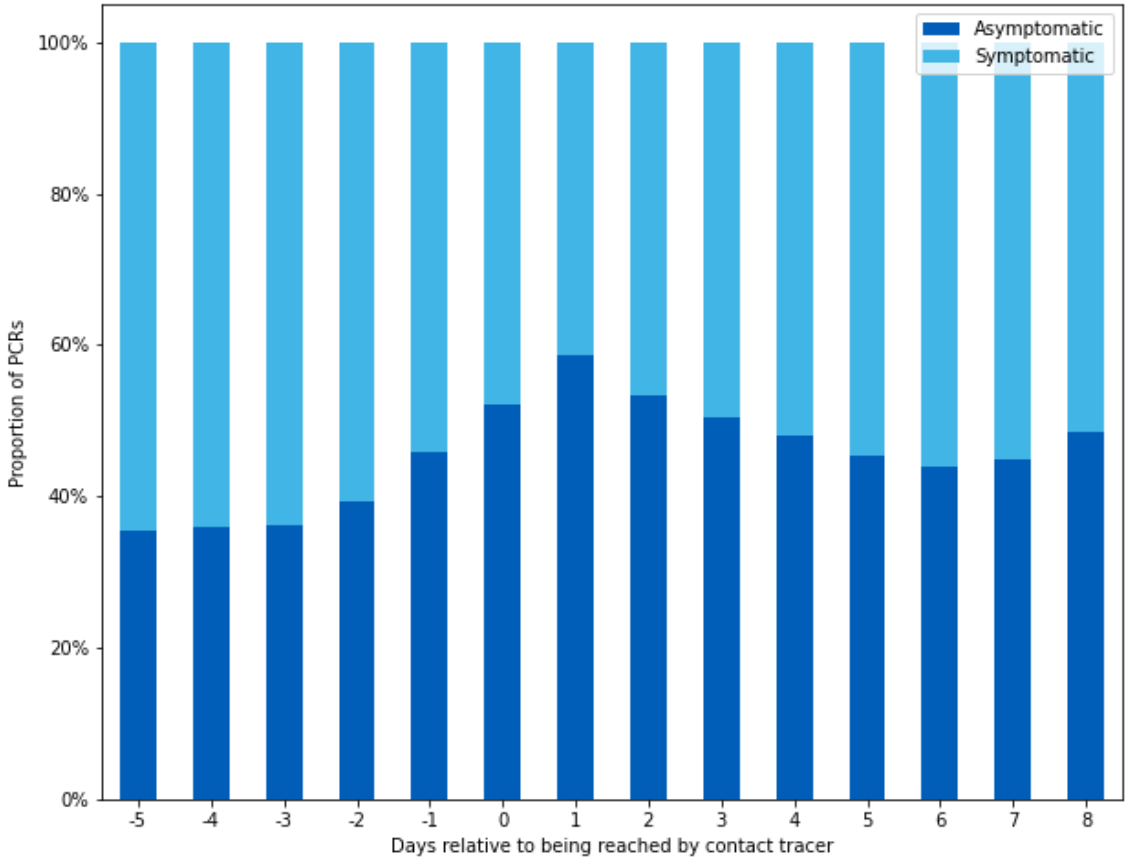


Figure 19 shows the day on which close contacts took a PCR test relative to when they were reached by a contact tracer. The majority of the contacts who tested (50.4%) took their test in the days prior to being reached by contact tracers. The median day for contacts to take a test was the day before (-1 day) they were reached by a contact tracer.

[7] This plot does not include a line for those that did not take give a contact type upon taking a test. As seen in figure 11, this was a larger proportion of all those testing in the spring.

While this suggests contact tracing might not be happening quickly enough to detect cases in exposed contacts before they become symptomatic, it is important to note the complexity of real world transmission networks. There are likely to be multiple opportunities for someone to have been exposed to the virus, particularly in times high prevalence. The case-contact pairing in our data may not been the actual route of transmission; there may have been a separate common exposure for both individuals. This may go some way to explaining why such a high proportion of contacts appear to be testing before they have been reached by the contact tracing service.

Figure 20: Proportions of PCR tests taken among CTAS contacts by symptom status as a function of the date the PCR test was taken relative to being reached by contact tracers



Because we are covering all CTAS contacts who took a test, it would be expected that some would have taken a test before being reached by contact tracers, as they may have developed symptoms or been told informally of their contact status. Figure 20 shows that for the days prior to notification from contact tracing, a higher proportion of those tested reported being symptomatic. For those who tested after being reached by contact tracers, a higher proportion reported being asymptomatic, which suggests a positive impact of contact tracing in reaching those who have been exposed to the virus and encouraging them to test.

4.4.6 Summary

The analysis of CTAS identified contacts found that between January and July 2021:

- test uptake amongst CTAS contacts was 42.3%
- test positivity for COVID-19 was higher in symptomatic CTAS contacts compared with asymptomatic contacts
- overall test positivity in CTAS contacts was high at 44.3% – this may be because test results analysed were in close contacts of cases (identified by CTAS) and also because they include symptomatic contacts, where the positivity was much higher than asymptomatic contacts
- in the demographic sub-groups, positivity was highest in the oldest and the youngest age groups
- positivity was lower in contacts who had 2 doses compared with those who had one dose of vaccination, and those who did not have vaccination
- the majority of CTAS contacts who took a test were household contacts

5. Multivariate analysis of factors affecting COVID-19 positivity

5.1 Introduction

This chapter presents a multivariate analysis, carried out to describe the interrelationship between the factors that affected positivity in close contacts and how they changed over time.

5.2 Methodology

5.2.1 Study population

In this analysis, all the contacts recorded in CTAS between January and July 2021 and the corresponding PCR test result records from NPEx database were assessed (the data set created for the analysis in Chapter 4).

5.2.2 Risk factor variables

For this analysis, the outcome variable was a positive PCR test result. We considered these factors as covariates:

- age groups – 20 years and under, 21 to 40 years, 41 to 60 years, 61 to 80 years, over 80 years
- sex – male, female, other
- ethnicity – White, Asian, Black, Mixed and other
- region – London, Midlands and East, North, South East, South West
- symptom status – asymptomatic, symptomatic, unknown
- vaccination status – not vaccinated, one dose, 2 doses, unknown
- contact type – work or education, household or accommodation, household visitor, event or activities

5.2.3 Statistical analysis

Sequential logistic regression modelling was used to demonstrate the effect of age, gender, ethnicity, region, symptom status, vaccination status and contact type on positive PCR test results in close contacts identified in CTAS. This accounted for potential correlation across covariates to ensure comparability and resulting adjusted odds ratios (ORs) were expressed as the risk change for a one standard deviation increase in the value of the covariate.

The Full model included the following COVID-19-specific variables: age, ethnicity, region, symptom status, vaccination status and contact type. This model did not include sex as it did

not show any significance. A Reduced model did not include ethnicity and region although they showed significance, as their effect sizes were small. Therefore, this model included only age, symptom status, vaccination status and contact type. However, the ORs of these variables did not vary much between the 2 models.

To understand the time-dependent changes in effect sizes, logistic regression which included age, symptom status, vaccination status and contact type was conducted for each month (January to July 2021).

For all regression analyses, mutually adjusted odds ratios (ORs) and 95% confidence intervals were calculated.

The effect sizes were grouped into the following categories for ease of interpretation in this analysis:

- strong risk if OR is greater than 2.0
- medium risk if OR is less than or equal to 2.0 but greater than 1.2
- low risk or weak association if OR is less than or equal to 1.2 but greater than 1.0
- reduced risk if OR is less than or equal to 1.0

5.3 Limitations

The data for this analysis was extracted from CTAS and NPEx databases and is therefore reliant on their completeness. Most of the variables were self-reported and have their own biases. There may be other confounding factors which were not addressed in this analysis due to lack of data.

5.4 Findings

5.4.1 Multivariate logistic regression analyses

Table 8: Multiple logistic regression for Reduced and Full models – results are presented as mutually adjusted Odds Ratios (ORs) (95% confidence interval)

Characteristic	Category	Reduced model OR [5%, 95%]	Full model OR [5%, 95%]
Age group	20 and under	1.05 [1.04, 1.06]	1.04 [1.04, 1.05]
	21 to 40 years	Ref	Ref
	41 to 60 years	1.04 [1.03, 1.04]	1.04 [1.03, 1.05]
	61 to 80 years	1.49 [1.47, 1.51]	1.49 [1.48, 1.51]
	Over 80 years	2.41 [2.31, 2.51]	2.41 [2.31, 2,51]
Symptom status	Symptomatic	4.69 [4.67, 4.72]	4.69 [4.67, 4.72]
	Asymptomatic	Ref	Ref
	Unknown	2.70 [2.66, 2.75]	2.63 [2.59, 2.68]
Vaccination status	One dose	0.83 [0.83, 0.84]	0.84 [0.83, 0.84]
	Two doses	0.48 [0.48, 0.49]	0.48 [0.48, 0.49]
	Not vaccinated	Ref	Ref
	Unknown	0.99 [0.99, 1.00]	1.01 [1.01, 1.02]
Contact type	Events/activities	1.67 [1.63, 1.70]	1.67 [1.63, 1.70]
	Household/accommodation	4.69 [4.61, 4.77]	4.59 [4.51, 4.66]
	Household visitor	1.41 [1.38, 1.44]	1.39 [1.37, 1.42]
	Work/education	Ref	Ref
	Unknown	0.42 [0.41, 0.43]	0.39 [0.38, 0.40]
Ethnicity	White	–	Ref
	Asian	–	1.28 [1.27, 129]
	Black	–	1.17 [1.16, 1.19]
	Mixed	–	1.05 [1.03, 1.07]
	Other	–	1.27 [1.24, 1.30]
	Unknown	–	1.09 [1.08, 1.11]
Region	London	–	1.05 [1.03, 1.06]
	Midlands and East	–	1.17 [1.16, 1.18]
	North	–	1.34 [1.33, 1.36]
	South East	–	1.05 [1.04, 1.07]

Characteristic	Category	Reduced model OR [5%, 95%]	Full model OR [5%, 95%]
	South West	–	Ref
	Other	–	1.17 [1.05, 1.30]

In the multivariate fully adjusted models of positive PCR tests in CTAS contacts between 1 January and 31 July 2021, there were significant associations between all variables (age, ethnicity, region, symptom status, vaccination status and contact type) except sex.

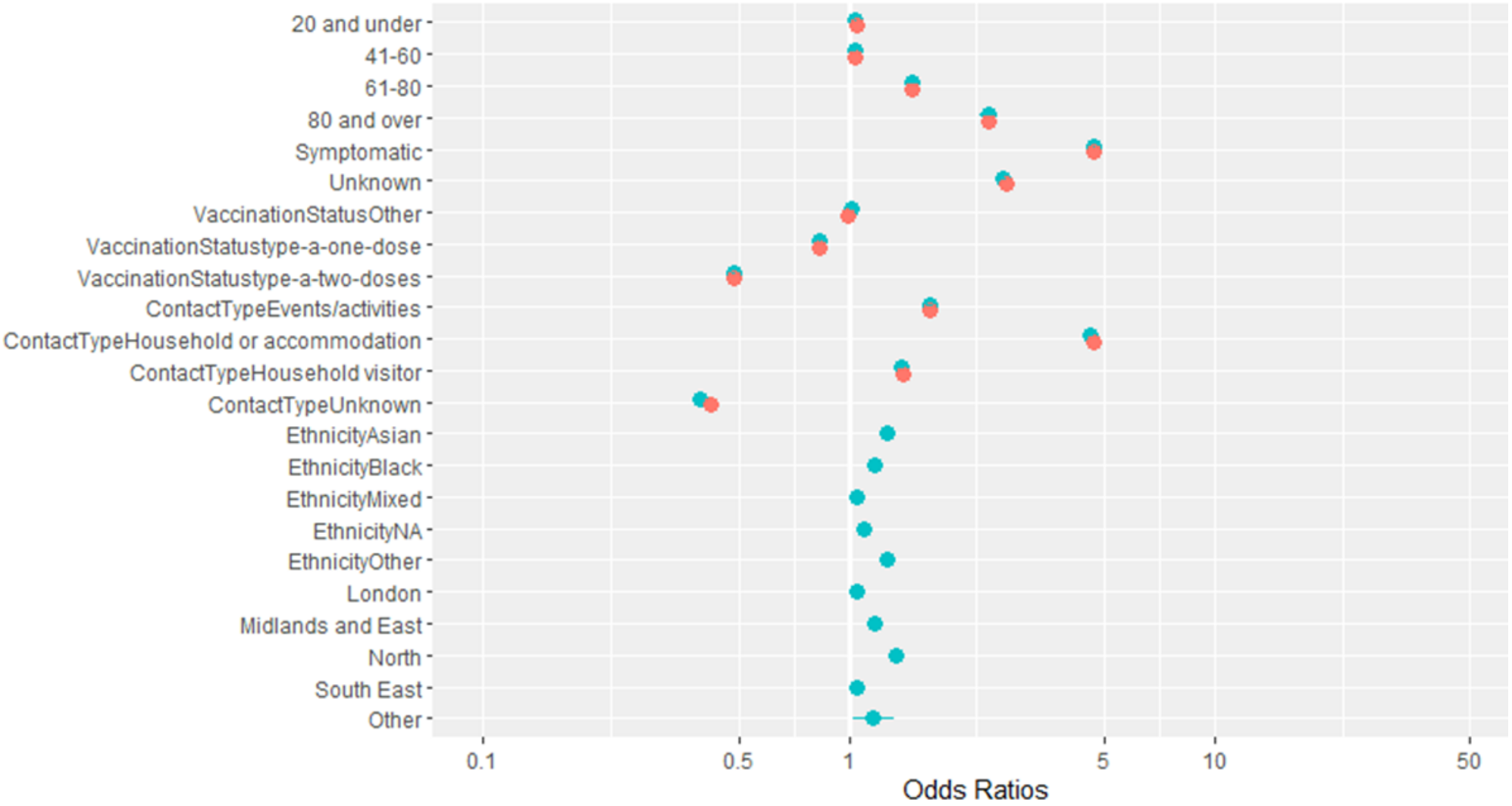
Table 8 shows ORs from Reduced and Full-models. The mutually adjusted ORs for these variables were similar, therefore, we are only discussing outputs from the Full-model here.

In the Full-model, of all the variables independently associated with higher risk of test positivity, older age (over 80 years: OR 2.41 [2.31, 2.51]), being a symptomatic contact (OR 4.69 [4.67, 4.72]), household or accommodation contact (OR 4.59 [4.51, 4.66]) were stronger compared with other covariates.

Vaccination status showed inverse association with positive test results. Contacts who took one dose (OR 0.84 [0.83, 0.84]) and those who took 2 doses (OR 0.48 [0.48, 0.49]) showed reduced risk.

Age group 61 to 80 years (OR 1.49 [1.48, 1.51]), contacts from events or activities (OR 1.67 [1.63, 1.70]), household visitor contacts (OR 1.39 [1.37, 1.42]), Asians (OR 1.28 [1.27, 1.29]), contacts from North region (OR 1.34 [1.33, 1.36]) and from showed medium association with positive tests. All other variables were weakly associated.

Figure 21: Odds ratios of variables from Reduced model and Full model



5.4.2 Time dependent multivariate logistic regression analysis

Table 9: Multiple logistic regression by month (January to July 2021) – results are presented as mutually adjusted Odds Ratios (95% confidence interval)

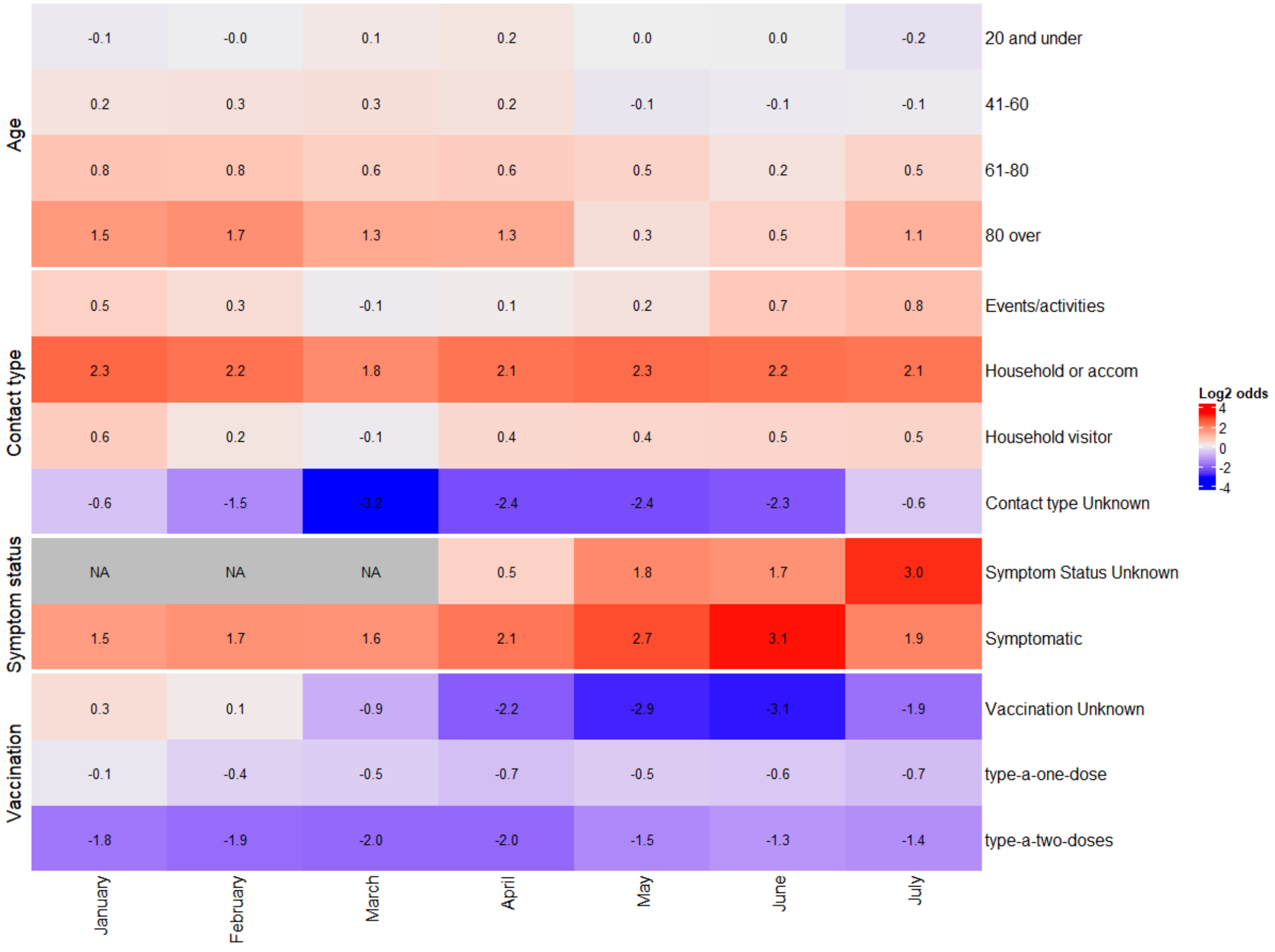
Characteristic	Category	January OR [5%, 95%]	February OR [5%, 95%]	March OR [5%, 95%]	April OR [5%, 95%]	May OR [5%, 95%]	June OR [5%, 95%]	July OR [5%, 95%]
Age group	20 and under	0.94 [0.93, 0.95]	0.98 [0.96, 1.00]	1.09 [1.06, 1.12]	1.13 [1.07, 1.19]	1.00 [0.95, 1.04]	1.01 [0.98, 1.03]	0.87 [0.85, 0.88]
	21 to 40 years	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	41 to 60 years	1.17 [1.16, 1.18]	1.19 [1.16, 1.21]	1.21 [1.18, 1.25]	1.18 [1.12, 1.25]	0.91 [0.87, 0.96]	0.94 [0.91, 0.96]	0.96 [0.94, 0.97]
	61 to 80 years	1.71 [1.68, 1.73]	1.69 [1.63, 1.75]	1.47 [1.38, 1.56]	1.52 [1.38, 1.68]	1.42 [1.28, 1.57]	1.17 [1.11, 1.22]	1.41 [1.38, 1.45]
	Over 80 years	2.87 [2.70, 3.05]	3.27 [2.87, 3.73]	2.39 [1.93, 2.96]	2.38 [1.68, 3.33]	1.24 [0.80, 1.86]	1.44 [1.22, 1.70]	2.16 [1.98, 2.36]
Symptom status	Symptomatic	2.81 [2.78, 2.84]	3.18 [3.12, 3.24]	3.11 [3.03, 3.20]	4.32 [4.15, 4.50	6.37 [6.14, 6.62]	8.82 [8.67, 8.98]	7.98 [7.90, 8.06]
	Asymptomatic	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Unknown	–	–	–	1.43 [0.61, 3.16]	3.48 [3.23, 3.75]	3.16 [3.05, 3.27]	3.69 [3.61, 3.78]
Vaccination status	One dose	0.92 [0.90, 0.95]	0.74 [0.71, 0.76]	0.72 [0.70, 0.75]	0.62 [0.59, 0.66]	0.70 [0.66, 0.74]	0.68 [0.67, 0.70]	0.60 [0.59, 0.61]
	Two doses	0.29 [0.25, 0.35]	0.26 [0.21, 0.32]	0.25 [0.21, 0.29]	0.25 [0.22, 0.28]	0.35 [0.33, 0.38]	0.40 [0.39, 0.41]	0.37 [0.36, 0.38]
	Not vaccinated	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Unknown	1.25 [1.24, 1.26]	1.06 [1.02, 1.09]	0.52 [0.47, 0.56]	0.22 [0.18, 0.27]	0.13 [0.10, 0.15]	0.12 [0.10, 0.13]	0.27 [0.25, 0.28]
Contact type	Event/activities	1.46 [1.40, 1.51]	1.25 [1.15, 1.35]	0.96 [0.85, 1.07]	1.05 [0.89, 1.25]	1.18 [1.02, 1.36]	1.62 [1.53, 1.72]	1.80 [1.73, 1.87]
	Household/ accommodation	4.99 [4.86, 5.12]	4.48 [4.27, 4.71]	3.45 [3.22, 3.71]	4.43 [3.91, 5.02]	4.82 [4.31, 5.40]	4.62 [4.41, 4.85]	4.33 [4.19, 4.47]
	Household visitor	1.53 [1.48, 1.57]	1.14 [1.07, 1.22]	0.96 [0.88, 1.06]	1.33 [1.14, 1.56]	1.36 [1.18, 1.58]	1.38 [1.30, 1.46]	1.40 [1.35, 1.46]
	Work/education	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Unknown	0.64 [0.60, 0.68]	0.36 [0.32, 0.39]	0.11 [0.10, 0.12]	0.19 [0.16, 0.22]	0.19 [0.17, 0.22]	0.21 [0.19, 0.24]	0.68 [0.65, 0.71]

We looked at mutually adjusted ORs[8] for the strongly associated variables (age, symptom status, vaccination status and contact type) by month to understand changes in effect sizes over time, shown in Table 10.

“Unknown” symptom status did not appear in the data until April 2021.

[8] The effect on the outcome (odds ratio) of each explanatory variable is mutually adjusted for the other explanatory variables.

Figure 22: Log odds of variables strongly associated with test positivity by month (January to July, 2021)



To show the variations in effect sizes by month, a heat map of log odds (LODs) is presented in Figure 22.

LODs of symptomatic contacts increased dramatically over time (1.5 in January 2021 to 3.1 in June 2021). This may be linked to lower prevalence of flu or other viral infections (that is symptoms were more likely to be due to COVID-19 [12]), or better understanding and awareness of COVID-19 specific symptoms.

Household or accommodation contacts showed steady LODs over the period indicating that their risk is consistent and not influenced by other factors.

The negative LODs in contacts who received 2 doses of vaccination decreased from May 2021 onwards, which could be linked to the emergence of the Delta variant happening at the same time as the rollout of the vaccine programme [13].

In those aged 20 years and under, the LODs slightly increased in March and April 2021 which can be associated with schools re-opening. Across all other age groups, the LODs were higher early in the year and reduced during May and June 2021. This could be a reflection of overall growing vaccination coverage (more people getting vaccinated) although, 2 doses of vaccination showed decreasing protective effect over that time.

5.4.3 Summary

Findings from the multivariate analysis of CTAS contacts who got a positive test result showed that:

- older age, being symptomatic and being a household or accommodation contact were strongly associated with COVID-19 positivity
- COVID-19 vaccination (one and 2 doses) was associated with decreased risk of positivity
- the risk associated changed over time for most variables which may be due to various underlying factors including changing background prevalence, COVID-19 restrictions and the emergence of new variants of concern

6. Conclusions

This report provides a comprehensive picture of PCR testing in close contacts in England between January and July 2021. It demonstrates the impact of the policy change extending the eligibility of PCR testing in asymptomatic close contacts, and how the testing pattern and positivity rates differed between the demographic groups. For assessing the uptake of PCR testing by close contacts of index cases, and the characteristics of those testing, we considered 2 different data sets. The first was an analysis of PCR tests in self-reported asymptomatic close contacts within the T&T digital ordering journey. The second is the analysis of tests taken by CTAS identified close contacts.

6.1 The number of users who took up the offer of a PCR test for asymptomatic close contacts

Over the 5 month period from 1 March 2021, when the test reason “Contact tracers told me to get a test” policy was introduced, to 31 July 2021, a total of 1,344,688 PCR tests were taken. This was 1.0% of the total PCR tests taken in pillar 2 over the same time period.

As a proportion of number of contacts in CTAS, the increase in asymptomatic testing between January and July 2021 was around five-fold. Around two-thirds of the tests were taken by those who were self-referring.

The change in policy and subsequent adjustments to the digital journey have enabled a significant number of PCR tests to be ordered by the general public. The high proportion of self-referral could be an indication that a significant amount of informal contact tracing was being done by the general public, without these contacts ever being reported to T&T, although we are not able to say from the data whether people were self-referring or incorrectly completing the digital journey to get a test.

6.2 The proportion of eligible close contacts taking up the testing offer

By using data matching, from a total of 5,070,780 CTAS contacts reached between 1 January and 31 July 2021, we identified PCR test taken around the time they were contacted for 2,147,379 contacts. This equates to an uptake rate of 42.3% (weekly uptake rates ranged between 29.0% and 46.8%). This suggests that consistently over the time period less than half of close contacts were taking up the testing they were eligible for.

Over time, the symptom status of CTAS contacts getting a PCR test has changed with asymptomatic contacts taking up a greater proportion of tests over time. The possible reasons are sharply changing prevalence in the general population over that period, changes to the

policy around the eligibility of PCR tests, changes to the digital journey, or a result of the vaccination programme, which was extending its reach throughout the population meaning people were less likely to be symptomatic [10].

As illustrated in Figure 11, although the uptake of tests increased after the introduction of the policy (May 2021 onwards), this was from a relatively low base compared to the uptake in January 2021. However, it may have been a factor behind the increasing proportion of tests taken by asymptomatic contacts after the introduction of policy.

Moreover, it is important to note that between 1 January and 31 July 2021, 57.7% of CTAS contacts did not take a PCR test. There can be many factors contributing to this such as people not willing to take a test for personal reasons/reasons not known, issues with the data matching used here or people not aware it was an available option.

6.3 The proportion of CTAS close contacts who go on to test positive for COVID-19 and how the positivity varies by demographics

Overall test positivity in CTAS contacts who took a PCR test between January and July 2021 was high at 44.3%, far higher than the positivity for those tests that used the test reason “Contact tracers told me to get a test”. This higher positivity can be attributed to the fact that the test results analysed were in CTAS identified close contacts of cases (potentially those that were at highest risk of having contracted COVID-19) and also include symptomatic contacts.

Positivity by demographics showed that: positivity was only slightly higher in males than females; positivity was higher in the oldest and the youngest age groups; Asian and Other ethnic groups; North and Midlands and East regions compared to other demographic sub-groups.

6.4 How COVID-19 positivity in close contacts varies by symptom status

As discussed, we have produced 2 different data sets of close contacts for analyses in this report. The symptomatic positivity in CTAS contacts analysis was very high at 63.7%. The asymptomatic positivity between test reason and CTAS contacts groups differed greatly. These groups are in theory comparable: they have all been identified by some means as close contacts. The asymptomatic positivity in the contact tracing test reason group was 10.1%, while in the CTAS contact group positivity was higher at 17.9%. The higher asymptomatic positivity in CTAS contacts may be because of the enhanced rigour of the contract tracing process for inclusion in this group. The lower asymptomatic positivity reported in the test reason group may be because users may have accidentally provided wrong information/clicked the wrong option

and thereby, not all of them were actual contacts. Also, there might have been a small group of users who were not contacts but deliberately used this method to get a PCR test.

Table 11: Positivity in test reason and CTAS contact groups

Test reason		CTAS contacts	
Asymptomatic positivity		Asymptomatic positivity	
Contact tracing	10.1%	CTAS contacts	17.9%
Self-referral	10.4%		
App notified	6.1%		
		Symptomatic positivity	
			63.7%

6.5 How the proportion of tests and test reason preference in close contacts varies by demographics

In both sets of analyses, females made up a greater proportion of the tests than in the general population. When considering the reasons for testing given, there was no difference between males and females.

On the other hand, males were more likely to test positive compared with females in both analyses. Although, it is not fully clear what factors drive the differences (females taking more tests and higher positivity in males), literature suggests that social/behavioural factors, biological/immune response, occupational settings (larger proportion of females are classified as essential workers) may be responsible [14,15,16]. However, the multivariate analysis of CTAS contacts did not show any significant association between sex and positive PCR test, implying no greater risk of being male or female to testing positive.

In both sets of analyses, younger demographics (0 to 60 years) made up a higher proportion of tests than their population estimates. In the test reason analyses, 21 to 40 years was the biggest group compared with the general population, while in CTAS matched contacts 41 to 60 years was the biggest group. This was expected considering a higher proportion of younger demographics who use the app and/or self-refer in the test reason analyses.

In the test reason analyses, for test reason preference, there were some differences between age groups. Those aged 20 and under were less likely to use app referral, which was associated with app not being advised for use in the under 16 population, while the older age groups (41 to 60 years and 61 to 80 years) were less likely to self-refer.

In the test reason analyses, all ethnic groups compared closely with the general population estimates with slightly lower figures for Black and Asian ethnic groups. The proportion of Asian

ethnic group were much higher in matched data which can be a reflection of disease epidemiology or greater likelihood to test if contacted. When considering reasons for testing, all groups other than White were more likely to say they were contacted by contact tracing, which may be due to lower willingness to self-refer or use the app.

6.6 The type of close contacts presenting for testing and how this relates to positivity

Of all the contacts in CTAS who took PCR tests, the largest proportion of contact type was household contact. Over the period, the trend in the proportion of tests was in line with policy and easing of restrictions: the proportion of work or education contacts increased during March 2021 linked to school re-opening; the proportion of household visitor contacts increased between April and May 2021; and the proportion of event or activity contacts increased from June until July 2021.

Amongst all contact types, the positivity was much higher amongst household contacts across the period. This was also in line with evidence that contacts living in a household were more likely to test positive or catch infection [17].

6.7 The vaccination status of close contacts who are testing

Over time, vaccination coverage in contacts in both data sets increased in line with vaccination roll out reported in the general population of England. In the test reason analysis, vaccination status of contacts in the week starting 16 July 2021 (the peak week in terms of tests taken), vaccination status was: 28.5% unvaccinated, 25.1% one dose vaccinated, 46.5% vaccinated with 2 doses.

Across the whole period, of all CTAS contacts who took a PCR test a high proportion (47.5%) said they were not vaccinated, 12.5% had one dose and 19.5% had 2 doses of vaccination.

6.8 How COVID-19 positivity in close contacts varies by vaccination status

COVID-19 positivity was lower in contacts with 2 doses compared with those who had one dose and unvaccinated contacts in both sets of analyses. This finding is consistent with the REACT-13 study that assessed PCR test data in England between 24 June and 12 July 2021. It showed that positive COVID-19 infections were 66.9% lower in people who were fully vaccinated/had 2 doses, compared to unvaccinated people [18].

6.9 When close contacts take their PCR test relative to when they were contacted by CTAS

Another finding in this analysis was that most contacts in CTAS who took a PCR test did so before they were reached by contact tracers. This was expected as there would have been some proportion of contacts who were informed informally and therefore, took tests before being reached by contact tracers.

Furthermore, this analysis showed that a large proportion of those tested in the days prior to notification from contact tracing were symptomatic. Suggesting that for a high proportion on contacts the incubation period and the development of symptoms took less time than the contact tracing process. A report on T&T for the period between June 2020 and April 2021 showed similar findings to our analysis, where only 10-20% of contacts were reached prior to reporting a positive test result [19].

6.10 The most significant drivers or predictors of possibility and whether and how have they changed over time

Multivariate analysis reiterates some of the key findings from Chapter 4. It showed that along with older age, being symptomatic and being a household or accommodation contact were strongly associated with COVID-19 positivity in contacts identified in CTAS and COVID-19 vaccination was associated with decreased risk of positivity. This analysis also suggested slight decrease in the protective effect of full vaccination over time however, this needs further research. These findings add evidence of risk factors, vulnerable groups and vaccine effectiveness in close contacts of COVID-19 cases.

6.11 Overall conclusions

The analyses in this report show the impact of the introduction of a PCR testing offer for close contacts in England, and how that influenced usage of testing by this group. It provides insights into close contacts PCR testing patterns (in terms of volume, and uptake), the resultant positivity, and how that is influenced by symptom status, vaccination status and contact type.

We have identified no clear evidence that the policy encouraging asymptomatic close contacts to get a PCR test substantially increased uptake in this group. However, of those who tested, positivity was relatively high, at 44.3% in symptomatic CTAS contacts and 17.9% in asymptomatic CTAS contacts. This suggests there is high value in targeting limited testing capacity at contacts because there are a high number of new cases detected per test used.

We have also shown that a number of PCR tests are taken prior to someone being notified that they are a contact, suggesting the incubation period of the disease may be shorter than the time taken for successful contact tracing in some cases. This suggests that improvements to the speed of contact tracing may be crucial in the early detection of infected contacts, to be able to quickly identify their infection status and minimise the risk of onwards transmission. However, it is important to reflect that the case-contact pairing through contact tracing may not always be the actual route of infection for the contact, as in reality there may be multiple common exposures for both cases and their contacts.

These findings were important in informing policy decisions during the COVID-19 pandemic. They also form important learnings for preparedness and planning for future pandemic responses.

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Acknowledgements

This project was conceived and guided by Tom Fowler. Toby Nonnenmacher and Niharika Dandamudi carried out the analysis and reporting, with oversight and critical feedback from Ashley Goddard, Stephen Finer and Joe Hillier.

We are grateful to the UKHSA Testing Initiatives Evaluation Board for providing comments on the analysis as it progressed. We are also grateful to Peter Marks and Sarah Tunkel for their comments on the report.

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Published: October 2022
Publishing reference: GOV-13103