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Security
Agency

Observational longitudinal (ObLong) study of asymptomatic COVID-19 testing in acute NHS hospitals

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Executive summary

This study aimed to determine the impact of asymptomatic COVID-19 in NHS acute trusts throughout the year 2022 and the challenges faced in implementing policy. Specifically, the study planned to utilise the time-specific changes in COVID-19 asymptomatic testing guidance to investigate the impact of routine asymptomatic testing of healthcare workers, with a focus on effectiveness in containing transmission of infection, cost-benefit and reduction of the impact of COVID-19. This was to be investigated in the context of multiple local interpretations of the prevailing policy for patient testing. It was also hoped to understand the facilitators and barriers to implementing different testing regimes that trusts encountered.

There were 2 parts to the study: a retrospective quantitative analysis of performance data (Part A, 122 trusts) and a qualitative study of trust experience of asymptomatic testing (Part B, 22 trusts). Part A consisted of developing a variable to capture lateral flow device (LFD) usage and allocation, which was then used to analyse the association between testing policy and 3 key measures of trust performance: staff absences, overall mortality and delayed discharges to a care home due to a positive COVID-19 result. Part B consisted of an online survey, a review of trusts' relevant documentation and a semi-structured interview.

The results from Part B showed that most trusts adhered to both national and international guidelines on asymptomatic testing with variations depending on local circumstances and resource availability. Trusts reported significant challenges due to the physical limitations of their infrastructure, such as a lack of isolation facilities and appropriate air changes in rooms, which posed ongoing difficulties for infection control. Those trusts that invested in additional staff and dedicated testing resources had confidence that they were better equipped to adapt to changes in guidance effectively.

Consistency of practice was impacted by difficulties in communication; however, many trusts shared good practice and learned from each other's experiences. Staff generally accepted asymptomatic testing as beneficial, though at staff level, trusts mostly believed that there was resistance to the implementation of guidance, scepticism about the effectiveness of testing, logistical challenges, and concerns about additional workload. It was reported that mental health and wellbeing of staff was materially impacted by the demands of asymptomatic testing and the broader pandemic response. Resource availability and external support were critical for trust operations, and the shortage of resources such as personal protective equipment underscored the need for rapid and substantial resource allocation to ensure the safety of both staff and patients.

In Part A, the relationship between LFD kit allocation and staff absence was patchy, with an initial decrease in staff absence rates as testing policy was relaxed, but with a later increase in rates. The evidence linking higher mortality rates with higher kit allocation was weak. However, there was an increase in mortality that coincided with the higher absence rates. There was no evidence that higher kit allocation was associated with delayed discharges due to COVID-19.

However, data reporting of delayed discharges was potentially poor with 89 out of 119 trusts not having any reported delayed discharges in the time period following the change in local testing policy. An exploration of staff absences and delayed discharges due to COVID-19 did not find any evidence of an association, although higher regional COVID-19 positivity rates were associated with more delayed discharges.

To support the quantitative analysis of performance data, the survey results were used to divide the trusts into different groups in terms of their approach to asymptomatic testing. Both a theory-driven manual scoring approach and data-driven k-means partitioning produced the same 2 clusters from 19 trusts, which provided confidence that there was a meaningful difference between the groups. After adding late data from 3 additional trusts using manual scoring, the following groups were produced: Group 1 (N=12), who did less to encourage compliance, and Group 2 (N=10), who did more to encourage compliance. In comparing the classifications of trusts into high and low resource trusts using the qualitative study and high and low kit allocations using the quantitative study, it was found that LFD kit allocations were not a reliable indicator of local asymptomatic testing in practice.

This study has demonstrated the difficulty of finding clear indicators of the effective implementation of asymptomatic testing of acute NHS trust healthcare staff in England in 2022 to 2023. Clear indicators of effective implementation are needed to show an observable impact on clinical or organisational outcomes. Although the qualitative element of the study did detect an impact of variability of implementation, the quantitative analysis could not detect an impact within the timeframe of the study, which may have been due to the types of data collected and analysed.

While the activity and performance data collected routinely by the NHS trusts during the COVID-19 pandemic may have been fit for operational purposes at that time, understandably it did not meet the needs of answering our research questions. In a future pandemic it will be important to consider what data will be collected and monitored in real time, and how the response can be appropriately tempered.

Introduction

Asymptomatic COVID-19 testing in 2022

By early 2022, the national COVID-19 vaccination programme had been in place for a full year. The Living with COVID strategy published by the Government in February 2022 set out that, in order to return to normal life, COVID-19 testing in the general population would be scaled back as the risk from the virus reduced.

March 2022 saw the withdrawal of both the Universal Testing Offer (LFDs) and the national testing service (PCR). Healthcare staff and clinically vulnerable patients were all prioritised for vaccination, and most had received at least 2 doses of vaccine by this time, providing good levels of immunity and significantly reducing risk of death and morbidity from infection ([1](#), [2](#), [3](#)). Following the discontinuation of the Universal Testing Offer at the end of March 2022 and the implementation of the Living with COVID strategy from April 2022 onwards, asymptomatic testing for SARS-CoV-2 continued to take place for staff and patients of acute NHS trusts until 31 August 2022 when a pause came into effect.

There has been continuous research and monitoring of different testing regimes in relation to epidemiological and clinical outcomes since this pause. For example, computational modelling of COVID-19 transmission in an English hospital concluded that the most efficient testing strategy (that is, the fewest tests required to prevent a single infection) was testing all patients on admission and the least efficient was repeated testing of patients twice weekly ([4](#)). Additionally, a retrospective evaluation of a multi-day testing approach with LFDs in patients eligible for community-based COVID-19 treatments ([5](#)) concluded that multi-day LFD testing was a feasible alternative to PCR testing, allowing swift prescription of treatments to this patient group.

Although some valuable work has been done in these areas, only a limited number of investigations have been conducted into real-world outcomes using readily available, routinely collected, NHS metrics. There is an ongoing need for a robust evidence base to inform future testing policy for routine asymptomatic testing.

Effectiveness of testing regimes

Several testing regimens were used to estimate the proportions of COVID-19 cases among different sections of the population. The testing regimens in use were largely determined by modelling work ([6](#), [7](#)). The effectiveness of different testing regimes has been evaluated both throughout the pandemic ([8](#)) and retrospectively ([5](#)) and continuous monitoring is ongoing to ensure the appropriateness of current provisions ([9](#)).

Multiple analyses were conducted to assess LFD testing for COVID-19 within high-risk secondary care cohorts. This included analyses in specific inpatient cohorts to assess the benefit and impact of regular screening for COVID-19 within neurosurgery ([10](#)) cancer ([11](#)), trauma ([12](#)), paediatric orthopaedic surgery ([13](#)) and vitreoretinal surgery ([14](#)). A substantial proportion of inpatients who tested positive were asymptomatic; these rates were often higher than the general testing populations ([10](#), [12](#), [14](#)). Specific challenges were noted in identifying COVID-19 via respiratory symptoms or verbal screening alone in some inpatient settings ([12](#), [13](#)). This illustrated the risk of asymptomatic transmission in high-risk inpatient NHS settings and the limitations of testing based on symptoms alone. Studies of LFD testing conducted in preoperative ([15](#)) and ambulatory settings ([16](#)) found that COVID-19 testing prior to treatments led to no COVID-19 related complications being reported. This suggests that this approach was successful in identifying cases at point-of-care and minimising clinical risk of COVID-19 complications.

Additional analyses indicated that high-frequency asymptomatic LFD testing and rapid isolation of patients with suspected COVID-19 could substantially reduce COVID-19 transmission and related complications in healthcare settings, highlighting the importance of early identification and prompt initiation of control measures for patients with new hospital-acquired infections ([17](#), [18](#)).

Nevertheless, there is a paucity of real-world evidence on the most effective testing approaches in these settings. Notably, no specific studies have assessed the impact of widespread asymptomatic testing of healthcare workers on wider performance metrics of acute hospitals. There is a gap in the evidence surrounding how changes in policy and enforcement can best be implemented and how they impact hospital performance and patient outcomes.

A quantitative evaluation report on the NHS workforce repeat asymptomatic testing was published by the government in August 2022 ([19](#)) with the aim to inform NHS England and NHS Test and Trace about the impact of routine LFD testing of asymptomatic NHS staff. This provided critical understanding on the detection rate among asymptomatic populations when testing with LFDs and on whether the testing approach was resilient to viral mutations at the time. However, this evaluation took place as part of a test, trace and isolate model with evaluation periods between October 2020 and September 2021, prior to the implementation of the Living with COVID strategy and the pause in routine NHS asymptomatic testing in 2022.

Study rationale

An evaluation of the national testing programme ([20](#)) concluded that asymptomatic testing of the NHS workforce was clinically effective and delivered value for money; this study was the first attempt to look at variability in the way that asymptomatic testing had been managed by different trusts.

Any change in asymptomatic testing guidance provided a new opportunity to understand effectiveness in terms of containing transmission of infection, cost-benefit and reduction of the

impact of COVID-19. The implementation of different testing regimens (for example, suspension of asymptomatic testing of patients on admission, during admission and prior to discharge) and the extent to which these were enforced or encouraged was left to the discretion of individual trusts based on local risk assessments. Therefore, these changes to local policy over time provided a specific opportunity to investigate the impact of routine asymptomatic testing of healthcare workers (HCWs), in the context of multiple local interpretations of the prevailing policy for patient testing. We also wanted to understand the facilitators and barriers to implementing different testing regimes that trusts encountered.

Although national guidance existed, operational testing policy was at the discretion of individual trusts. It was hoped, therefore, that a robust examination of variation in policies of trusts and exploration of how this variation might be associated with measures of organisational performance, after consideration of other plausible sources of variation, would help understand the impact of different local testing policies.

The intention of the ObLong study was to help inform decisions around future testing policy for routine asymptomatic testing of COVID-19 in hospital trusts in the UK NHS. Of particular interest was:

- whether routine, repeat asymptomatic testing of NHS HCWs and patients was a beneficial public health intervention in 2022
- whether testing policy changes had an observable impact on COVID-19 transmission and on operational performance metrics in individual trusts

Given previous reports that frequent, widespread testing of healthcare workers may be effective at reducing transmission and optimising work output, reducing length of hospital stay and readmission ([21](#), [22](#), [23](#), [24](#), [25](#)). Our main hypothesis was that avidly-implemented staff testing would decrease transmission of COVID-19 from asymptomatic staff to patients, potentially resulting in fewer delayed discharges of patients to care homes. Additionally, our assumption was that routine staff testing for COVID-19 would lead to increased absence of staff who might be otherwise well enough to work. This would put pressure on staffing, which could then be associated with operational challenges in the hospital.

Different approaches to maximising learning were considered, however, given the time lag and difficulty of implementing a randomised clinical trial in the testing climate at the time, an achievable approach was sought. It was agreed that UKHSA and NHS England would work in collaboration with Professor Timothy Peto's group at The University of Oxford to develop and implement an observational longitudinal (ObLong) study, which is the subject of this report. As a result of an academic tendering process, Professor Henry Potts's group from University College London (UCL) was subsequently invited to join the UKHSA/NHS England/academic collaboration to manage and deliver the qualitative aspect of the study.

Summary of study design

The ObLong study aimed to determine the impact of asymptomatic COVID-19 testing in NHS acute trusts throughout the year 2022 and the challenges faced in implementing testing policy. ObLong was a mixed-methods observational longitudinal non-randomised retrospective study, made up of 2 parts:

- Part A. Retrospective analysis of performance data
- Part B. Qualitative study of trust experience of asymptomatic testing

There were 3 elements to Part B:

- i) Online survey
- ii) Review of trusts' documentation relevant to asymptomatic testing
- iii) Semi-structured qualitative interview (sample of participating trusts)

The online survey and documentation review (Parts B(i) and B(ii)) were to be used to refine semi-structured interview questions (Part B(iii)) and categorise trust asymptomatic testing approaches, which would support analysis of retrospective trust data (Part A).

All parts of ObLong considered the timeframe between December 2021 until March 2023.

In Part A of the study, a retrospective quantitative analysis of existing trust performance data was carried out. In Part B of the study, trusts were sent a survey to complete, and semi-structured interviews were conducted for a subset of these trusts. The survey and interview component of the study aimed to explore asymptomatic testing practices within NHS trusts across England focusing on several key themes that emerged from the semi-structured interviews of trust representatives. The themes included adherence to guidance and changes over time, communication, collaboration and implementation, adaptation and support, perception and wellbeing, and training and practical considerations.

The performance data component of the study aimed to determine the association between unbiased key metrics of the trusts and enacted asymptomatic testing policy using categories derived from 2 sources: trust LFD kit allocation as a proxy for uptake of asymptomatic testing, and local intelligence gathered in the survey study.

The overall approach was to assess trust operational performance metrics in the context of the prevailing testing culture at each trust and against the background of local COVID-19 prevalence. Testing culture was assessed through a variety of subjective and objective data points collected using qualitative and quantitative research techniques.

Original study objectives and outcomes

During the course of the study, changes were made to the key objectives and outcome measures for the study. These were described in the study Statistical Analysis Plan (SAP) but, by definition, were not described in the original protocol.

This report, including data analyses, conclusions and the linked discussion, are based on the updated objectives and outcome measures described in [Appendix A](#).

There were initially 2 planned key objectives of this study ([26](#)):

1. Detect any observable association between the enforcement of routine asymptomatic testing for different acute and specialist NHS trusts and:

- patient outcomes
- measures of organisational capacity
- measures of operational efficiency, including proxies for infection transmission

2. Gain an understanding of underlying circumstances in which routine asymptomatic testing has most value and consider how this could be applied to future testing policy.

Exploratory analyses were also to be considered for the study.

The planned key outcome measures for this study were as given in Table 1. These were to be presented at an organisational level rather than an individual level and were split into those routinely collected prior to the COVID-19 pandemic, and those that were introduced during the pandemic.

Table 1. Outcome measures

Routinely collected measures	- Staff absence rate (long and short term) - Patient length of stay - Bed occupancy rate - ITU admission rate - Delayed discharges (all causes) - Mortality (all causes)
Not routinely collected prior to COVID-19	- Staff absence by different staff groups and clinical services - COVID-19 infections - COVID-19 positivity from symptomatic testing - Mortality (COVID-19 as a primary or other cause) - NHS staff COVID-19 vaccine update by trust - NHS staff COVID-19 testing indications by trust

Metrics were to be collected retrospectively for each participating NHS trust from the data sources above over pre-defined periods based on key policy changes in testing. Operational metrics were to be interpreted against the context of local trust-level intelligence about the testing culture and behaviours, and contemporaneous local COVID-19 prevalence data.

Changes to study design: rationale and explanation

The published study protocol ([26](#)) outlined a wide series of clinical and organisational outcomes pertinent to the research questions. However, the study involved working with real-world data and, once this had been received and reviewed for quality, the SAP was adapted based on what could be reasonably analysed. Changes in study design applied only to the analysis of retrospective data, and not to the prospective survey or interview data. These changes were primarily driven by the availability of data and the potential for more specific analyses based on that data. In all cases, the original objectives remained central and guided the reconsideration of what analyses could be undertaken. As a result, the outcomes indicators of interest in the analysis were:

- staff absence rate
- mortality rate (all causes)
- delayed discharges to a care home due to a positive COVID-19 test

While it is recognised that being led by data availability introduces a potential risk of bias, the retrospective analysis objectives were only revised once the availability and integrity of the data were established. The analysis was not conducted in an exploratory manner—though such an approach is valid—but was instead shaped by pre-defined objectives aligned with the data constraints.

A full comparison of what had originally been proposed with what was actually analysed can be found in [Appendix A](#).

Clarification of nomenclature between protocol and Statistical Analysis Plan (SAP)

In version 2.0 of the SAP, the study is described as having 3 parts:

- Part A is a retrospective observational analysis of trust-level data, and is equivalent to Part A of the protocol
- Part B is a prospective study using primary web surveys administered to trust employees to capture detailed trust-level quantitative information, and is equivalent to Parts B(i) and B(ii) of the protocol
- Part C consists of a limited number of in-person semi-structured interviews to collect qualitative information, which will enrich interpretation of the study findings, and is equivalent to Part B(iii) of the protocol

As this relabelling of study parts does not affect the analysis or procedures in the study, the nomenclature used in the protocol has been retained in this report, and the study is described as having 2 parts: A and B.

Trusts included in the study

Trusts included in quantitative analysis (Part A)

A total of 122 acute non-specialist NHS trusts in England were included in the quantitative analysis over the time period between December 2021 and March 2023.

A formal sample size calculation was deemed unnecessary for Part A of the study, as it was an observational study making use of extant datasets, and the study was to make use of all available trust-level information available from NHS England data sets.

Recruitment of trusts for qualitative analysis (Part B)

For Part B, trusts meeting the eligibility criteria were invited to take part in the qualitative online survey. Per the study protocol, eligibility was determined based on NHS trusts which provided acute inpatient care, provisionally responded to initial requests to participate, and were willing and able to follow the study protocol including the provision of agreed data and information. The survey was completed by 22 trusts. For the synthesis of survey and performance data findings, sample sizes of 19 trusts (which completed the survey on time) or 22 trusts (including 3 trusts which provided survey results late) were used, as specified in the relevant sections.

It was planned for a sample size of 10 to 15 trusts to take part in semi-structured qualitative interviews. A total of 14 trusts participated in this element of the study.

Inclusion and exclusion criteria

All acute trusts in England were eligible to participate in Part B of the study, as long as they were willing and able to follow the research protocol and supply required documentation. Reasons for exclusion were not providing acute inpatient services and unwillingness to participate in a national research study.

Recruitment and sampling strategy

UKHSA supported UCL in identifying the most appropriate contact in each trust. Trusts were contacted via an NHS newsletter to Chief Operating Officers. Directors of Infection Prevention and Control (DIPCs) were targeted through communications from professional bodies (for example British Infection Association) and other networks.

A lead contact within each trust was identified with the knowledge and ability to answer the survey and potentially take part in an interview. Usually, this was the trust DIPC. UCL approached all eligible trusts. Trusts that provided multiple clinical services were asked to focus

on General Medicine and Care of the Elderly. A subset of trusts that completed the survey was invited to take part in an interview. The subset was chosen to be representative of trusts nationally. [Appendix B](#) sets out the expected journey for an individual to participate in this study on behalf of their trust.

Participating trusts were paid up to £9,000 to cover administrative costs in participating if they undertook all 3 elements of the qualitative study (completion of the survey, participation in a semi-structured interview, and submission of additional documents related to asymptomatic testing). Trusts have been anonymised in this report.

Part B was an observational study with no formal assessable hypotheses. A total of 70 trusts met the eligibility criteria and were invited to take part in the online survey. The planned sample size for the trusts taking part in semi-structured qualitative interviews was 10 to 15, which was a pragmatic choice, informed by Fugard and Potts (2015) ([27](#)).

Clustering approach

UCL developed a methodology to support the categorisation of the NHS trusts according to their approach to asymptomatic testing. The methodology is described under the 'Grouping trusts' section. This variable functioned as the primary variable in quantitative data analysis and had to be reliable and robust.

Methodology

There were 2 parts to the ObLong study:

1. Quantitative retrospective analysis of performance data of acute NHS trusts
2. Survey and interviews of trust experience of asymptomatic testing

Quantitative data collection and analysis

Outcomes and trusts of interest

Table 2 summarises key testing policy changes that, a priori, were considered important to the analysis. The key policy change of interest is the pause in asymptomatic testing in late August 2022, with the analysis of the impact of local trust asymptomatic testing policy focused after this time point as this was when the difference in policy between trusts would have been the largest.

All available data from non-specialist acute NHS trusts in England over the time period December 2021 to March 2023 was included in the analysis. Non-acute trusts and acute specialist trusts were excluded from the analysis as key outcome measures were not applicable to these trusts.

The key outcomes of interest were:

- staff absence rate
- mortality rate (all causes)
- delayed discharges to a care home due to a positive COVID-19 test

Table 2. Summary of meaningful time points

Date	Change in policy
December 2021	High prevalence of the Omicron variant of COVID-19 leading to new guidance on management of contacts for healthcare workers and testing changes.
1 April 2022	Implementation of Living with COVID policy: Universal Testing Offer (LFDs) ends, national testing service (PCR) closes.
31 August 2022	Pause to asymptomatic testing in the NHS. (Note: though originally proposed as a pause, this was never in fact unpaused.)
March 2023	End to asymptomatic testing in more settings.

Data sources and processing

Table 3 lists the data sources used in the quantitative analysis. In most instances, data was either used directly as provided from the source or, if data was provided on a daily basis, this was aggregated to create a mean value for the month.

To take account of different trust sizes and numbers of patients, delayed discharges to a care home due to COVID-19 was divided by the number of adult beds as given in the Urgent and Emergency Care Daily Situation Reports ([28](#)) and multiplied by 100 to become percentage of beds occupied due to delayed discharges. Overall number of deaths and numbers of paediatric and elderly patients were divided by the total number of hospital episodes that month and multiplied by 100 to become mortality rate as percentage and percentages of paediatric and elderly patients respectively.

LFD order and results data was collected both on a trust and on an individual level, which contained the postcode of the individual and was not initially assigned to a trust. To match individual data to trusts, data was aggregated based on postcode to a Middle layer Super Output Area, and the number of orders and results could then be attributed to trusts based on a previously developed algorithm ([29](#), [30](#)).

Table 3. Summary of data sources and data used from each source

Data source	Data used from source
Hospital Episode Statistics	Overall mortality, length of hospital stay, age of patients, discharges to a care home
Electronic Staff Record (31 , 32)	Number of NHS staff by trust and job type, NHS staff absence rates
Urgent and Emergency Care Daily Situation Reports (28)	Beds available and beds occupied by type of bed
COVID-19 Patient Notification System (33)	COVID-19 mortality (determined by positive test or is mentioned on the death certificate)
Data Processing Service (34)	NHS staff COVID-19 vaccination rates
ONS COVID-19 Infection Survey (35)	Regional COVID-19 positivity
NHS England Sitrep Data	Discharges to a care home delayed by a positive COVID-19 test
UKHSA Salesforce and Edap databases	LFD orders and results
Oxford COVID-19 Government Response Tracker (36)	National testing policy
Department of Health and Social Care official statistics via NHS Acute (Hospital) Trust Catchment Populations dashboard (30)	Trust type, index of multiple deprivation and ethnicity of local residents

Data source	Data used from source
Department for Environment, Food and Rural Affairs official statistics (37)	Rural urban classification

Statistical methods

Those members of the study team carrying out the quantitative analysis of performance data were blinded to the allocation of trusts to the groupings determined by the survey until the main analysis had been performed and presented to the study team at a results meeting.

All analyses were performed using R v4.3.3 ([38](#)). Commands that are not included with the base installation of R have been specified.

Trust characteristic data was summarised, with time-varying characteristics summarised both by the median value for each trust over the whole analysis time period and the median value of all trusts at each month, to understand how the factors changed over time.

To assess the effect of local trust policy on asymptomatic COVID-19 testing, trusts had to be classified into groups that reflected local policy. For the quantitative analysis, local policy could not be measured but was considered a latent variable that could be inferred by trust LFD orders and reported LFD results. As neither orders nor results were likely to be representative of true LFD use, the median of the 2 values was considered, divided by the total number of full-time equivalent (FTE) staff employed by the trust to account for differences in trust size. Trust classification was derived using latent growth curves featuring this outcome and modelled over time using splines with knots corresponding to dates of policy changes (April and September 2022), using the R command *lcmm* ([39](#)). Models considering 2, 3, and 4-class solutions were assessed graphically and using Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC).

Synthetic control methodology ([40](#), [41](#)) was used to analyse the association between testing policy and the 3 primary measures of trust performance using the R package *gsynth* ([42](#)). This method compared trusts with a higher allocation of LFDs, as determined in the latent class analysis, against an artificially generated counterfactual version of these trusts that behave as if they had lower allocations of LFDs. The models in this analysis were adjusted for all longitudinally measured confounders. Plots of both the raw outcome data for the higher allocation trusts and their counterfactuals as well as the estimated difference in outcome and 95% confidence interval (CI) were plotted.

The correlation between staff absence and delayed discharge to a care home was assessed using Spearman's rho and scatter plots using total percentage days lost for each trust for the time post-asymptomatic policy change. The association between these factors was assessed using a linear mixed model adjusting for regional COVID-19 positivity rate with trust as a random effect using the R command *lmer* ([43](#)).

As specialist trusts were excluded from the initial analyses, sensitivity analyses including specialist trusts were conducted to assess whether classifications were affected by the inclusion of these trusts, which were anticipated to have substantially different testing policies and performance characteristics to non-specialist trusts. New latent classifications of testing policy were derived, and the outcome of staff absence was assessed; the outcomes of mortality and delayed discharges to a care home were not analysed as these were not considered relevant for specialist trusts.

During the time period considered in the analysis, one trust merged into another larger trust. In the primary analysis, data from the larger trust and the smaller trust was categorised as separate trusts prior to the merger, and following the merger all data from the combined trust was categorised under the larger trust. To assess the impact of this merger on the data for the larger trust, sensitivity analyses were performed on the 3 outcomes of interest (staff absences, delayed discharges and mortality), which looked for any difference in results when all data from both trusts was included, compared to when all data from both trusts was excluded.

A subgroup analysis was performed to see if the effect of local trust policy varied between trusts of differing characteristics. K-means longitudinal clustering was used to categorise trusts into similar subgroups using the R command *kml3d* ([44](#)). For the configuration of initial clusters, 'randomAll' was used, while for any other optional parameters the *kml3d* defaults were applied. Cluster sizes of 3, 4 and 5 were assessed with the optimal cluster size chosen using the Calinski and Harabatz criterion. For each primary outcome, the synthetic control analysis was performed on each of the subgroups separately and plotted together to allow comparison. Due to the exploratory nature of this analysis and the small size of some clusters, confidence intervals were not included.

As the numbers of known missing values for both characteristics and outcomes were very small, analysis was performed on the available data with no imputation. For the outcome of delayed discharge to a care home due to a positive COVID-19 test, if trusts did not report any delayed discharges, it was unclear whether they had zero delays or whether any delays were unreported and therefore missing data. As the extent of the missing data was unknown, where possible analyses using this outcome were performed both assuming all zero delayed discharges were true zeroes and also assuming all zero values were missing data. Methods to handle missing data such as multiple imputation were not performed due to the inability to ascertain which was genuine zeroes and which was missing data, the large proportion of data potentially missing and because the missing data was assumed to be missing not at random.

Design of trust experience (qualitative) study

We sought to assess how each organisation had interpreted the asymptomatic staff testing guidance, how they had implemented that locally, and how well they believed their staff were adhering to it during the time in question. Similarly, there were lines of enquiry regarding

asymptomatic testing of patients. All eligible NHS trusts were invited to participate in the study. The study included:

- an online survey
- review of trusts' documentation relevant to asymptomatic testing
- semi-structured qualitative interviews (sample of participating trusts)

The online survey and documentation review were used to refine semi-structured interview questions and categorise trust asymptomatic testing approaches, which supported analysis of retrospective trust data.

Online survey

We designed an online survey with the facility to choose responses that best described the local situation and to provide free-text further information. UCL developed the survey and methodology through qualitative testing. The survey was also intended to generate different groups of trusts, with different approaches to asymptomatic testing, that could be compared quantitatively. The survey was deployed using REDCAP-DHS.

Review of asymptomatic testing documentation from trusts

Trusts were asked to provide documentation of their approach to asymptomatic testing for staff and patients at each of the 4 identified time points. This documentation was used to clarify any uncertainties in answers to the survey or interview.

Semi-structured qualitative interview

A semi-structured qualitative interview format was used to complement the survey. The DIPC from each trust, or the individual who had completed the survey, was contacted and invited to participate in an interview. Interviews were scheduled at a convenient time, with an anticipated duration of 45 to 60 minutes, adjustable as needed. A Microsoft Teams invitation was then sent. The interviews were conducted remotely via Microsoft Teams. Each session was recorded and anonymised transcripts were generated and checked for accuracy. All data was securely stored in the UCL Data Safe Haven, accessible only to designated researchers.

Thematic analysis of survey and interviews

The survey responses and interview transcripts were analysed using NVivo/ATLAS.ti using thematic analysis ([45](#)).

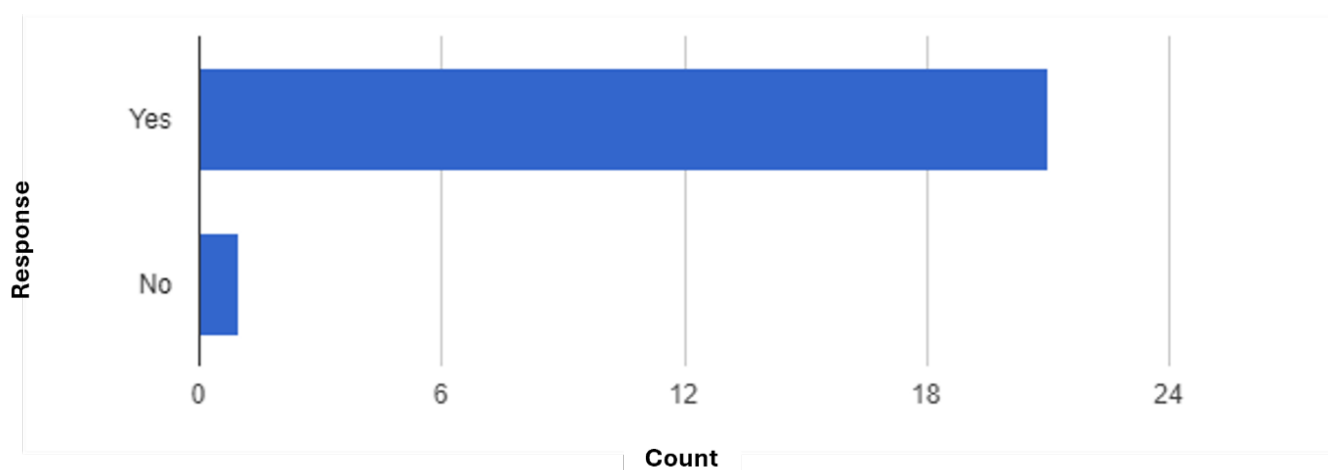
Survey and interview findings

Survey findings

All trust respondents worked in a relevant role (for example, were involved in creating or implementing the COVID-19 testing policies or infection control measures within their hospital or trust). All respondents bar one said that they had local guidance on asymptomatic testing of staff in their trusts.

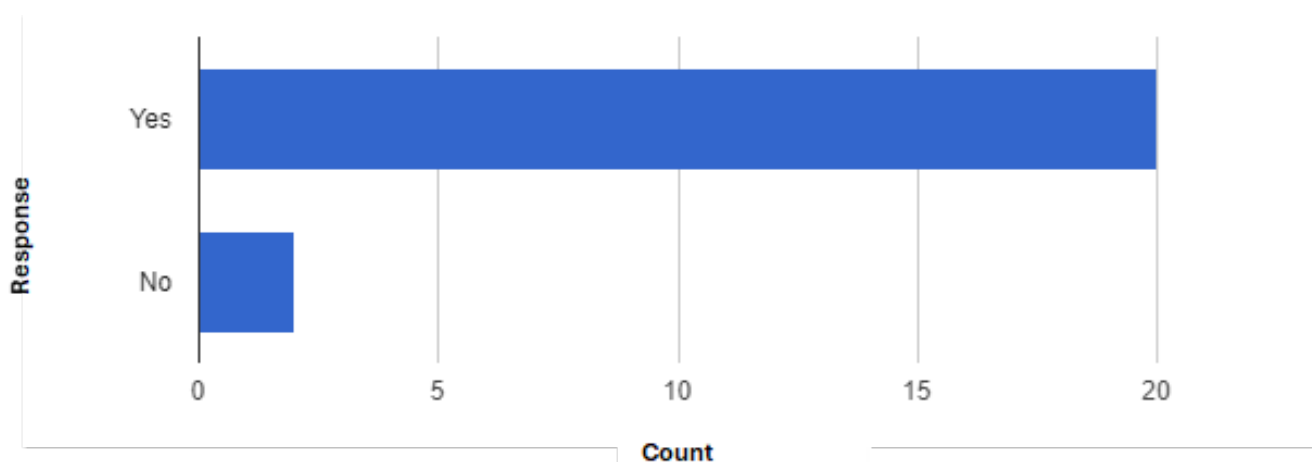
The following figures illustrate trust responses to additional questions within our survey. Free-text responses provided for answers categorised as 'Other – please provide details below' may be found in [Appendix C](#).

Figure 1. Responses to 'Did you have local guidance on asymptomatic testing of patients at your trust?'



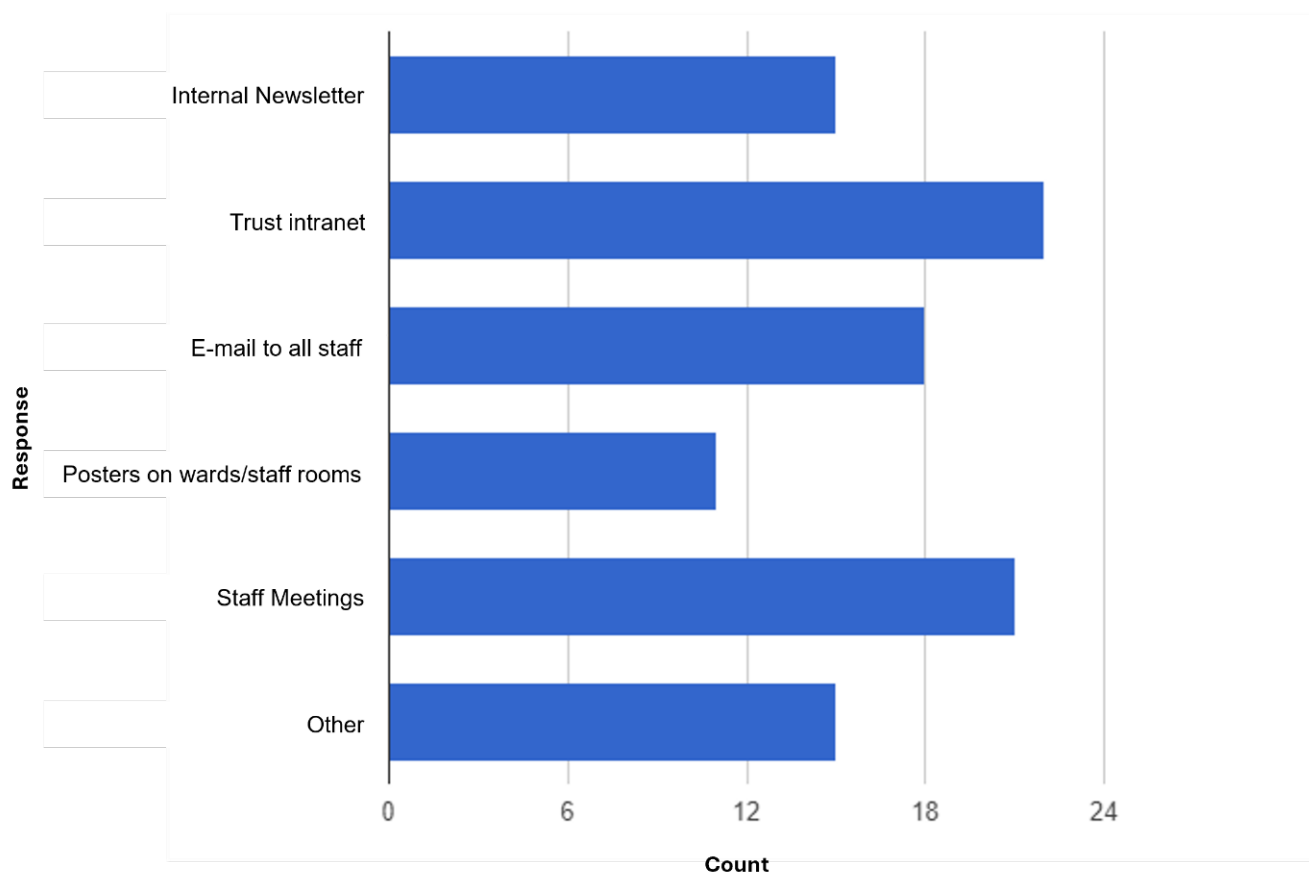
Counts/Frequency: Yes (21, 95.5%), No (1, 4.5%).

Figure 2. Responses to 'Did you have any other local guidance regarding asymptomatic testing (for example, for visitors or birth partners)?'



Counts/Frequency: Yes (20, 90.9%), No (2, 9.1%).

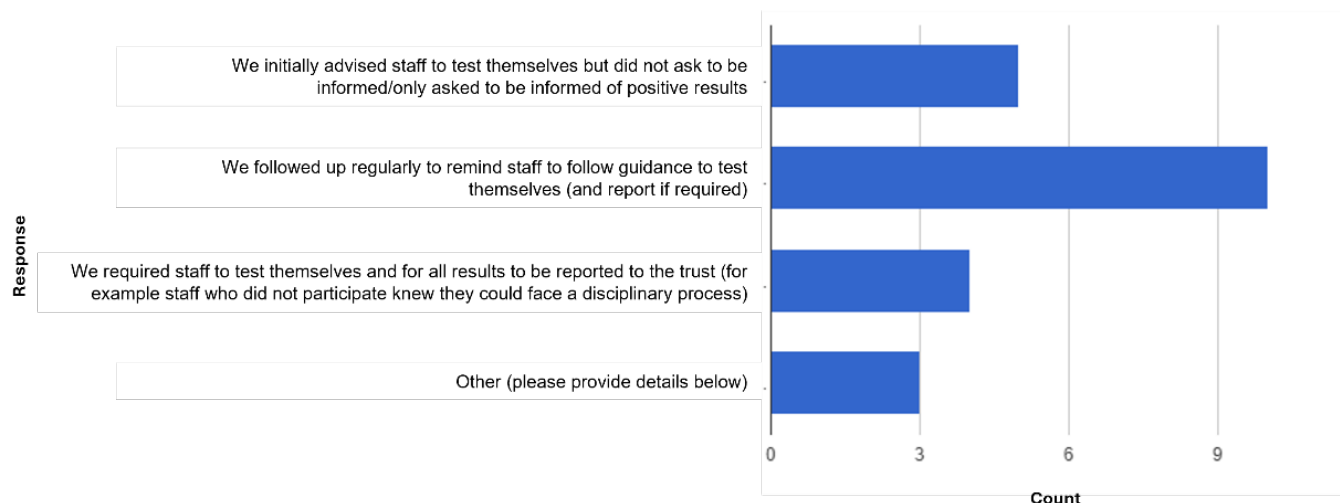
Figure 3. Responses to 'How was guidance on asymptomatic testing of staff and patients communicated to trust staff in 2022? Please select all that apply'



Counts/Frequency: Internal newsletter (15, 68.2%), Trust intranet (22, 100%), Email to all staff (18, 81.8%), Posters on wards/staff rooms (11, 50%), Staff meetings (21, 95.5%), Other (15, 68.2%).

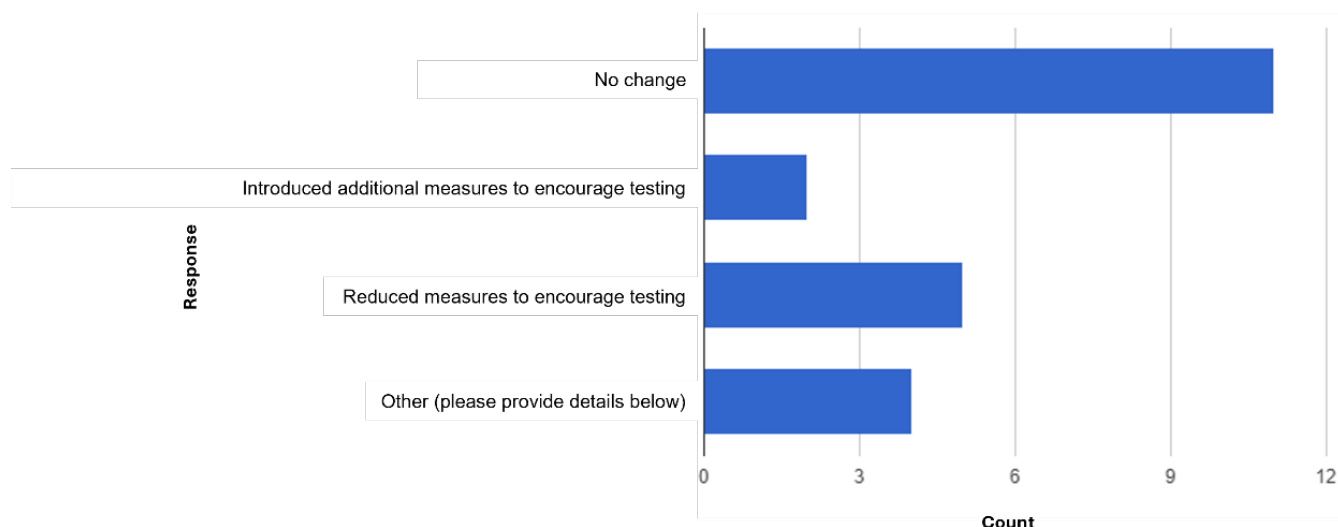
Guidance on asymptomatic testing was communicated to trust staff primarily through regular intranet updates, line managers, and IT-based reporting systems. Many trusts encouraged staff to test and report results but did not mandate compliance, instead using reminders, surveys, and targeted efforts in high-risk areas like chemotherapy units. A few unique approaches included a customised app for reporting, national database reminders, and focused staff engagement in specific clinical areas.

Figure 4. Responses to 'In January to March 2022 (before the end of the universal asymptomatic testing offer), how did you engage with the workforce to participate in asymptomatic testing?'



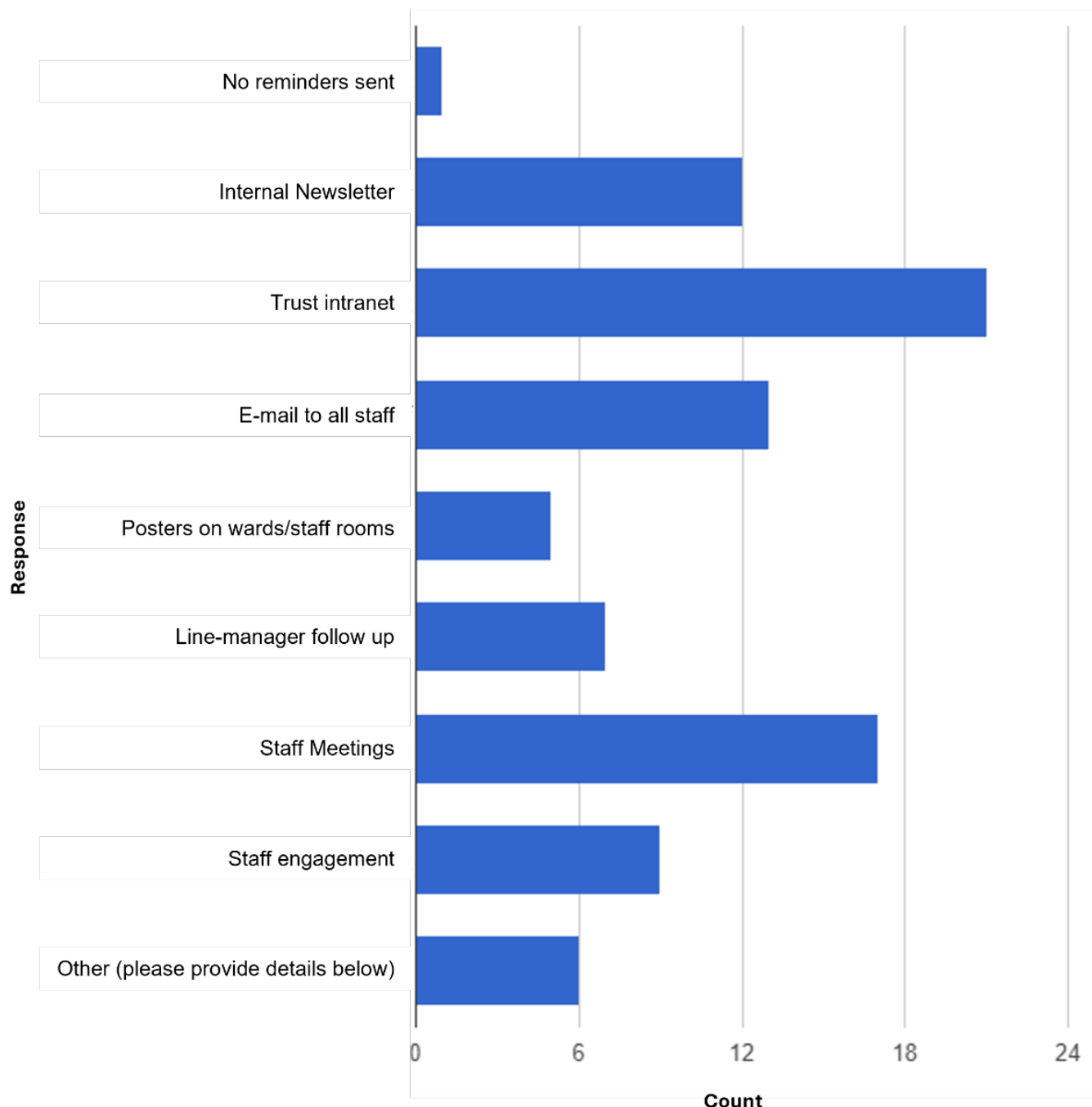
Counts/Frequency: We initially advised staff to test themselves but did not ask to be informed/only asked to be informed of positive results (5, 22.7%), We followed up regularly to remind staff to follow guidance to test themselves (and report if required) (10, 45.5%), We required staff to test themselves and for all results to be reported to the trust (for example staff who did not participate knew they could face a disciplinary process) (4, 18.2%), Other (please provide details below) (3, 13.6%).

Figure 5. Responses to 'Between April to August 2022 had there been significant change to your approach to engaging with the workforce to participate in asymptomatic testing? Please select the option that closest matches your approach'



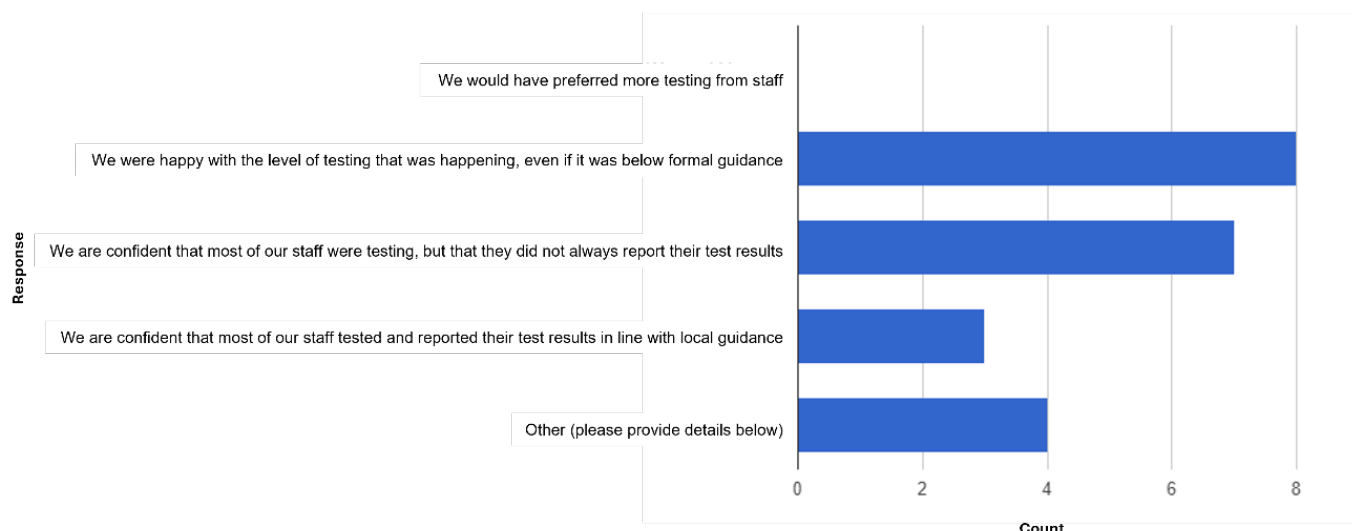
Counts/Frequency: No change (11, 50.0%), Introduced additional measures to encourage testing (2, 9.1%), Reduced measures to encourage testing (5, 22.7%), Other (please provide details below) (4, 18.2%).

Figure 6. Responses to 'In 2022, how, if at all, did you remind staff of guidance on asymptomatic testing? Please select all that apply'



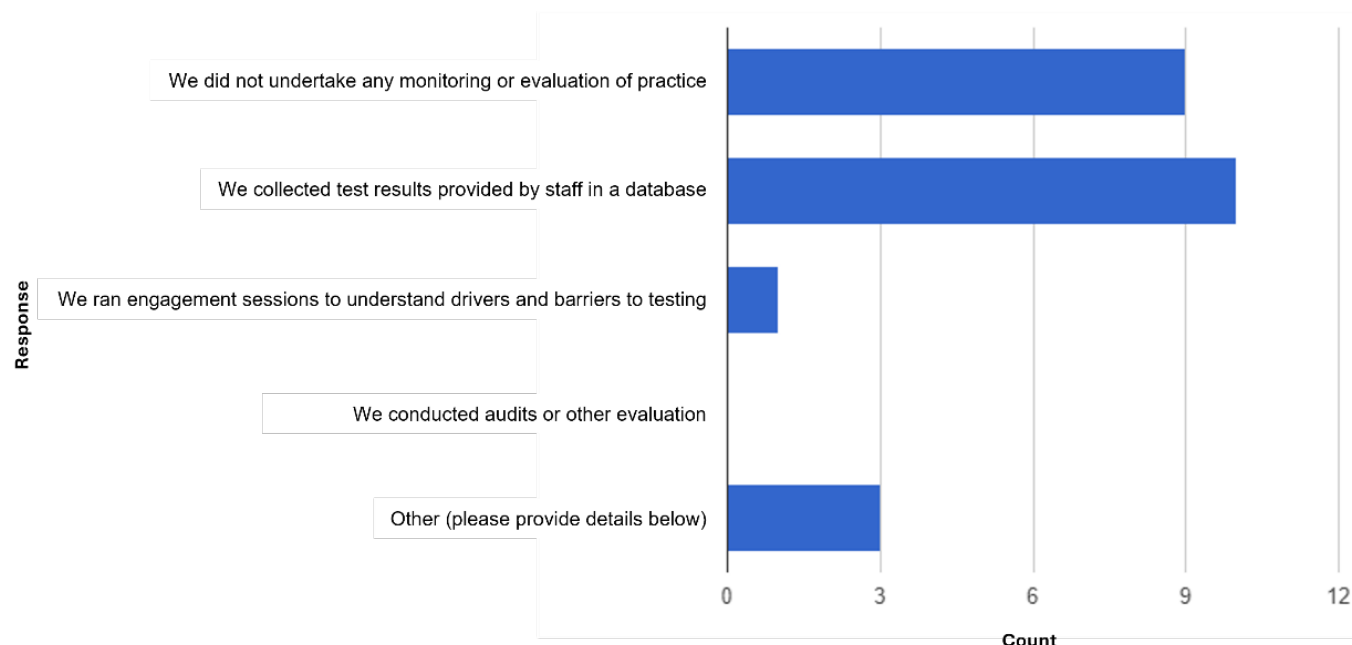
Counts/Frequency: No reminders sent (1, 4.5%), Internal Newsletter (12, 54.5%), Trust intranet (21, 95.5%), Email to all staff (13, 59.1%), Posters on wards/staff rooms (5, 22.7%), Line-manager follow up (7, 31.8%), Staff Meetings (17, 77.3%), Staff engagement (9, 40.9%), Other (please provide details below) (6, 27.3%).

Figure 7. Responses to 'What is your perception of workforce practice in relation to local guidance in 2022? Please select the option that closest matches the experience of your trust'



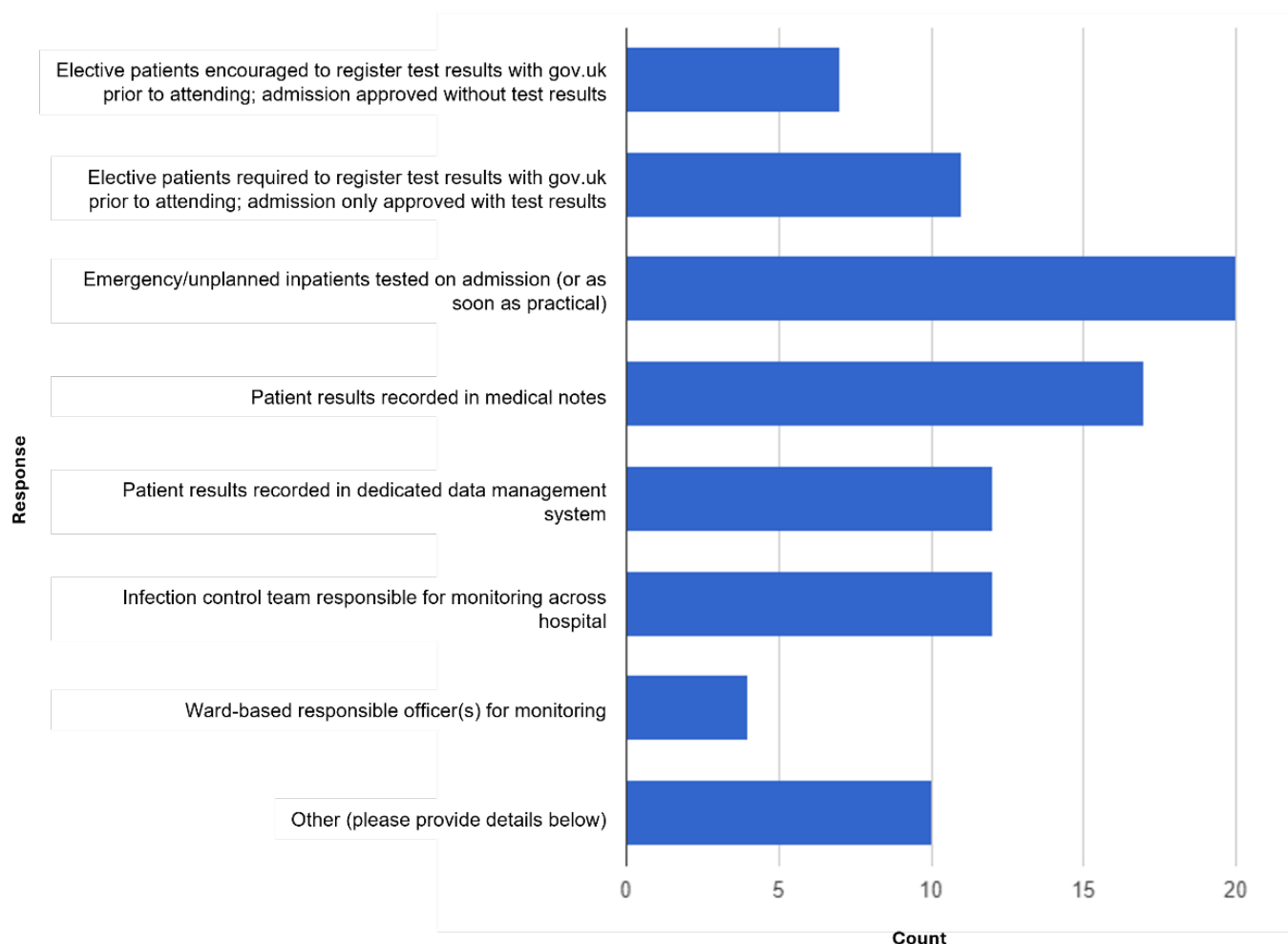
Counts/Frequency: We would have preferred more testing from staff (0, 0%), We were happy with the level of testing that was happening, even if it was below formal guidance (8, 36.4%), We are confident that most of our staff were testing, but that they did not always report their test results (7, 31.8%), We are confident that most of our staff tested and reported their test results in line with local guidance (3, 13.6%), Other (please provide details below) (4, 18.2%).

Figure 8. Responses to 'In 2022, how did you monitor and evaluate asymptomatic workforce testing practice at your trust, if at all? Please select all options that apply'



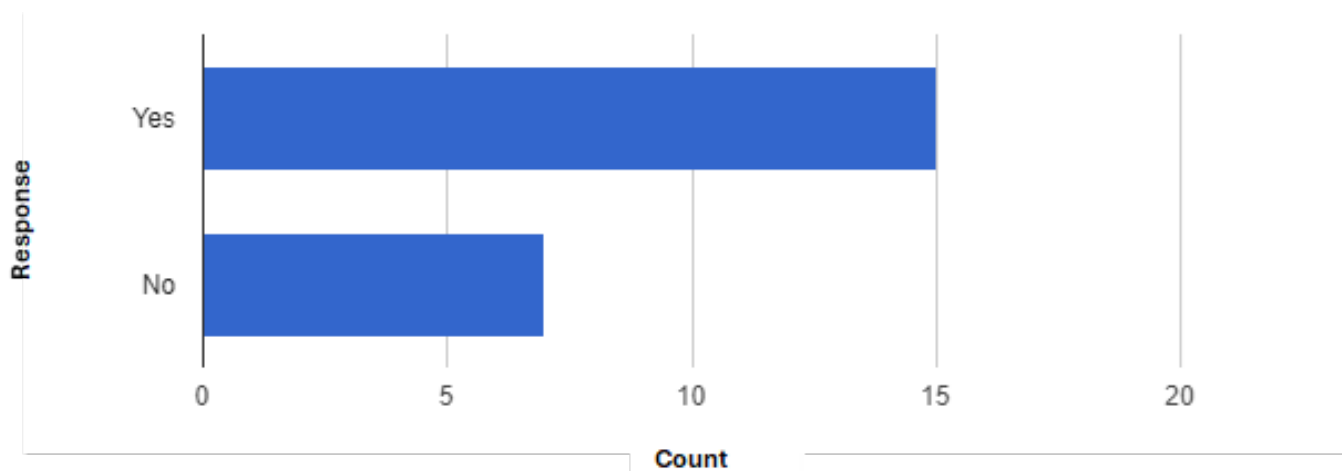
Counts/Frequency: We did not undertake any monitoring or evaluation of practice (9, 40.9%), We collected test results provided by staff in a database (10, 45.5%), We ran engagement sessions to understand drivers and barriers to testing (1, 4.5%), We conducted audits or other evaluation (0, 0%), Other (please provide details below) (3, 13.6%).

Figure 9. Responses to 'In 2022, how was asymptomatic testing for patients enforced and monitored at the trust? Please select all options that apply'



Counts/Frequency: Elective patients encouraged to register test results with gov.uk prior to attending; admission approved without test results (7, 31.8%), Elective patients required to register test results with gov.uk prior to attending; admission only approved with test results (11, 50%), Emergency/unplanned inpatients tested on admission (or as soon as practical) (20, 90.9%), Patient results recorded in medical notes (17, 77.3%), Patient results recorded in dedicated data management system (12, 54.5%), Infection control team responsible for monitoring across hospital (12, 54.5%), Ward-based responsible officer(s) for monitoring (4, 18.2%), Other (Please provide details) (10, 45.5%).

Figure 10. Responses to 'Did you create, or had you created, any new job roles or teams to manage the testing process?'



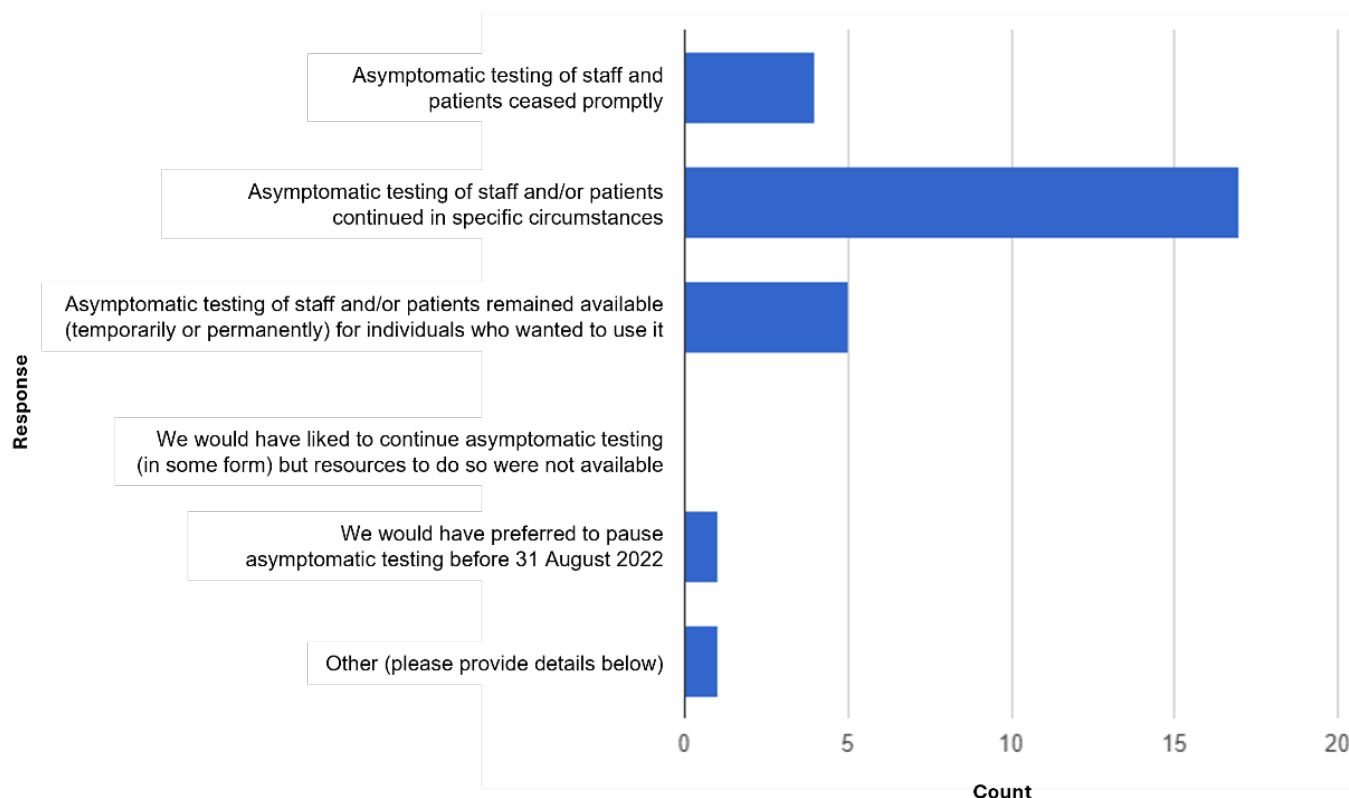
Counts/Frequency: Yes (15, 68.2%), No (7, 31.8%).

Figure 11. Responses to 'Were there any circumstances in which parts or all of the trust was required to pause or change local asymptomatic testing practice?'



Counts/Frequency: Yes (12, 54.5%), No (10, 45.5%).

Figure 12. Responses to 'How long did you continue with asymptomatic testing? Please select the options that are the closest match for your trust'



Count/Frequency: Asymptomatic testing of staff and patients ceased promptly (4, 18.2%), Asymptomatic testing of staff and/or patients continued in specific circumstances (17, 77.3%), Asymptomatic testing of staff and/or patients remained available (temporarily or permanently) for individuals who wanted to use it (5, 22.7%), We would have liked to continue asymptomatic testing (in some form) but resources to do so were not available (0, 0%), We would have preferred to pause asymptomatic testing before 31 August 2022 (1, 4.5%), Other (please provide details below) (1, 4.5%).

Grouping trusts

To support the quantitative analysis of performance data, we used the survey results to divide the trusts into different groups in terms of their approach to asymptomatic testing. We took an inductive and exploratory approach rather than having a pre-defined metric.

All trusts told us that they followed national guidance, but they varied in terms of additional local rules and the methods used to promulgate guidance. Twenty-two trusts completed the survey. At first, we used 2 different approaches to generate 2 groups using 19 trusts: a more theory-driven approach creating a score based on survey responses of trust efforts towards greater compliance on asymptomatic testing; and a data-driven approach using all of the survey questions and k-means partitioning techniques. After seeing that the 2 methods were consistent, 3 additional trusts, who supplied data late, were incorporated into the analysis and categorised using the theory-driven approach.

Manual scoring

We reviewed the survey to identify questions that would provide comparable responses across all trust participants. Six key questions were identified. These focused on aspects related to encouraging compliance to national guidance and/or attempts to continue asymptomatic testing.

Responses to the 6 key questions were scored. The scoring system was designed such that higher scores indicated more effort and resource put into encouragement towards compliance or attempts to continue asymptomatic testing. For each Trust, the scores from the 6 questions were aggregated to produce a total score.

The trusts were divided into 2 groups at the mid-point. Group 1 included trusts with lower scores, indicating relatively lower resource devoted towards compliance to national guidance, while Group 2 included trusts with higher scores.

A detailed breakdown of the questions identified, and the scoring used can be found in Appendix D.

Partitioning analysis

In parallel with the manual scoring, we created 2 clusters of trusts using k-means partitioning. All the binary and categorical answers to survey questions were used. K-means partitioning creates groups of trusts that are similar, based on survey responses, and then generates as many clusters as requested, in this case 2. This analysis was performed on survey responses from 19 trusts that submitted data on time. We can then examine which survey responses the groups differ on most. The main variables that the 2 clusters differed on are detailed in the table below.

Table 4. Variables to determine clusters by k-means partitioning

Variable	Cluster 1	Cluster 2
How was guidance on asymptomatic testing of staff and patients communicated to Trust staff: Internal newsletter	40 to 59% used	80 to 100% used
How was guidance on asymptomatic testing of staff and patients communicated to Trust staff: E-mail to all staff	40 to 59% used	80 to 100% used
How, if at all, did you remind staff of guidance on asymptomatic testing: Posters on wards/staff rooms	0 to 20% used	40 to 59% used
How, if at all, did you remind staff of guidance on asymptomatic testing: Staff engagement	0 to 20% used	60 to 79% used

Variable	Cluster 1	Cluster 2
Did you create, or had you created, any new job roles or teams to manage the testing process?	40 to 59% used	80 to 100% used

Comparing approaches

The manual scoring and the k-means partitioning produced the same 2 clusters in the 19 trusts, providing confidence that there is a meaningful difference between the groups. When late data was received from an additional 3 trusts, we used the manual scoring method to group them.

We thus have the following 2 groups of trusts:

- **Group 1**, who did less to encourage compliance (n=12)
- **Group 2**, who did more to encourage compliance (n=10)

Interviews with trusts

Thematic analysis

A total of 14 trusts participated in a semi-structured interview. Thematic analysis yielded 5 core themes and further sub-themes, shown in Table 5:

Table 5. Thematic analysis of interviews with trusts

Theme	Sub-themes
1. Adherence to guidance and changes over time	• Adherence to national and international guidance • Changes in testing protocols over time
2. Communication, collaboration and implementation	• Communication and implementation challenges • Collaboration and shared practices • Barriers and resistance to guidance implementation
3. Adaptation and support	• Adaptation to infrastructure limitations • Resources and support
4. Perception and wellbeing	• Perceived benefits of testing • Non-judgmental listening and affirming identities • Mental health and wellbeing of staff
5. Training and practical considerations	• Training and capacity building • Balancing guidance with practicalities

Adherence to guidance and changes over time

Trusts' responses to the pandemic were heavily guided by adherence to national and international health guidelines. Most participants emphasised following guidance from UKHSA, NHS England and Royal Colleges, indicating a structured approach to implementing protocols as they evolved over time. This highlights the importance given to following established guidelines to maintain consistency and reliability in healthcare practices during the pandemic.

Trust representatives consistently referenced their reliance on official guidelines to shape their testing and prevention strategies. A Consultant Microbiologist from Trust 1 said:

"So we are following either national guidance from UKHSA, PHE, NHS England guidance, or Royal College guidance."

Adherence to guidelines was stringent, with most trusts reporting that they made minimal deviations from the prescribed protocols. An Assistant Director of Infection Prevention and Control from Trust 2 said:

"We did exactly what the guidance said. We didn't make any exceptions apart from towards the end."

This highlights the initial strict compliance and the slight adjustments made only as the situation evolved and more localised responses became necessary.

Trusts were vigilant about staying updated with the latest guidance and ensuring that their protocols reflected these updates. As noted by a representative from Trust 4:

"So we always followed the NHSE guidance. So we obviously kept a look out for any updates coming through. We always review that and update our trust guidelines accordingly."

This proactive approach ensured that their practices were always aligned with the most current recommendations. A representative from Trust 14 said:

"We pretty much implemented as I said what the national guidelines said and we went with that."

This straightforward adherence to national guidelines underscores the reliance on established authorities to navigate the complexities of the pandemic.

Communication, collaboration and implementation

Effective communication was crucial in disseminating updated guidance and ensuring adherence to new protocols. Trusts employed various methods, such as face-to-face meetings, emails and internal newsletters, to ensure staff were informed of testing practices. However, challenges included the rapid change of guidance and ensuring that all staff, including those in

the community or external to the hospital (for example, temporary staff), received and understood the information.

Collaboration with other trusts and organisations was felt to be vital for sharing practices and experiences, especially when implementing new guidelines or addressing challenges. Forums and regular meetings facilitated the exchange of information, helping trusts to align their practices and address gaps in knowledge or resources.

Implementing new testing guidance and protocols was met with various barriers and resistance, including issues with supply chains, staff reluctance due to perceived safety concerns, and the need for rapid upskilling. Overcoming these barriers required strategic planning, reassurance, and sometimes innovative solutions, such as building testing facilities in car parks.

Trusts faced significant challenges in maintaining effective communication across all parts of a trust throughout the pandemic. A representative from Trust 4 said:

"There was often queries from rural colleges who often had different opinions. Ensuring everyone is on the same page has been a major challenge."

Similarly, a participant from Trust 3 said:

"Implementing changes across departments is a huge challenge."

The rapid pace of changing information complicated communication efforts. A representative from Trust 8 noted:

"It was very difficult to find an effective way to communicate throughout the pandemic. One of the problems early on was things changed so often that there was no way for that to be communicated effectively."

This constant flux made it challenging to keep all staff updated and compliant with the latest protocols.

Collaboration was a key strategy to address these communication challenges and align practices across trusts. Trust 14 said:

"We have a very good collaborative group. So the [Trust name removed] Infection Control group we have a leadership group that at that point was meeting weekly."

This regular interaction facilitated the exchange of vital information and unified approaches to testing and infection control. Similarly, Trust 4 highlighted the importance of internal collaboration in achieving consistency:

"Interdepartmental meetings have helped us unify our approaches"

Despite these collaborative efforts, resistance to new guidelines and protocols presented substantial barriers. Trust 3 said:

"There was significant resistance to implementing new guidelines."

Overcoming such resistance required strategic communication, reassurance, and clear demonstration of the importance of the new measures.

Convincing staff to adhere to testing protocols was another notable barrier. A representative from Trust 9 explained:

"The main problem with staff testing was just the will, just convincing staff that it was necessary or important and getting them to actually do it."

This highlights the need for effective motivational strategies and support to ensure compliance.

Adaptation and support

Many trusts faced significant challenges due to the physical limitations of their infrastructure. The lack of isolation facilities and appropriate air changes in rooms posed ongoing difficulties for infection control. These limitations necessitated adaptive strategies and highlighted the need for infrastructure improvements to manage respiratory viruses effectively. Adaptation to infrastructure limitations required trusts to develop solutions to maintain infection control standards. For example, high bed occupancy rates complicated efforts to conduct necessary deep cleaning. The Assistant Director of Infection Prevention and Control from Trust 2 stated:

"We run with quite a high bed occupancy rate so that means from a deep cleaning point of view and things like that it's really difficult to facilitate."

Technological adaptations were also seen to play a crucial role. Trust 3's representative said:

"The trust supported the development of the IT system for testing and that includes asymptomatic testing."

This investment in digital infrastructure was essential for tracking and managing testing data efficiently. However, not all technological adaptations were successful. Trust 9 experienced difficulties with implementing secure communication methods:

"We tried to do text-based communications, and we couldn't get it up and running. In the end, I think the comms team didn't feel it was secure."

Resource availability and external support were critical for trust operations, especially during the pandemic's peak. Trust 5's representative said:

"Initial lack of PPE and other resources was a major issue."

This shortage underscored the need for rapid and substantial resource allocation to ensure the safety of both staff and patients.

Government funding was seen as a vital element in maintaining essential services. Trust 5 highlighted this support, stating:

"Government funding helped us maintain 24/7 pathology services during the peak of the pandemic."

Similarly, Trust 4's representative said:

"Government funding has been crucial for our operations."

Additionally, the role of community support and volunteers was significant. Trust 4 noted:

"We rely heavily on community support and volunteers."

Adaptation to infrastructure limitations and securing resources and support were pivotal for managing asymptomatic testing and overall pandemic response. Trusts had to innovate within their physical and technological constraints while heavily relying on government funding and community support to overcome resource shortages.

Perception and wellbeing

This theme outlines the perceived benefits of testing, such as reassurance to staff and patient safety. Additionally, this theme encompasses statements regarding the provision of a safe environment for staff to share their views regarding asymptomatic testing without judgment; and the impact of testing protocols and pandemic response on the mental health and wellbeing of staff involved in the process.

The perceived benefits of asymptomatic testing were widely recognised among the trusts. Testing provided reassurance and confidence to both patients and staff. Trust 8 said:

"It was a way to provide assurance to our patients and our staff that are really trying for them."

Beyond reassurance, testing played a critical role in patient care and infection control. Trust 5 noted:

"Testing helped ensure accurate treatment for symptomatic patients"

And:

"It limited the risk of outbreaks by identifying positive cases early."

Creating a supportive environment where staff could express their views on asymptomatic testing without judgment was essential for managing resistance and fostering a collaborative atmosphere. Trust 4 said:

"Our approach is always to listen first and provide non-judgmental support."

This sentiment was echoed by Trust 5, which recognised the importance of listening to staff concerns in overcoming resistance:

"Listening to staff concerns was crucial in managing resistance to changes."

Trust 3 extended this principle to patient care, stating:

"It's important that patients feel heard and validated."

This highlights the broader application of non-judgmental listening in maintaining a compassionate healthcare environment.

The mental health and wellbeing of staff were significantly impacted by the demands of asymptomatic testing and the broader pandemic response. Trust 4 acknowledged the toll of constant stress and long hours:

"The constant stress and long hours have taken a toll on our mental health."

This strain was particularly pronounced among infection prevention and control (IPC) teams, as noted by Trust 5:

"The IPC team faced significant stress and personal backlash."

To address these challenges, psychological support for staff was deemed necessary. Trust 5 emphasised this need:

"Psychological support was necessary for staff to cope with the pressure."

Despite these efforts, the prolonged impact of the pandemic continued to affect staff wellbeing and productivity. As observed by Trust 10:

"I think staff are still quite tired, you know, and productivity is way down compared to what it was pre-pandemic."

Training and practical considerations

This theme encompasses trust responses that reflected efforts to train staff and build capacity to handle evolving testing protocols and pandemic responses. It also refers to efforts to balance national guidance with the practical challenges in implementation at the local level.

Training and capacity building were essential components in the response to the pandemic. Trust 5 said:

"We needed to train staff to adapt to changing guidelines."

This was a common sentiment, reflecting the dynamic nature of the pandemic and the frequent updates to testing protocols. Building capacity to manage these evolving requirements was seen as crucial. As Trust 5 noted:

"Capacity building was crucial to manage the evolving testing requirements."

Regular training sessions were fundamental in ensuring staff remained informed and capable. Trust 4 said:

"Regular training sessions are essential to keep up with the changes."

These sessions helped ensure that staff were not only aware of the latest guidelines but also proficient in implementing them effectively. Trust 10 illustrated a proactive approach with the establishment of the COVID Clinical Forum:

"I convened something called the COVID Clinical Forum and that started meeting in January 2020."

This early and ongoing forum provided a platform for continuous education and discussion, ensuring that the trust could rapidly adapt to new information and strategies.

Balancing national guidance with local practicalities presented significant challenges. Trust 12 discussed the reliance on ward leadership teams to disseminate information:

"We were relying on those ward leadership teams to cascade to the staff the difficult-to-reach groups."

This approach highlighted the practical necessity of using established communication hierarchies to ensure comprehensive dissemination of guidelines, particularly to those who might be less accessible.

Additional trust documentation

Each interviewed trust was asked if they could provide anonymised documentation that was used to guide and inform asymptomatic testing practices. Twelve of the 14 trusts that were interviewed provided documentation. We cannot guarantee that the documentation provided represents the entirety of what each trust was using. We reviewed the documentation and incorporated our findings into the overall discussion.

Synthesis of survey and performance data findings

Using the trusts and groups determined from the survey data, the outcomes of staff absence and delayed discharge to a care home due to a positive COVID-19 test were plotted over time and the synthetic control analysis was performed as for the main analysis.

Although the main quantitative analysis focused on kit allocation as the key indicator as to the amount of resources a trust allocated towards asymptomatic testing, other factors within the data may have been better indicators. The analysis to identify these factors was performed using linear regression models with qualitative survey score as the outcome; potential indicators were identified using backwards selection using the R command *mfp* ([46](#)) to allow for potential non-linear effects of the factors. Due to the small sample size of 19 trusts, a p-value of 0.157 was used for the cut-off for selection to the model, which is equivalent to a significant change in AIC, and the fractional polynomial models were restricted to 1 or 2 degrees of freedom, which restricts the models to linear or first degree fractional polynomial models respectively. As kit allocation may still have been a useful indicator, models with and without kit allocation were developed.

Potential factors considered in the analysis were number of sites in the trust, trust type, rural urban classification, index of multiple deprivation of local area, ethnicity of local residents, number of clinical and support staff and percentage of staff vaccinated for COVID-19. Time-varying factors were summarised, and the median values were included. Bed numbers (all categories) and staff numbers were very highly correlated ($p > 0.8$), so could not be considered in the same model. Regional COVID-19 positivity was not considered as this was very variable over time and could not be adequately summarised for inclusion into the model. Factors specific to an age group were not considered due to the 2 children's trusts included in the qualitative analysis.

Quantitative analysis of performance data findings

Trust characteristics

In total, 122 acute non-specialist trusts were included in the quantitative analysis (Table 6). As all suitable trusts were included, there is a good distribution of trusts both geographically and in terms of trust type, with a small number of multi-service trusts. Most sites were multi-site trusts (66%) with a median (interquartile range, IQR) number of 2 (1, 4) sites per trust. The majority of trusts were located in predominately urban areas (60%), median (IQR) index of deprivation (IMD) score was 21.0 (17.3, 25.4) and median (IQR) percentage of local residents from a minority ethnicity was 8% (5%, 17%). At the start of the analysis period, a median (IQR) 91.9% (89.6%, 96.3%) of staff had received 2 vaccinations for COVID-19.

Table 6. Trust characteristics

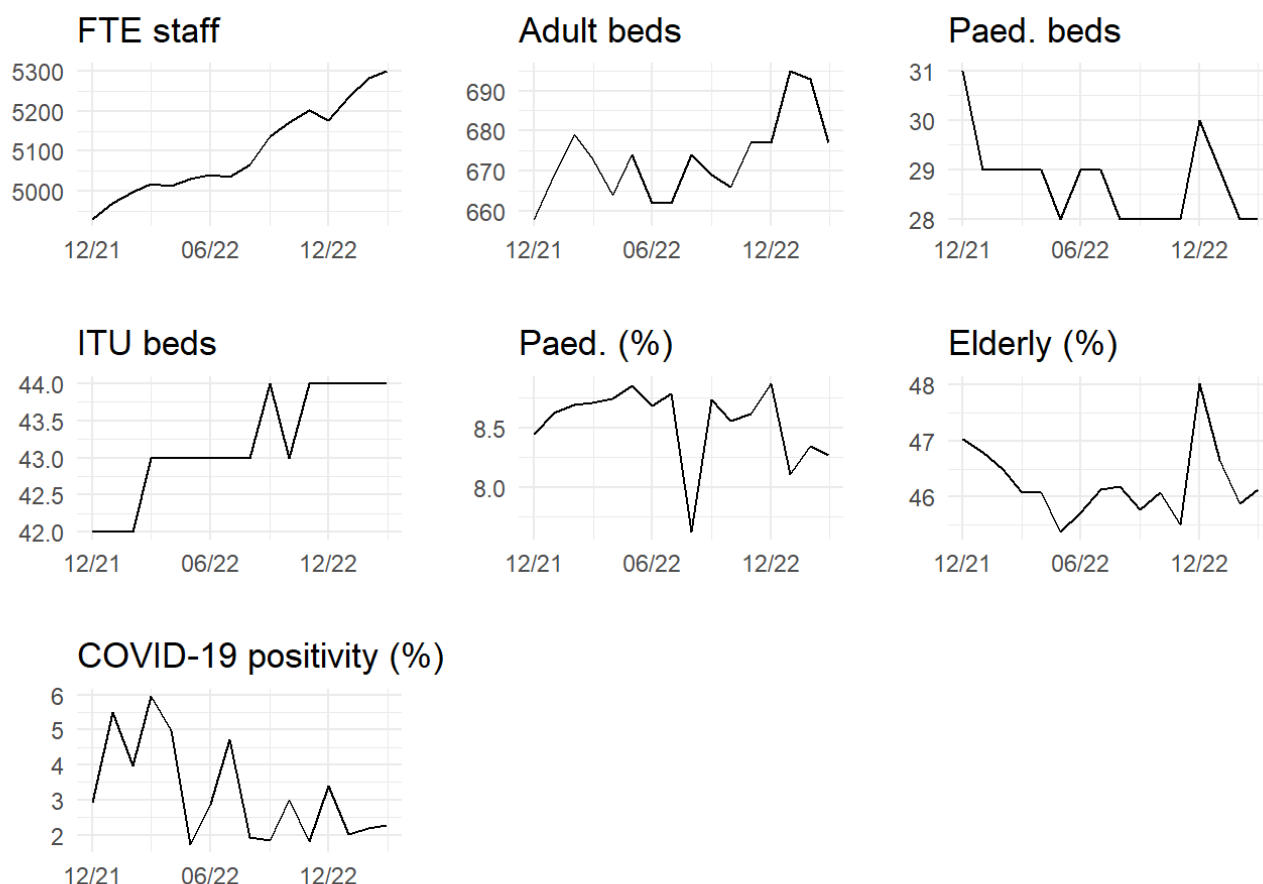
Fixed characteristics (N = 122)	
NHS region	
East of England	13 (11%)
London	18 (15%)
Midlands	20 (16%)
North East and Yorkshire	21 (17%)
North West	18 (15%)
South East	17 (14%)
South West	15 (12%)
Trust type	
Large	28 (23%)
Medium	23 (19%)
Multi-service	4 (3%)
Small	28 (23%)
Teaching	39 (32%)
Multi-site	80 (66%)
Number of sites	2 (1, 4)
Rural urban classification	
Predominantly rural	20 (16%)
Predominantly urban	73 (60%)
Urban with significant rural	29 (24%)

Fixed characteristics (N = 122)	
Index of multiple deprivation score	21 (17.3, 25.4)
Percentage of local residents from a minority ethnicity	8 (5, 17)
Percentage of staff with 2 COVID-19 vaccine doses (N=121)	91.9 (89.6, 93.3)
Time-varying characteristics	
Full-time equivalent clinical and clinical support staff	5,051 (3,505, 7,178)
Number of adult beds (N=121)	675 (490, 991)
Number of paediatric beds (N=121)	29 (20, 62)
Number of ITU beds (N=121)	43 (29, 62)
Percentage of patients <18 years old	8.6 (6.8, 10.1)
Percentage of patients ≥65 years old	46 (42, 51)
Regional COVID-19 positivity rate (%)	2.86 (2.76, 2.89)

Data is presented as median (IQR) or n (%). For time-varying demographics, summaries are the median value over the period December 2021 to March 2023.

Due to the variety in trust size, there was a wide variation in the numbers of FTE clinical and clinical support staff (median (IQR) 5,051 (3,505, 7,178)) and in the numbers of available adult beds (median (IQR) 675 (490, 991)). The median (IQR) of available paediatric beds and available ITU beds was 29 (20, 62) and 43 (29, 62), respectively. Percentages of paediatric and elderly patients were similar between trusts with a median (IQR) 8.6% (6.8%, 10.1%) and 46% (42%, 51%) of total patients respectively. The COVID-19 positivity rate was similar between the regions with a median (IQR) rate of 2.86% (2.76%, 2.89%). Although there were changes in the time-varying characteristics during the analysis period (Figure 13), these were mostly small in scale, with the exception of change in the regional COVID-19 positivity rate which ranged from 2 to 6%.

Figure 13. Median values for the time-varying characteristics over the analysis period



Classifying trusts into groups indicating local testing policy

The median number of LFD orders and reported results for all trusts in each monthly period are reported in Table 7. The general trend of the number of kits ordered and results reported was to decrease over time with increases in months that also experienced higher rates of COVID-19 infections; of note, there was a very large increase in the number of both kit orders and results in July 2022, which coincided with a very large increase in the COVID-19 positivity rate (Figure 13). The smallest number of kits were ordered in the month after the change in the national policy of asymptomatic testing, September 2022, after which numbers of orders rose again, likely due to increasing COVID-19 infections, but the number of reported LFD results continued to fall. In all months, the numbers of LFD results were far smaller than the number of orders, with the number of results being at most 0.3% of LFD orders.

Table 7. Summary of LFD orders and reported test results over the analysis time period

Month	LFDs ordered [notes 2,4]	LFD results [note 4]	Kits allocated per staff member [note 1]: all trusts	Kits allocated per staff member [note 1]: Class 1. greater kit allocation	Kits allocated per staff member [note 1]: Class 2. lower kit allocation
Dec 2021	211546 (136162, 330152)	248 (100, 2110)	17.2 (12.5, 26.0)	26.0 (20.1, 32.8)	12.5 (10.4, 14.6)
Jan 2022	331182 (233445, 496726)	254 (113, 1788)	28.7 (21.7, 38.9)	38.9 (34.2, 46.9)	21.7 (18.3, 25.4)
Feb 2022	206640 (139319, 316827)	154 (72, 878)	17.0 (13.0, 24.9)	24.9 (20.7, 31.1)	12.9 (10.1, 15.2)
Mar 2022	265440 (185127, 420980)	130 (67, 758)	22.6 (17.5, 33.0)	32.9 (26.0, 38.1)	17.7 (13.4, 20.4)
Apr 2022	174776 (120484, 280189)	96 (46, 616)	14.7 (11.3, 19.9)	19.9 (17.4, 23.0)	11.2 (9.7, 13.3)
May 2022	52356 (39865, 80171)	78 (28, 570)	4.7 (3.5, 6.1)	6.1 (5.2, 7.3)	3.5 (2.9, 4.1)
Jun 2022	81648 (59094, 128205)	79 (29, 1457)	7.1 (5.3, 9.7)	9.7 (8.1, 11.2)	5.2 (4.6, 6.2)
Jul 2022	145495 (104714, 230972)	86 (28, 1630)	12.5 (9.4, 16.6)	16.6 (14.4, 20.1)	9.4 (8.1, 11.1)
Aug 2022 [note 3]	63315 (45843, 103502)	48 (19, 1022)	5.6 (4.1, 7.6)	7.6 (6.5, 8.8)	4.1 (3.5, 4.9)
Sep 2022	31318 (22953, 51471)	25 (9, 463)	2.8 (2.1, 3.8)	3.7 (3.1, 4.3)	2.1 (1.6, 2.5)
Oct 2022	61621	25 (10, 232)	5.2 (4.3, 6.9)	6.9 (6.2, 8.3)	4.2 (3.6, 4.9)

Month	LFDs ordered [notes 2,4]	LFD results [note 4]	Kits allocated per staff member [note 1]: all trusts	Kits allocated per staff member [note 1]: Class 1. greater kit allocation	Kits allocated per staff member [note 1]: Class 2. lower kit allocation
	(45500, 103887)				
Nov 2022	40352 (29288, 59542)	15 (5, 160)	3.6 (2.8, 4.5)	4.3 (4.0, 5.3)	2.7 (2.4, 3.1)
Dec 2022	54852 (38346, 89513)	15 (6, 168)	5.0 (3.8, 6.5)	6.4 (5.5, 7.7)	3.8 (3.0, 4.5)
Jan 2023	34013 (24150, 53781)	11 (4, 180)	3.3 (2.5, 4.3)	3.9 (3.5, 5.0)	2.5 (1.9, 2.9)
Feb 2023	31640 (22855, 52213)	12 (3, 134)	3.2 (2.2, 4.3)	3.9 (3.4, 5.3)	2.3 (1.7, 2.7)
Mar 2023	40110 (30457, 66822)	11 (4, 175)	3.9 (2.9, 5.1)	4.6 (4.2, 5.9)	2.9 (2.4, 3.5)

Notes

1. The number of kits allocated per staff member was estimated as the median of orders and results divided by the number of FTE staff.
2. Number of kits and test results is presented as median (IQR).
3. The bold line indicates the timing of the change of national NHS asymptomatic testing policy.
4. LFD results column shows all tests reported; we are aware of substantial under-reporting of negative results. It is also likely that positive results triggered a confirmatory PCR test, with the result of that test reported into the national system, in place of the LFD. This is discussed in this report under 'Strengths and weaknesses'.

Table 8. Summary statistics of the latent class models

	2-class model	3-class model	4-class model
AIC	10,782.43	10,599.33	10,483.89
BIC	10,810.47	10,635.78	10,528.76
Percentage in each class			
1	50%	25.4%	4.9%
2	50%	50.0%	38.5%
3	-	24.6%	40.9%
4	-	-	15.6%

AIC = Akaike Information Criteria

BIC = Bayesian Information Criteria

The summary statistics of the 2, 3 and 4-class latent growth models are displayed in Table 8. In the 2-class model (Table 7, Figure 14), the trusts were evenly split between a group with a higher LFD allocation and a lower LFD allocation. The difference between the classes was greater when the total kit allocation was greater and more similar otherwise. In the 3-class model (Figure 15), 25% of trusts were classified as a high kit allocation, 50% as medium allocation and 25% as lower allocation. The new medium allocation class contains the bottom and top half of the higher and lower allocation classes respectively from the 2-class model, allowing greater differentiation between the higher and lower allocation classes. In the 4-class model (Figure 16), 5% of trusts were classified as very high allocation, 39% as high allocation, 41% as medium allocation and 16% as low allocation. The identification of a very high allocation class is the key difference with this model, as the high allocation classes are similar between the 2 and 4-class models and the medium and low allocation classes are a split of the low allocation class along with the trusts with the lowest kit allocation in the high allocation class from the 2-class model.

Figure 14. Kit allocation in the groups from the 2-class latent growth model

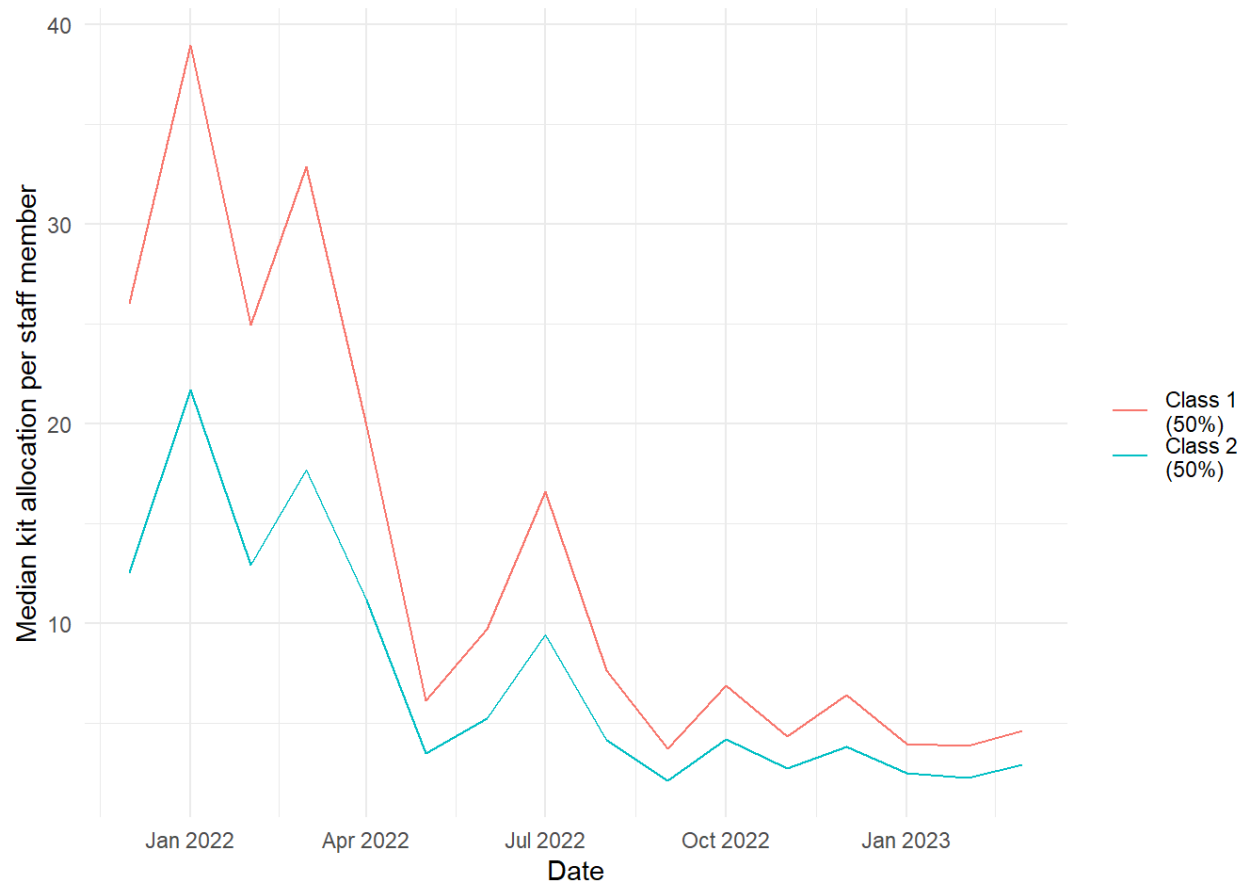


Figure 15. Kit allocation in the groups from the 3-class latent growth model

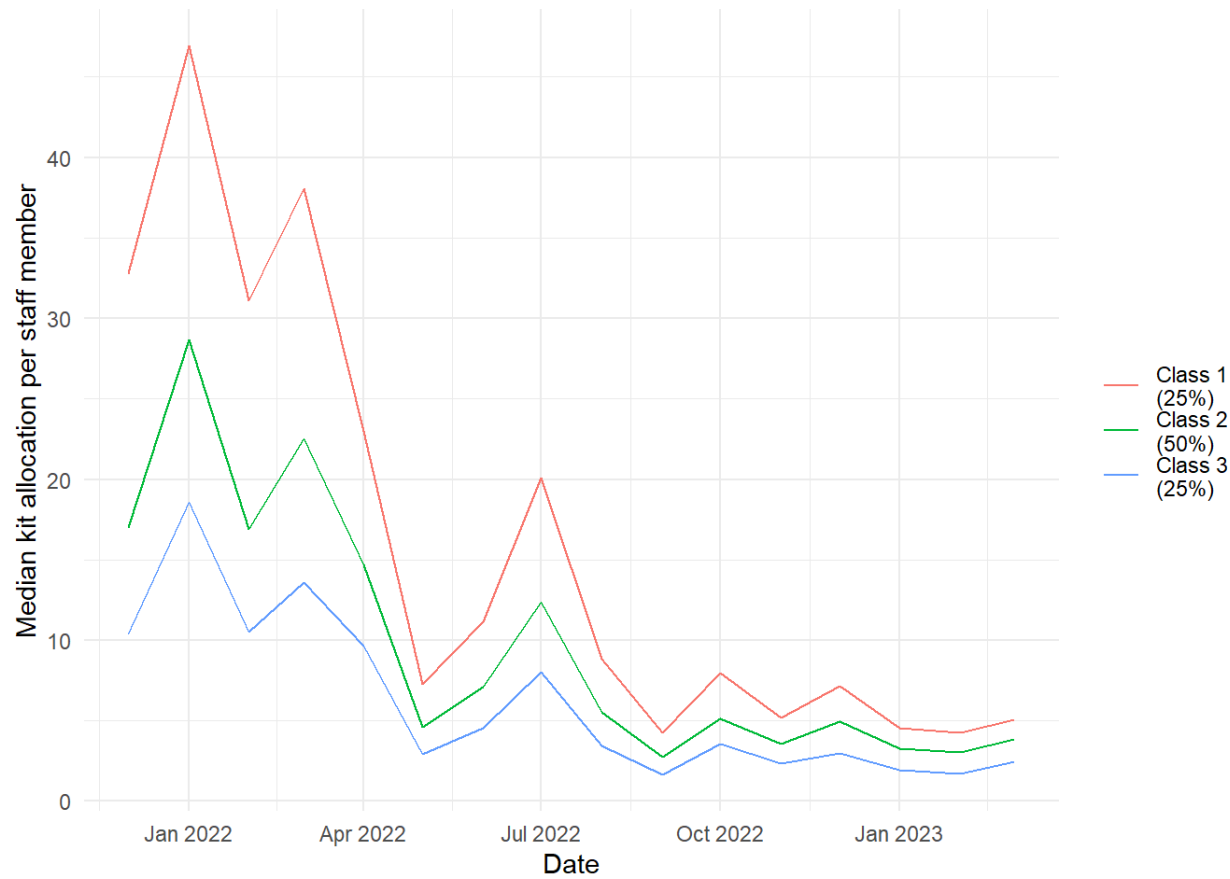
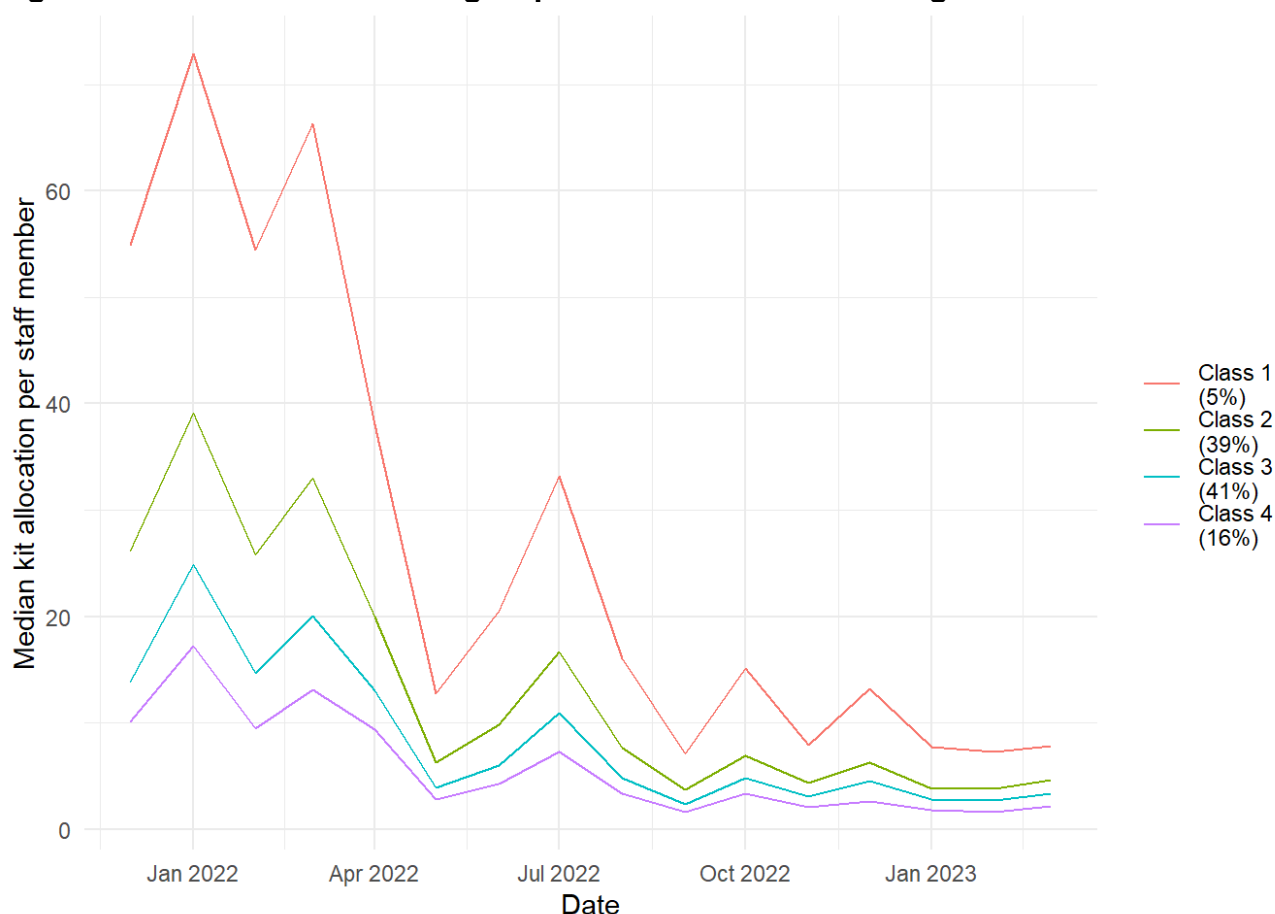


Figure 16. Kit allocation in the groups from the 4-class latent growth model



Both the AIC and BIC indicated that the models with more classes were better fits, with the 4-group classification being the best fit out of those tested. These 3 and 4-group classifications indicated that there were more than 2 types of trust response to asymptomatic testing that were not explored. However, the small group sizes meant that this might not be generalisable to future scenarios, and these are therefore less useful for future recommendations.

Because of this, it was determined that the analysis should proceed with the 2-group classification as this would then match the number of groups determined in the qualitative analysis in *Qualitative Findings*. The 2 groups would also allow for easier analysis using the synthetic control methodology, further justifying the compromise in model fit.

The effect of higher kit allocations on key performance measures

Table 9. Average effect of higher kit allocation on NHS trust performance measures

	Staff absence rates (%) (95% CI)	Mortality rates (%) (95% CI)	Beds occupied due to positive COVID-19 tests delaying care home discharges (%) (95% CI): assuming all zero delays true	Beds occupied due to positive COVID-19 tests delaying care home discharges (%) (95% CI): assuming all zero delays missing data
Average difference (all time)	0.00 (-0.07, 0.08)	0.00 (-0.02, 0.03)	0.00 (-0.09, 0.10)	-0.28 (-0.52, -0.03)
Dec 2021	-0.02 (-0.11, 0.08)	0.00 (-0.05, 0.06)	-0.27 (-0.60, 0.05)	-0.67 (-1.04, -0.29)
Jan 2022	0.00 (-0.05, 0.05)	0.06 (0.01, 0.11)	-0.09 (-0.24, 0.06)	-0.02 (-0.36, 0.33)
Feb 2022	0.05 (-0.04, 0.13)	0.01 (-0.03, 0.05)	0.01 (-0.09, 0.10)	0.06 (-0.18, 0.31)
Mar 2022	-0.06 (-0.13, 0.01)	-0.00 (-0.05, 0.04)	0.08 (-0.02, 0.17)	0.40 (0.18, 0.62)
Apr 2022	0.02 (-0.08, 0.12)	-0.03 (-0.07, 0.02)	0.08 (-0.01, 0.17)	0.26 (0.08, 0.44)
May 2022	-0.04 (-0.12, 0.03)	0.02 (-0.07, 0.02)	0.08 (-0.01, 0.17)	0.12 (-0.09, 0.33)
Jun 2022	-0.01 (-0.08, 0.05)	-0.04 (-0.08, 0.00)	0.06 (-0.03, 0.14)	-0.12 (-0.33, 0.08)
Jul 2022	0.06 (-0.03, 0.16)	0.02 (-0.03, 0.06)	0.03 (-0.07, 0.12)	-0.07 (-0.31, 0.17)
Aug 2022	-0.02 (-0.08, 0.05)	-0.03 (-0.07, 0.00)	0.03 (-0.05, 0.12)	0.01 (-0.25, 0.26)
Sep 2022	0.02 (-0.05, 0.08)	-0.00 (-0.04, 0.04)	0.01 (-0.08, 0.10)	-0.10 (-0.38, 0.18)
Oct 2022	-0.13	-0.03	0.08	0.01

	Staff absence rates (%) (95% CI)	Mortality rates (%) (95% CI)	Beds occupied due to positive COVID-19 tests delaying care home discharges (%) (95% CI): assuming all zero delays true	Beds occupied due to positive COVID-19 tests delaying care home discharges (%) (95% CI): assuming all zero delays missing data
	(-0.24, -0.02)	(-0.08, 0.03)	(-0.03, 0.18)	(-0.26, 0.28)
Nov 2022	-0.03 (-0.15, 0.09)	-0.00 (-0.05, 0.04)	0.04 (-0.07, 0.15)	-0.34 (-0.71, 0.04)
Dec 2022	-0.12 (-0.26, 0.03)	-0.03 (-0.10, 0.03)	-0.01 (-0.12, 0.10)	-0.37 (-0.78, 0.04)
Jan 2023	0.02 (-0.09, 0.14)	-0.01 (-0.06, 0.04)	0.00 (-0.11, 0.11)	-0.31 (-0.73, 0.12)
Feb 2023	0.15 (0.04, 0.26)	0.06 (0.01, 0.11)	-0.08 (-0.31, 0.16)	-0.39 (-0.79, 0.02)
Mar 2023	0.13 (0.01, 0.25)	0.04 (-0.01, 0.10)	-0.01 (-0.11, 0.10)	-0.42 (-0.81, -0.03)

Note: NHS national policy on asymptomatic testing changed from 31 August 2022. The bold line indicates the timing of the change of national NHS asymptomatic testing policy.

Clinical and clinical support staff absences

The estimated difference between trusts with high kit allocations and their counterfactuals, the same trusts if they had been classified as a low kit allocation trust, is listed in Table 9 and displayed in Figure 17, with the actual rates of staff absence of the high allocation trusts and the estimated rates of their counterfactuals in Figure 18. Initially, after the asymptomatic policy change, there was evidence that trusts who had more LFDs had a lower staff absence rate than if they had allocated fewer LFDs to staff. However, in the months following there was a mixed effect, and in the fifth and sixth months after the policy change (February and March 2023) there was evidence that trusts with higher kit allocations had higher rates of staff absences than if they had fewer kit allocations per staff member.

Figure 17. Effect of higher LFD allocation per staff member on staff absence rates

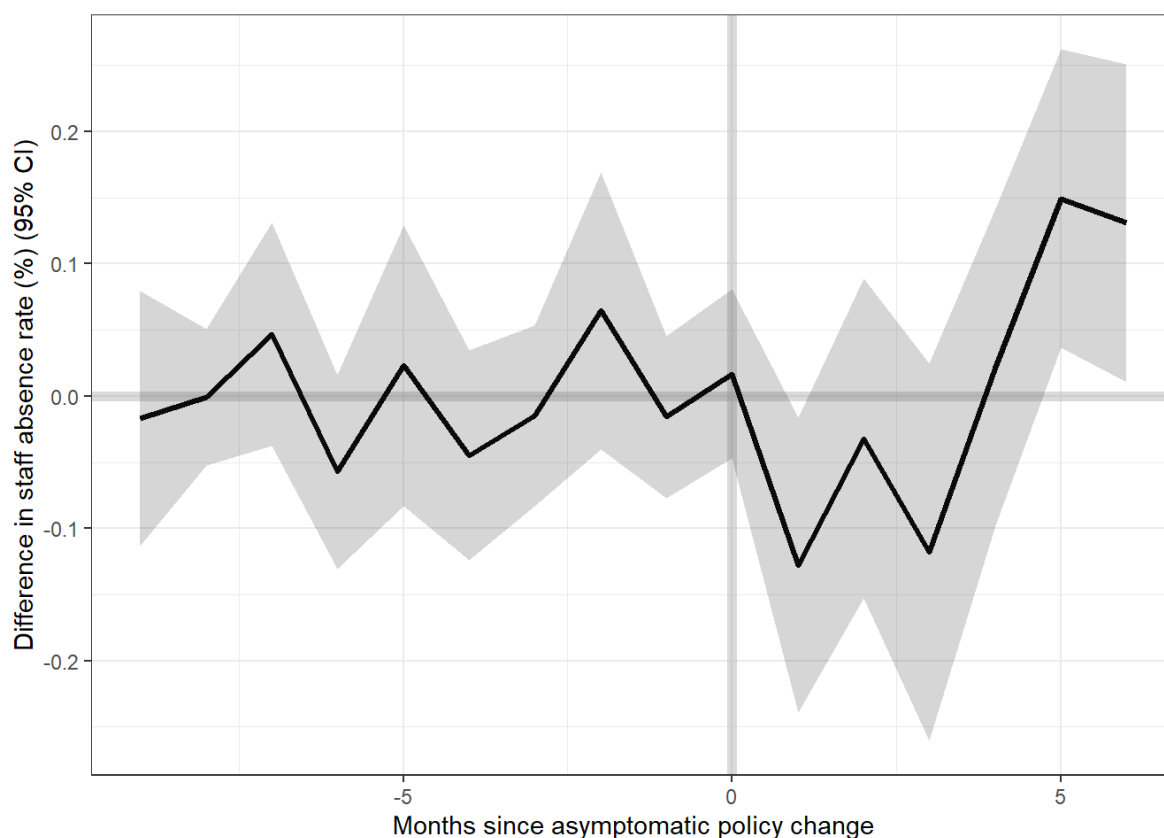
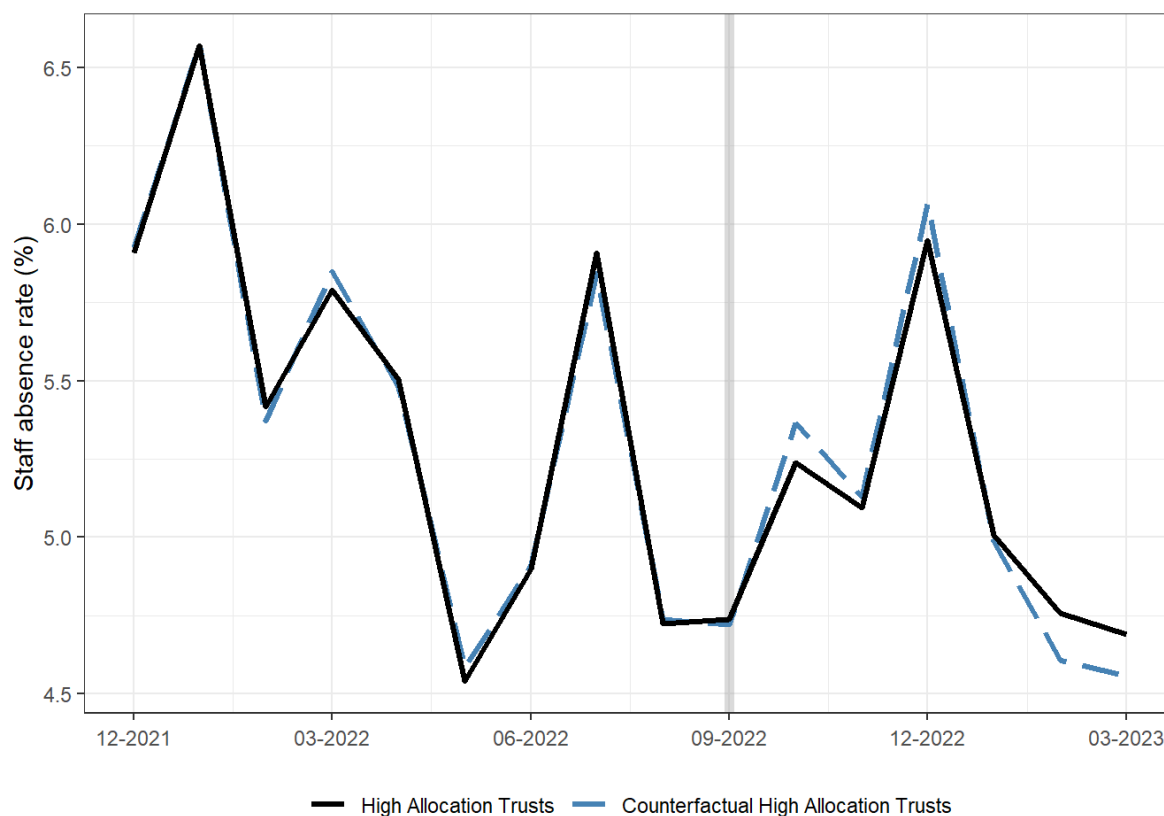


Figure 18. Actual and predicted staff absence rates for trusts who have higher kit allocations and their counterfactuals



Mortality

The estimated difference between trusts with high kit allocations and their counterfactuals (that is the same trusts if they had been classified as a low kit allocation trust) is listed in Table 9 and displayed in Figure 19, with the actual rates of mortality of the high allocation trusts and the estimated rates of their counterfactuals in Figure 20. After the change in asymptomatic testing policy, there was no difference in mortality rates between trusts that had a higher allocation of kits per staff member and those trusts if they had a lower allocation. There was weak evidence that those trusts had a higher mortality rate in February 2023 but the difference in mortality rate became smaller in the following month so this may be an outlier or due to chance.

Figure 19. Effect of higher LFD allocation per staff member on mortality rates

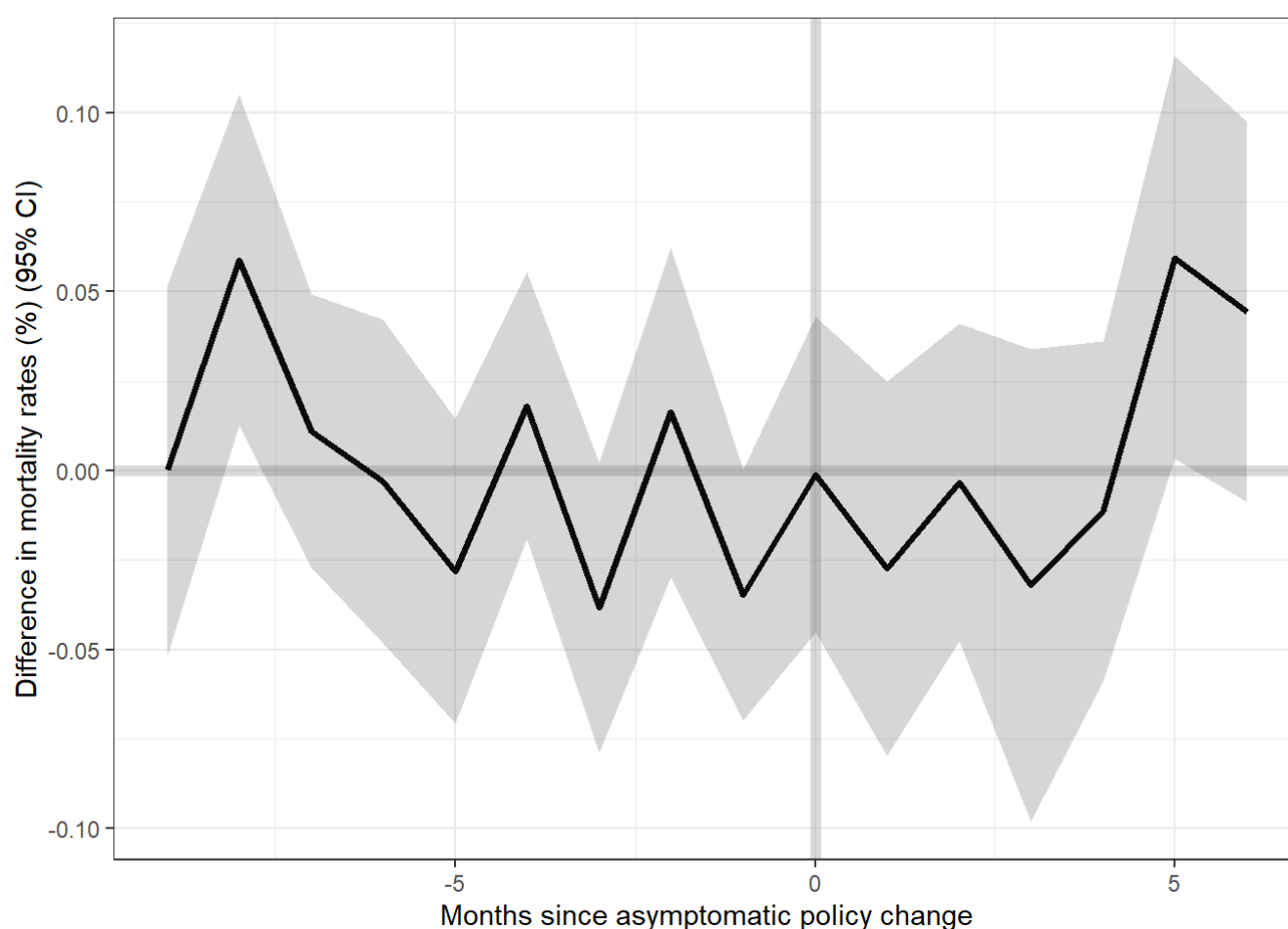
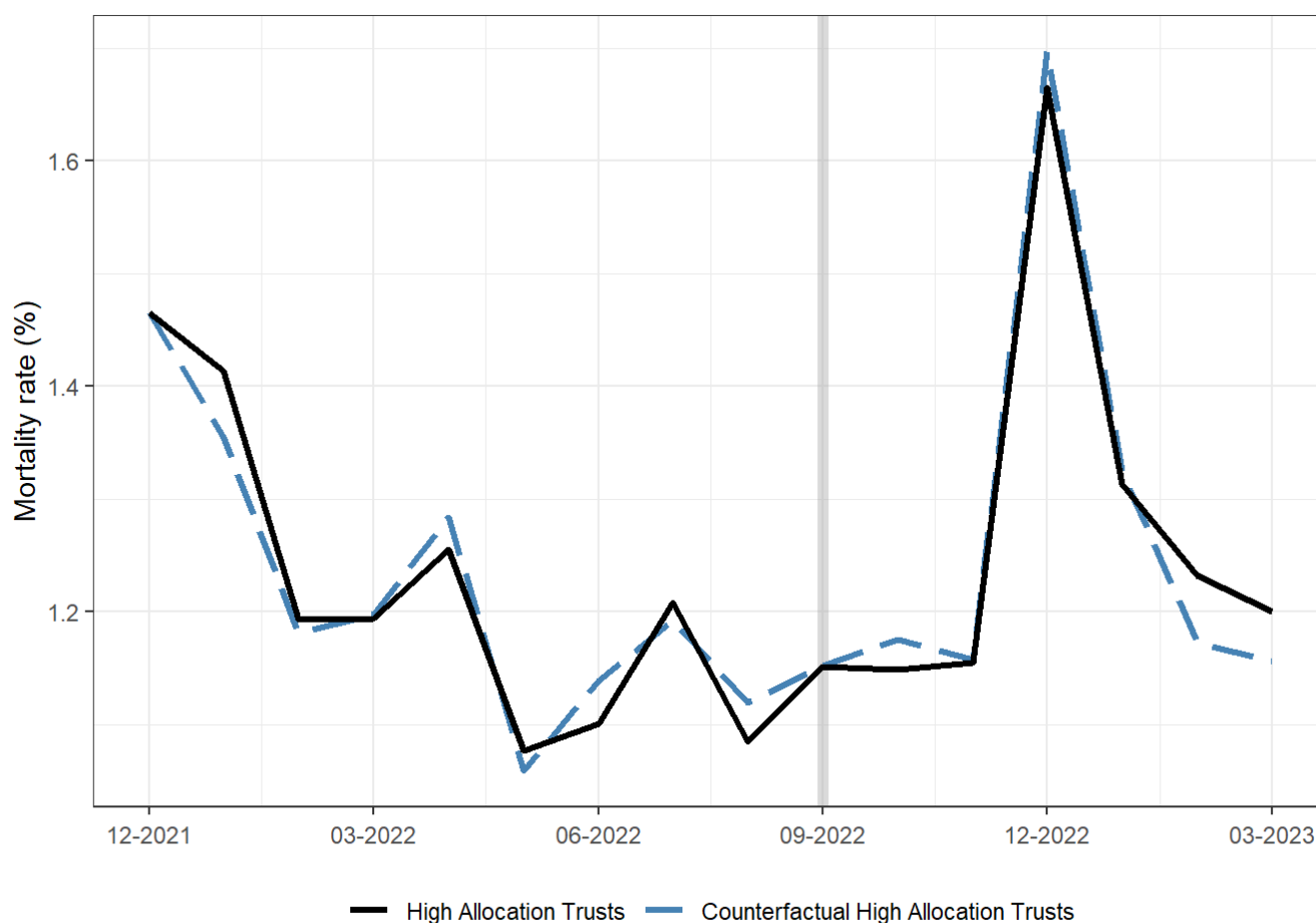


Figure 20. Actual and predicted mortality rates for trusts that have higher kit allocations and their counterfactuals



Delayed discharges to care homes due to positive COVID-19 tests

Although data for other outcomes and factors was distributed as expected with little missing data, the data for the number of delayed discharges to a care home due to a positive COVID-19 test contained more reports of zero delayed discharges than was expected. In the time period of interest after the national policy on asymptomatic testing changed, 89 (75%) trusts did not report any delayed discharges due to COVID-19 and only 12 (10%) reported delays every month (Table 10). Due to how the data was collected and collated, it is not clear which of these zero reports are because there were genuinely zero delayed discharges in the trust that month and which are because trusts did not report a number at all and so the zero should be read as missing data for that month.

Table 10. Distribution of months with reported delayed discharges to a care home due to a positive COVID-19 test September 2022 to March 2023

Number of months with reported delayed discharges due to COVID-19 (maximum 7)	Number (%) of trusts (N=119)
0	89 (75%)
1	6 (5%)
2	3 (3%)
3	3 (3%)
4	2 (2%)
5	2 (2%)
6	2 (2%)
7	12 (10%)

Assuming all zero reports of delayed discharges are true

The estimated difference between trusts with high kit allocations and their counterfactuals (that is the same trusts if they had been classified as a low kit allocation trust) is listed in Table 9 and displayed in Figure 21, with the actual rates of beds occupied due to positive COVID-19 tests delaying discharges to care homes of the high allocation trusts and the estimated rates of their counterfactuals in Figure 22. There was no difference in the rates of delayed discharges to care home in the months following the testing policy change between high allocation trusts and their counterfactuals, however in the many trusts that reported no delayed discharges to care homes due to positive COVID-19 tests it would not be possible to see a difference in these trusts.

Figure 21. Effect of higher LFD allocation per staff member on beds occupied due to positive COVID-19 tests delaying care home discharges assuming all zero reports true

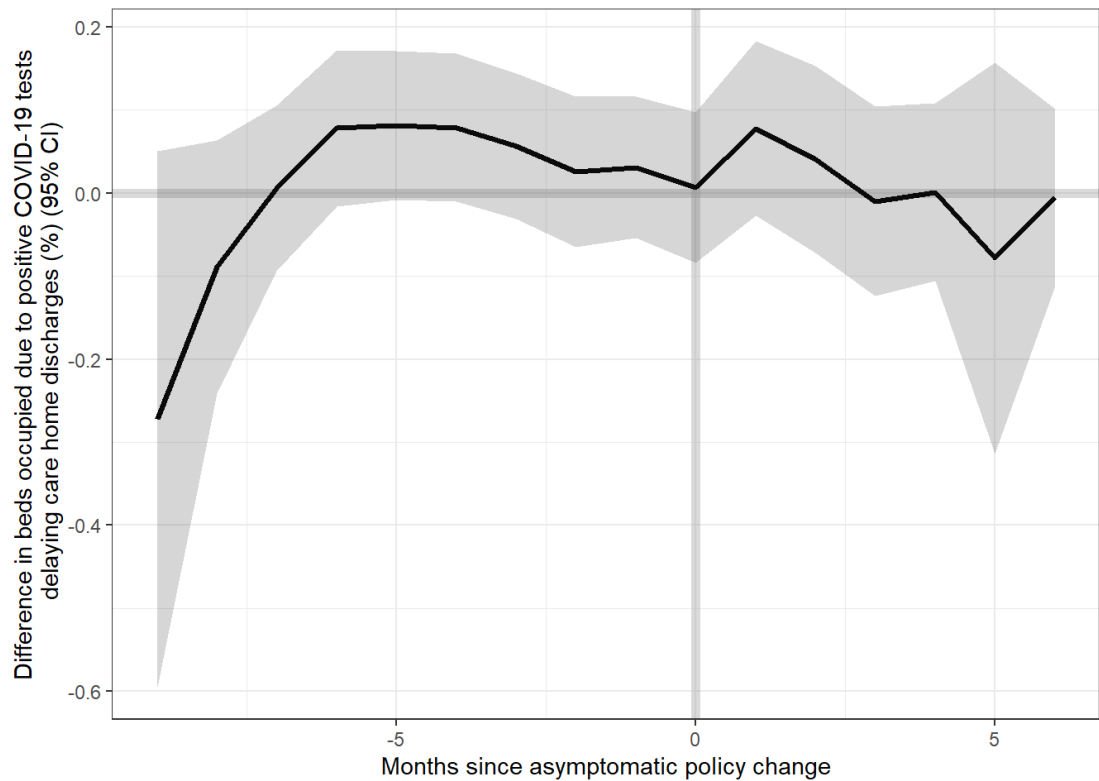
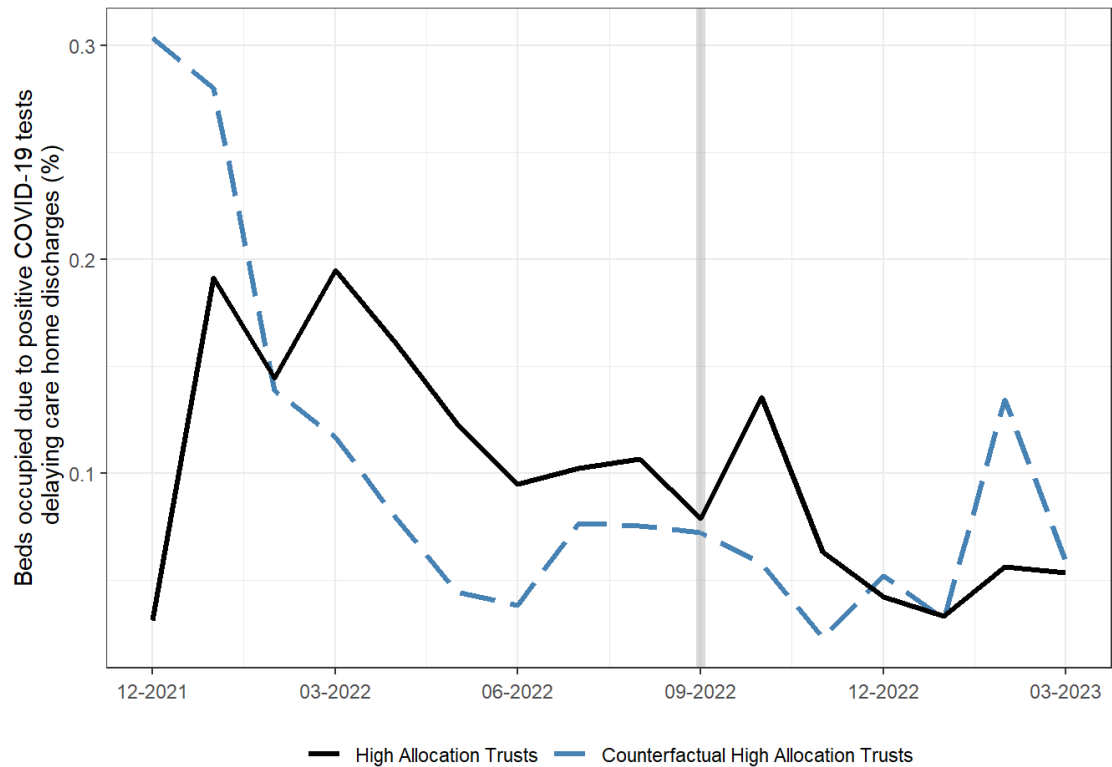


Figure 22. Actual and predicted beds occupied due to positive COVID-19 tests delaying care home discharges for trusts who have higher kit allocations and their counterfactuals assuming all zero reports true



Assuming all zero reports of delayed discharges are missing data.

The estimated difference between trusts with high kit allocations and their counterfactuals, the same trusts if they had been classified as a low kit allocation trust, is listed in Table 9 and displayed in Figure 23, with the actual rates of beds occupied due to positive COVID-19 tests delaying discharges to care homes of the high allocation trusts and the estimated rates of their counterfactuals in Figure 24. In total, 22 trusts were removed from this analysis as they did not report any delayed discharges to a care home due to a positive COVID-19 test during the full analysis period. A further 89 did not contribute any data in the time period of interest but their earlier data was included in the model. Trusts with a high allocation of kits had a numerically lower percentage of delayed discharges than their counterfactuals with low allocation of kits from October 2022 onwards, although this difference was not statistically significant likely due to the smaller sample size.

Figure 23. Effect of higher LFD allocation per staff member on beds occupied due to positive COVID-19 tests delaying care home discharges assuming all zero reports missing data

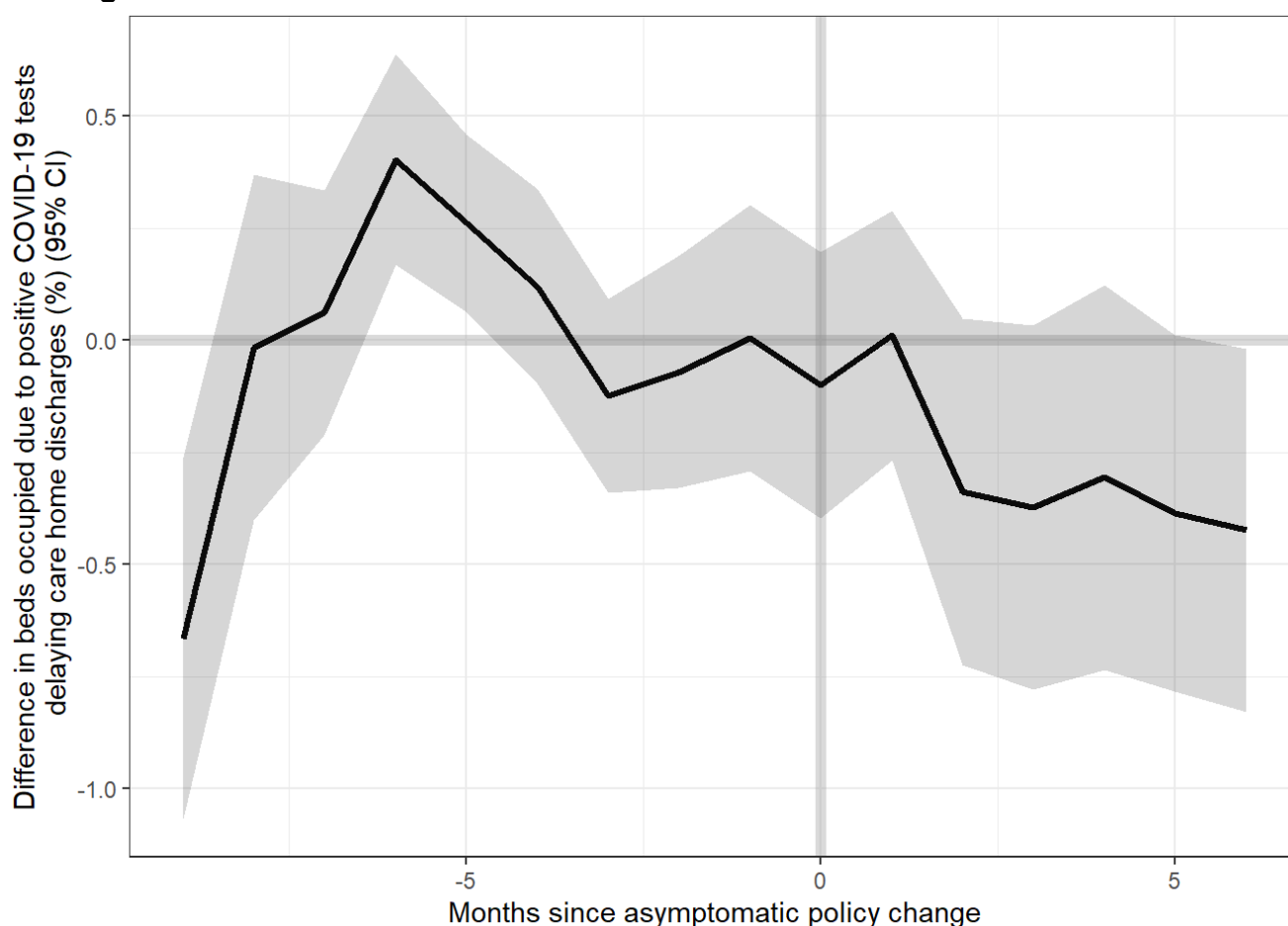
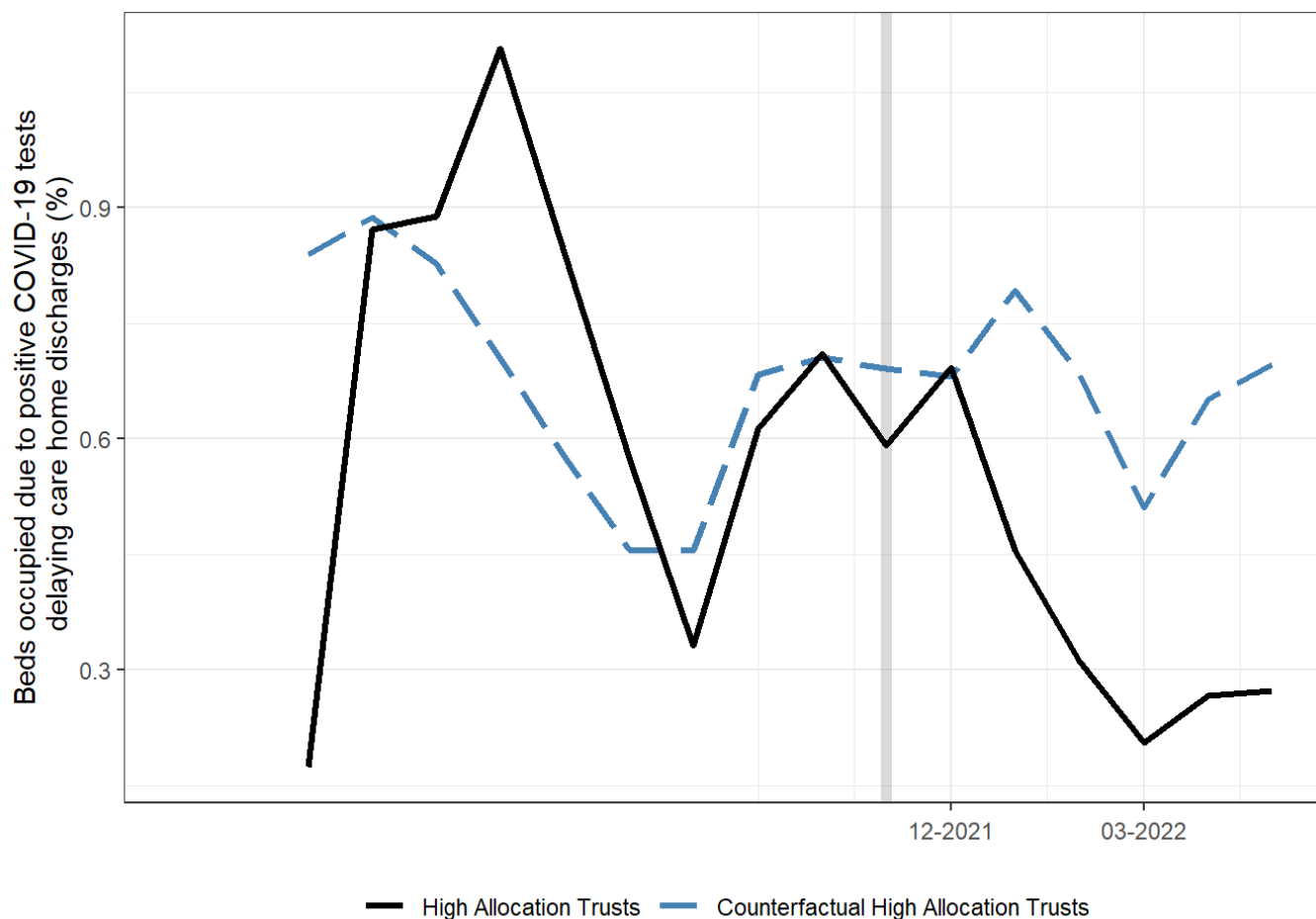


Figure 24. Actual and predicted beds occupied due to positive COVID-19 tests delaying care home discharges for trusts who have higher kit allocations and their counterfactuals assuming all zero reports missing data



Relationship between staff absence rates and beds occupied due to delayed discharges to a care home

Comparing the median value of staff absences to percentage of bed days lost due to delayed discharges to a care home in the time period after the change in asymptomatic testing policy, both assuming all zero delayed discharges are true (Figure 25) or missing data (Figure 26), there was no correlation observed between the 2 measures (Spearman's $\rho = -0.02$ and -0.07 , respectively).

Figure 25. Scatter plot of staff absence rate and beds occupied due to positive COVID-19 tests delaying care home discharges assuming all zero delayed discharges are true

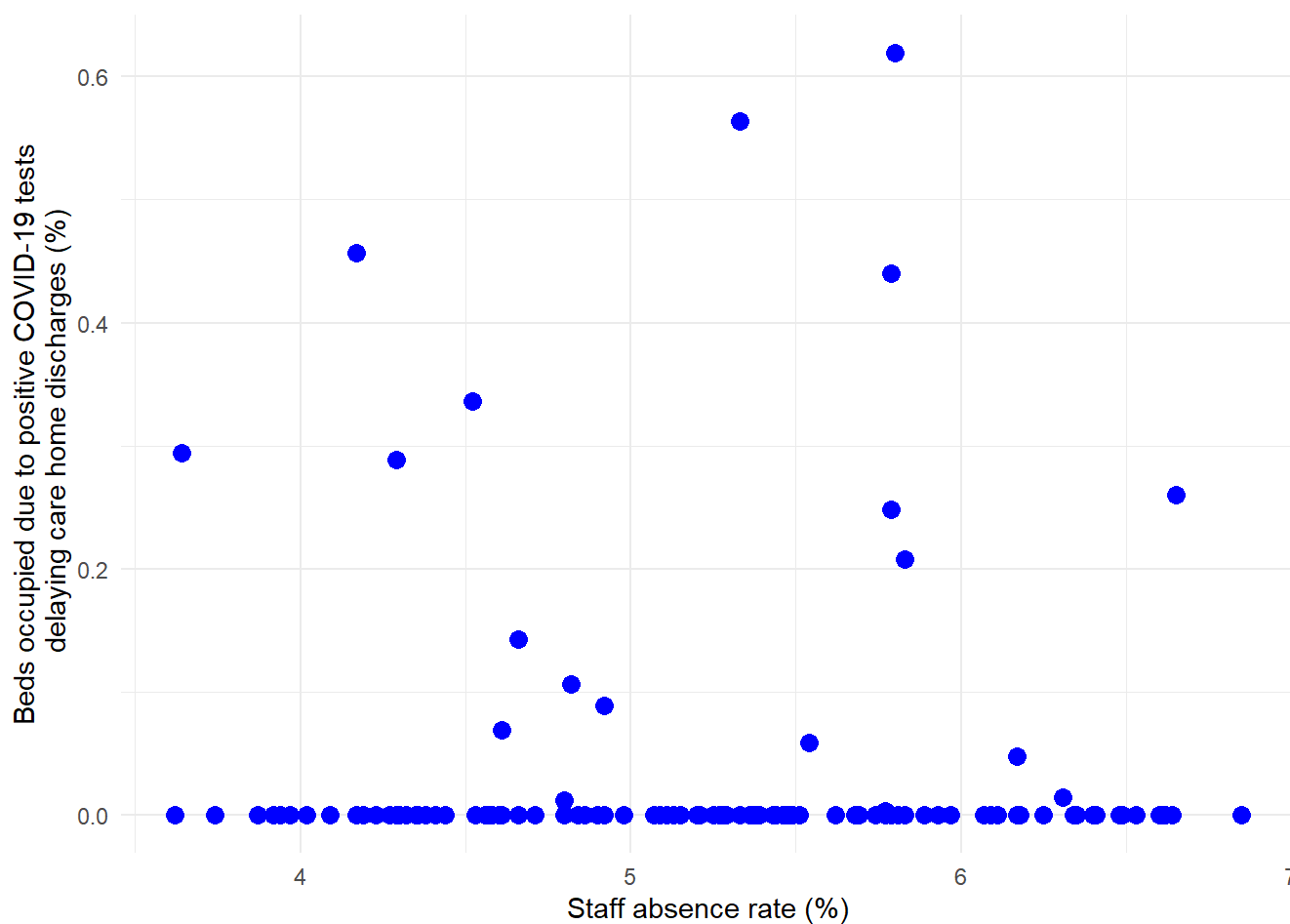
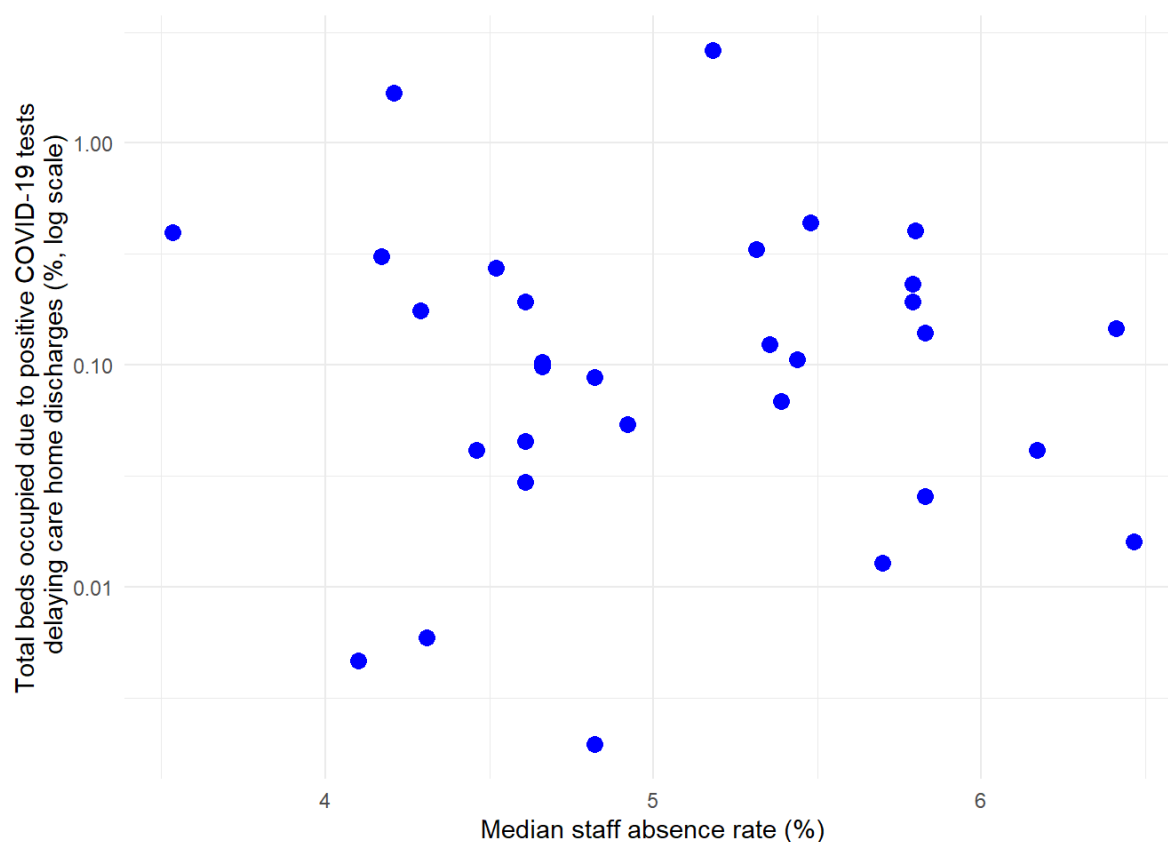


Figure 26. Scatter plot of staff absence rate and beds occupied due to positive COVID-19 tests delaying care home discharges assuming all zero delayed discharges are missing data

After adjusting for the regional COVID-19 positivity rate, there was no evidence of an association between staff absence rate and bed days lost to delayed discharges regardless of if zero delay reports were either all true or all missing data ($p=0.20$, 0.42 respectively, Table 11). After adjusting for staff absence rate, there was no association between COVID-19 positivity rate and bed days lost to delayed discharges if all zero delay reports were true ($p=0.29$), but if assuming these were all missing data then a 1% increase in the COVID-19 positivity rate was associated with a 0.09% increase in bed days lost (95% CI 0.02%, 0.17%, $p=0.02$).

Table 11. Association between staff absences, COVID-19 positivity and delayed discharges due to COVID-19

	Total bed days lost (%) (95% CI): assuming all zeroes true	Total bed days lost (%) (95% CI): assuming all zeroes missing data
Change per one percentage point increase in staff absence	0.01 (−0.01, 0.03) $p=0.29$	−0.03 (−0.12, 0.05) $p=0.42$
Change per one percentage point increase in regional COVID-19 positivity rate		0.09 (0.02, 0.17) $p=0.02$

Note: The results come from a model adjusted for both factors and trust as a random effect.

Sensitivity analyses

Excluding trusts that merged

Excluding data from the 2 trusts that merged did not lead to substantially different results and therefore these results are not presented here.

Including specialist trusts

Once specialist trusts had been incorporated into the 2-class latent growth model (Figure 27), there was a more unequal split of trusts between the high and low kit allocation trusts (14% vs 86%) compared to the model without specialist trusts (50% versus 50%). Additionally, the difference in the number of kits allocated between the 2 groups was also greater: at its greatest, the higher kit class were allocated 75 more kits per FTE staff member. It is possible that specialist trusts were ordering more LFDs, or it may be that the methodology of attributing LFD orders from individuals to trusts (as described in 'Data sources and processing') was not suitable for specialist trusts.

Figure 27. Kit allocation in the groups from the 2-class latent growth model including specialist trusts

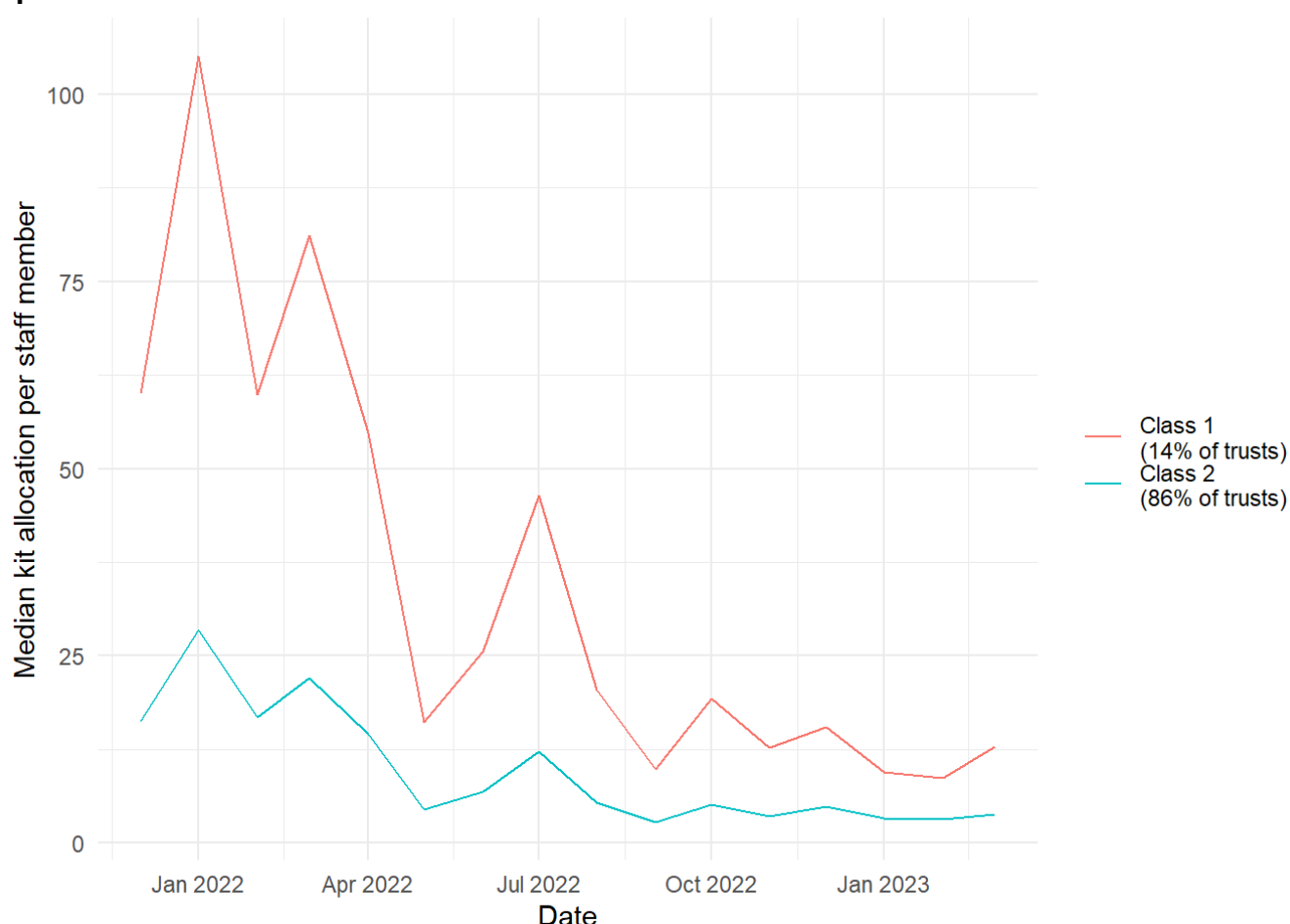


Figure 28 displays the estimated difference in staff absence rates between trusts with high kit allocations and their counterfactuals, the same trusts if they had been classified as a low kit allocation trust and Figure 29 displays the actual absence rates of the high allocation trusts and the estimated rates of their counterfactuals. Similarly to the estimated differences in the non-specialist trusts, there is a decrease in the first month after the asymptomatic policy change, but this is only a numeric difference. However, following that month the trusts with a higher allocation of kits had more staff absences than their counterfactuals for the rest of the analysis time period.

Figure 28. Effect of higher LFD allocation per staff member on staff absence rates including specialist trusts

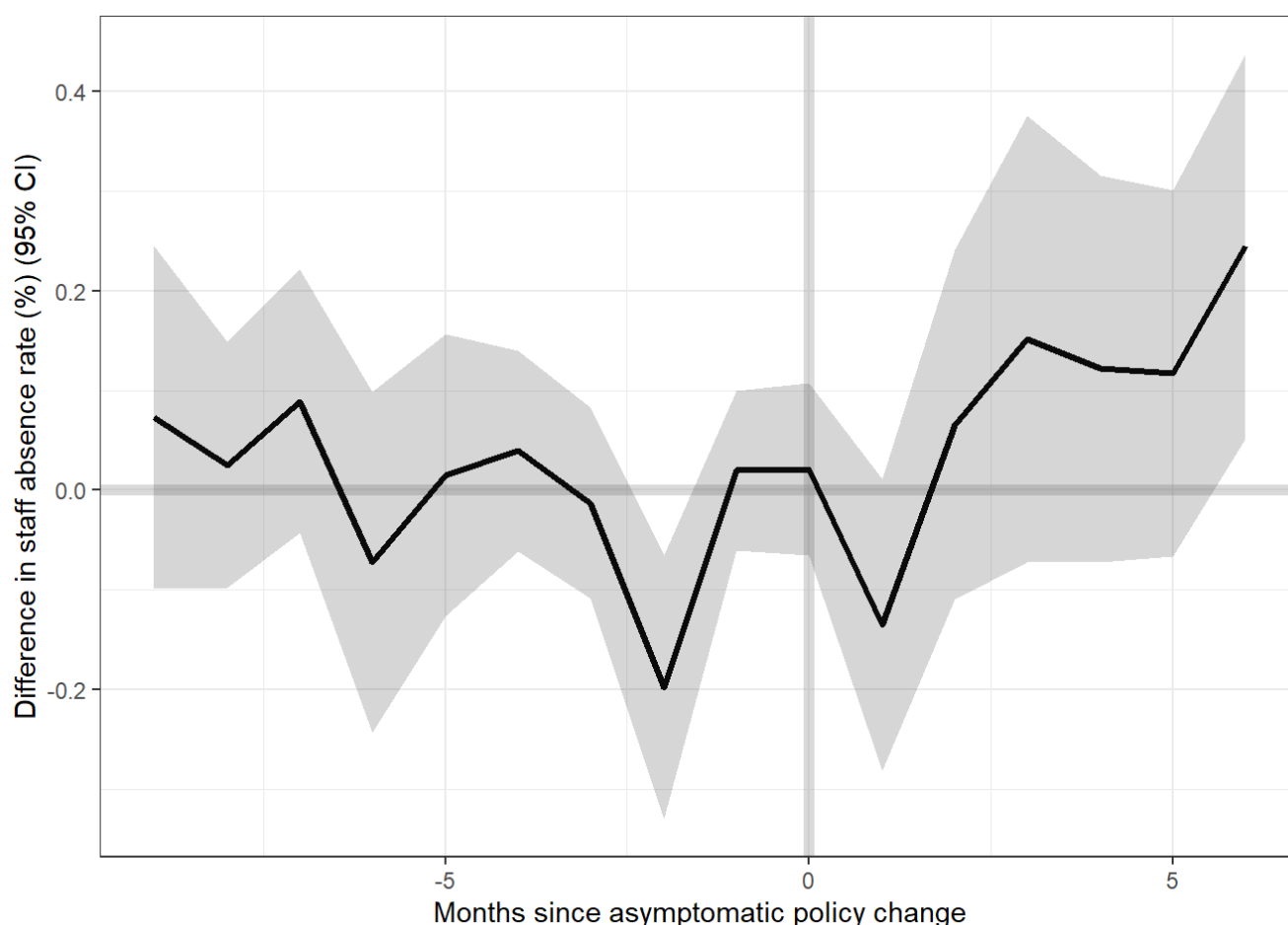
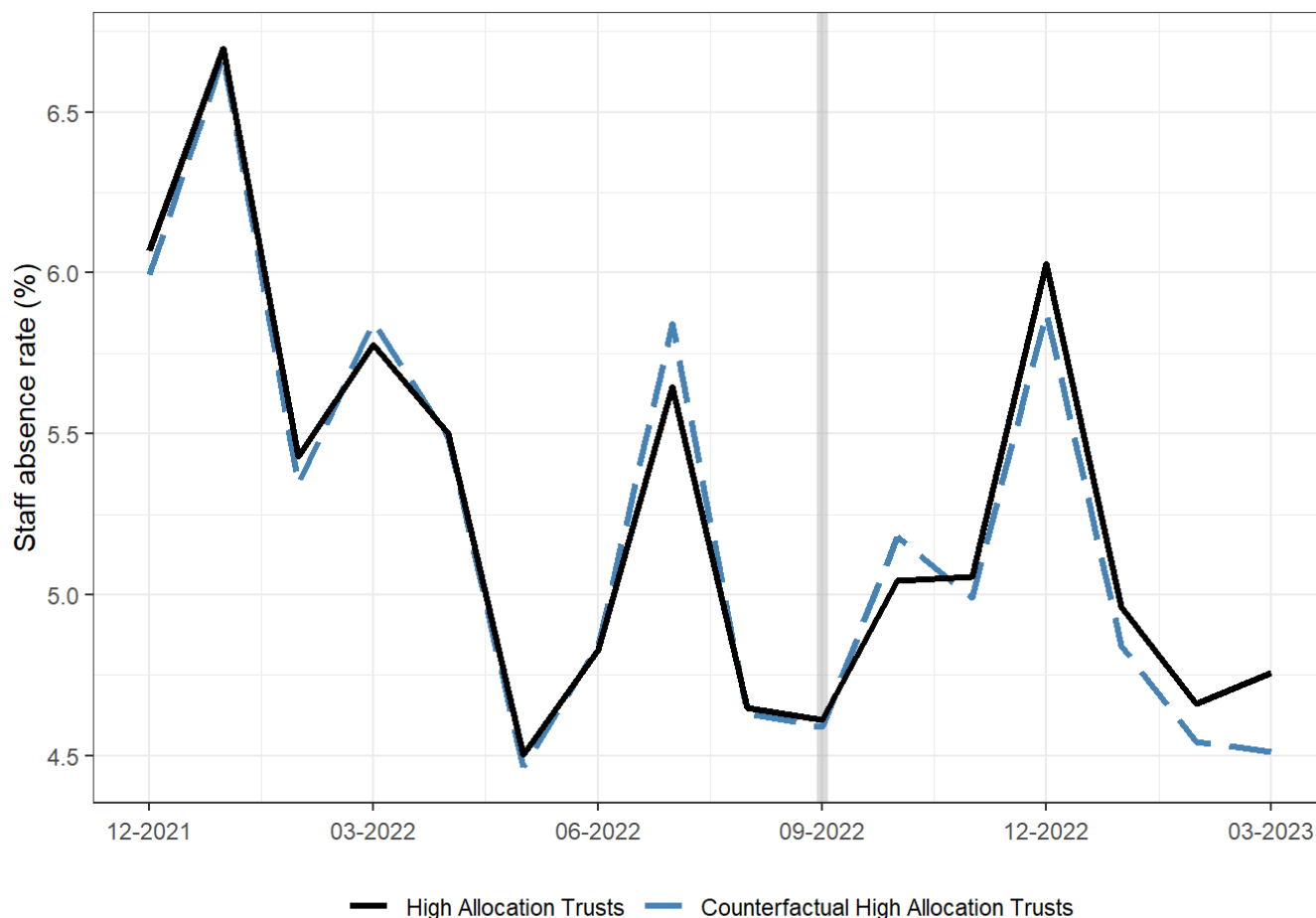


Figure 29. Actual and predicted staff absence rates for Trusts who have higher kit allocations and their counterfactuals including specialist trusts



Fixed and time-varying demographics of the trust clusters

Table 12. Trust demographics by subtype cluster

	Cluster 1: N=67 (56% of total trusts)	Cluster 2: N=33 (28% of total trusts)	Cluster 3: N=20 (17% of total trusts)
Fixed demographics			
NHS region			
East of England	6 (9%)	5 (15%)	2 (10%)
London	0	14 (42%)	4 (20%)
Midlands	9 (13%)	6 (18%)	5 (25%)
North East and Yorkshire	16 (24%)	2 (6%)	3 (15%)
North West	13 (19%)	3 (9%)	1 (5%)
South East	10 (15%)	3 (9%)	4 (20%)

	Cluster 1: N=67 (56% of total trusts)	Cluster 2: N=33 (28% of total trusts)	Cluster 3: N=20 (17% of total trusts)
South West	13 (19%)	0	1 (5%)
Trust type			
Large	16 (24%)	10 (30%)	2 (10%)
Medium	14 (21%)	9 (27%)	0
Multi-service	3 (5%)	1 (3%)	0
Small	20 (30%)	7 (21%)	0
Teaching	14 (21%)	6 (18%)	18 (90%)
Multi-site	43 (64%)	17 (52%)	18 (90%)
Number of sites	2 (1, 3)	2 (1, 3)	4 (3, 7)
Rural urban classification			
Predominantly rural	14 (21%)	1 (3%)	5 (25%)
Predominantly urban	33 (49%)	28 (85%)	11 (55%)
Urban with significant rural	20 (30%)	4 (12%)	4 (20%)
Index of multiple deprivation score	21.0 (16.3, 24.6)	19.8 (17.7, 26.4)	20.5 (18.4, 24.2)
Percentage of local residents from a minority ethnicity	5 (4, 8)	22 (17, 32)	11 (8, 17)
Percentage of staff with 2 COVID-19 vaccine doses	93.0 (92.0, 93.9)	88.5 (85.9, 90.0)	91.2 (88.7, 92.3)
Time-varying demographics			
Full-time equivalent clinical and clinical support staff	4,704 (3,485, 6,086)	4,584 (3,351, 6,346)	11,865 (10,167, 13,274)
Number of adult beds	639 (455, 851)	609 (482, 723)	1,409 (1,057, 1,647)
Number of paediatric beds	25 (18, 35)	29 (21, 53)	116 (97, 130)
Number of ITU/ACC beds	34 (24, 47)	44 (33, 57)	132 (94, 161)
Percentage of patients <18 years old	7.6 (6.4, 8.7)	10.4 (9.5, 12.0)	8.8 (7.1, 12.2)
Percentage of patients ≥65 years old	50 (47, 53)	41 (38, 43)	43 (40, 46)
Local COVID-19 positivity rate	3.16 (3.13, 3.20)	3.20 (3.11, 3.33)	3.16 (3.11, 3.20)

Notes

Data is presented as median (IQR) or n (%).

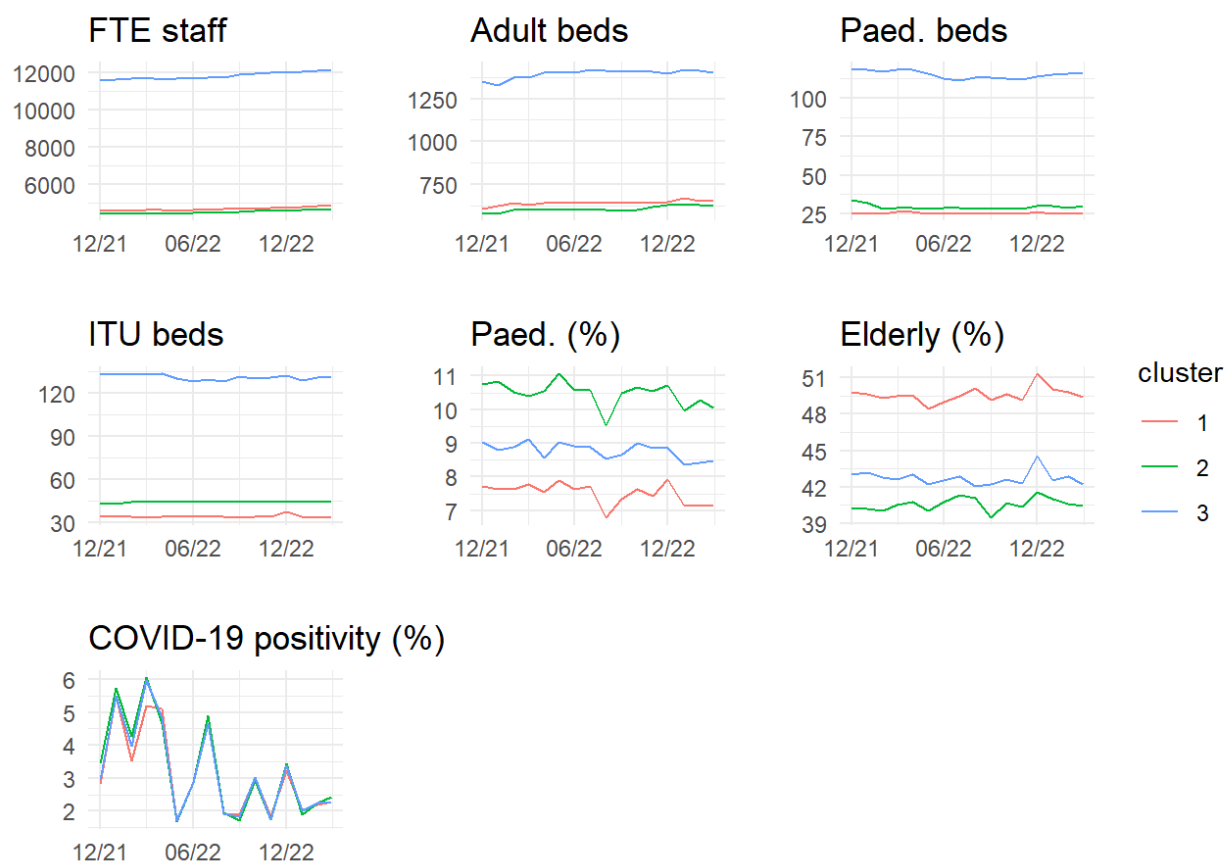
For time-varying demographics, summaries are of the mean value over the time period December 2021 to March 2023.

All data is recorded at trust level except local COVID-19 positivity which is at region level.

Cluster summary

The optimal number of subtypes determined by the longitudinal k-means cluster analysis was 3 (Table 12). Cluster 1 contained 56% of trusts and may be considered the average cluster. This cluster had more trusts in the North East, North West and South West than other clusters as well as lower proportions of local residents from a minority ethnicity, greater rates of COVID-19 vaccination and higher proportions of elderly patients. Cluster 2 contained 28% of trusts and was mostly city trusts: 42% of these trusts were located in London and they had a higher proportion of local residents from a minority ethnicity, lower rates of COVID-19 vaccination, and a larger proportion of paediatric patients compared to the other clusters. Cluster 3 contained 17% of trusts and these are very large trusts: 90% of these trusts were teaching trusts and they had a larger number of sites and correspondingly much larger numbers of staff and beds of all types compared to the other clusters. All clusters were mutually exclusive.

Figure 30. Median values for the time-varying characteristics over the analysis period, by subtype cluster



The time-varying characteristics followed similar patterns for each subtype cluster over the analysis period, with the exception of the percentage of paediatric and elderly patients (Figure 30). Of note, clusters 1 and 2, as well as trusts overall, had a decrease in paediatric patients in July 2022, likely due to the large increase in COVID-19 infections in that month increasing the number of adult admissions, but cluster 3 did not see the same increase. Also, cluster 2 did not have the same increase in elderly patients in December 2022 as the other 2 trusts which may be due to city regions having younger populations.

Comparison of outcomes between subtype clusters

The estimated difference in staff absences between the high kit allocation trusts and their counterfactuals for each cluster are plotted in Figure 31, while the difference in mortality is plotted in Figure 32. Trusts with high kit allocations had a decrease in staff absences initially and an increase at the end of the analysis period in all subtype clusters. However, trusts in cluster 1 had more staff absences than their counterfactuals earlier and by a larger amount than the other clusters which had similar trajectories. The estimated differences in mortality between high allocation trusts and their counterfactuals was again similar in clusters 2 and 3 with lower mortality in the high allocation trusts in most months after the testing policy change, compared to cluster 1 in which high allocation trusts saw an increase in mortality compared to their counterfactuals, particularly in February 2022. For both outcomes, it appears that the clusters are converging at the last month included in the analysis (March 2023), but later data would be required to confirm that.

Figure 31. Effect of higher LFD allocation per staff member on staff absence rates by subtype cluster

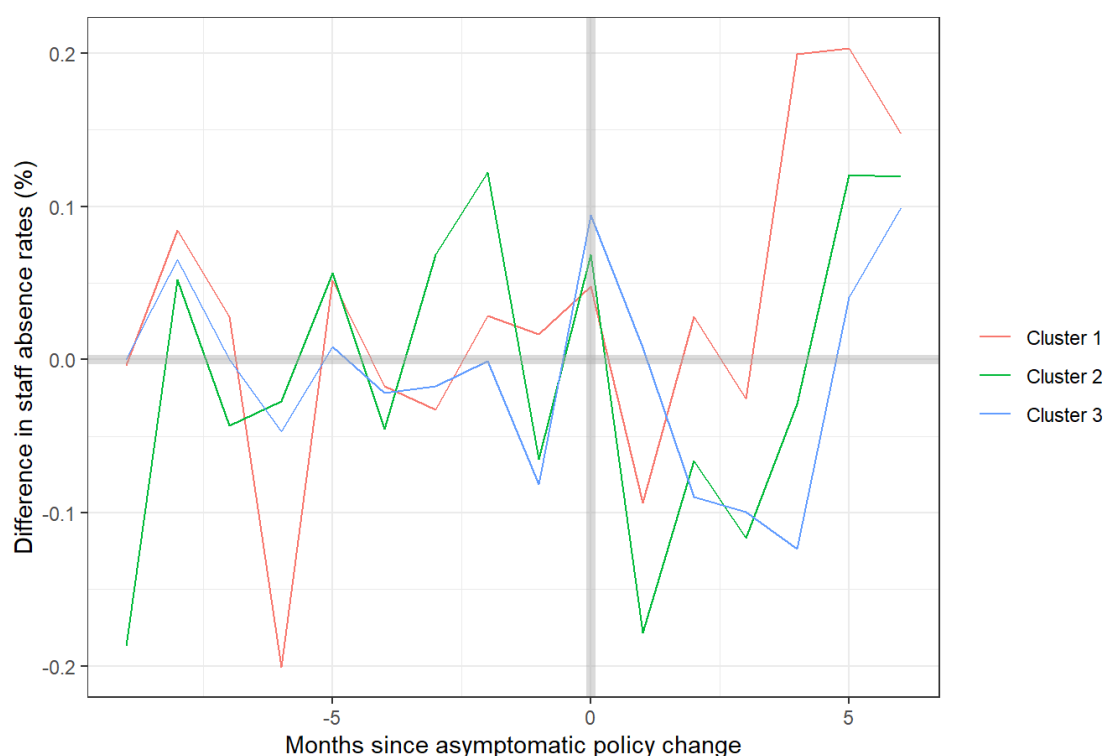
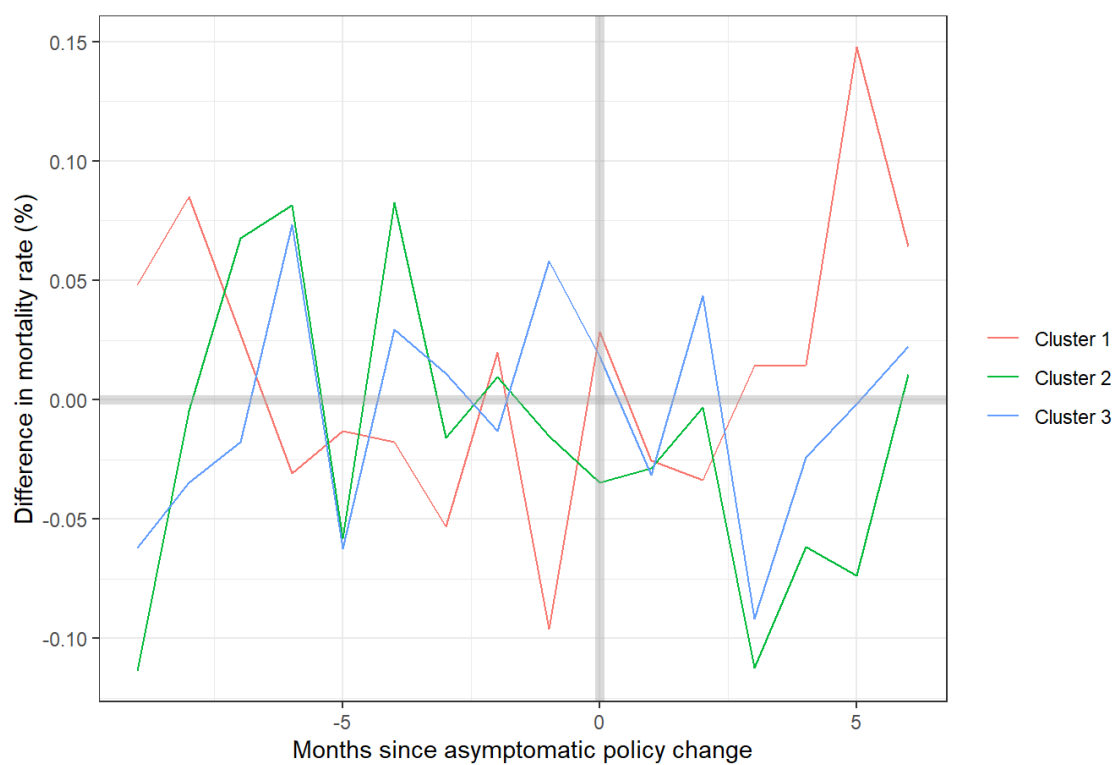


Figure 32. Effect of higher LFD allocation per staff member on mortality rates by subtype cluster



Analyses specified in the SAP that are not included in this report

As the outcomes considered to indicate trust operational performance are diverse and multidimensional, it was planned to explore whether performance can be simplified into one variable. This was a 2-step process using the R command *lgca*:⁴⁷ the first step created a latent class variable for each outcome, the second step combined these latent variables into an overall latent variable which could be used as the outcome to assess overall performance. Additional outcomes to be included alongside the 3 primary outcomes were bed occupancy rate, discharges to a care home, length of hospital stay and COVID-19 specific mortality rate. However, for the outcomes of COVID-19 mortality, overall mortality and bed occupancy rates, the first step models that created latent variables of each outcome would not converge, which is likely to be due to either very small rates or a lack of difference between trusts. Because of this, the analysis could not proceed to the second stage of creating the overall latent variable.

Analyses of the outcome of delayed discharges to a care home due to a positive COVID-19 test could not be performed due to the large number of trusts reporting zero delays. In particular, from the SAP, the subgroup analysis could not be performed.

It was planned in the SAP to report unadjusted, and Benjamini-Hochberg adjusted, CIs. However, due to the small number of significant unadjusted p-values, it was not possible to estimate the adjusted CIs and it was felt that an alternative method was not necessary. It was planned to incorporate the cluster variable derived from the cluster analysis into the synthetic control model. This was not possible as the *gsynth* command only allows time-varying factors into the model and so the analysis was performed as described in 'Statistical Methods'.

The subgroup analysis could not be performed on the outcome of delayed discharges to a care home due to a positive COVID-19 test as once the data had been split into 3 for the 3 clusters, there was not enough data to create the counterfactuals of the high allocation trusts.

Synthesis of survey and performance data findings

Based on the survey data, we constructed 2 groups of trusts. One group (N=10) did more to encourage compliance with testing, that is they devoted more resources to the task. The other group (N=12) did less to encourage compliance with testing, that is they devoted fewer resources. Comparing the groups identified in the survey and the performance data analysis (Table 13), there was not an exact match between the 2 groups. LFD orders and results were not a strong indicator of local trust asymptomatic testing policy (exact test $p=0.4$).

In the latent class grouping from the performance data analysis that did include specialist trusts, only the 2 specialist children's trusts included in the survey were in the higher kit allocation group (data not reported here).

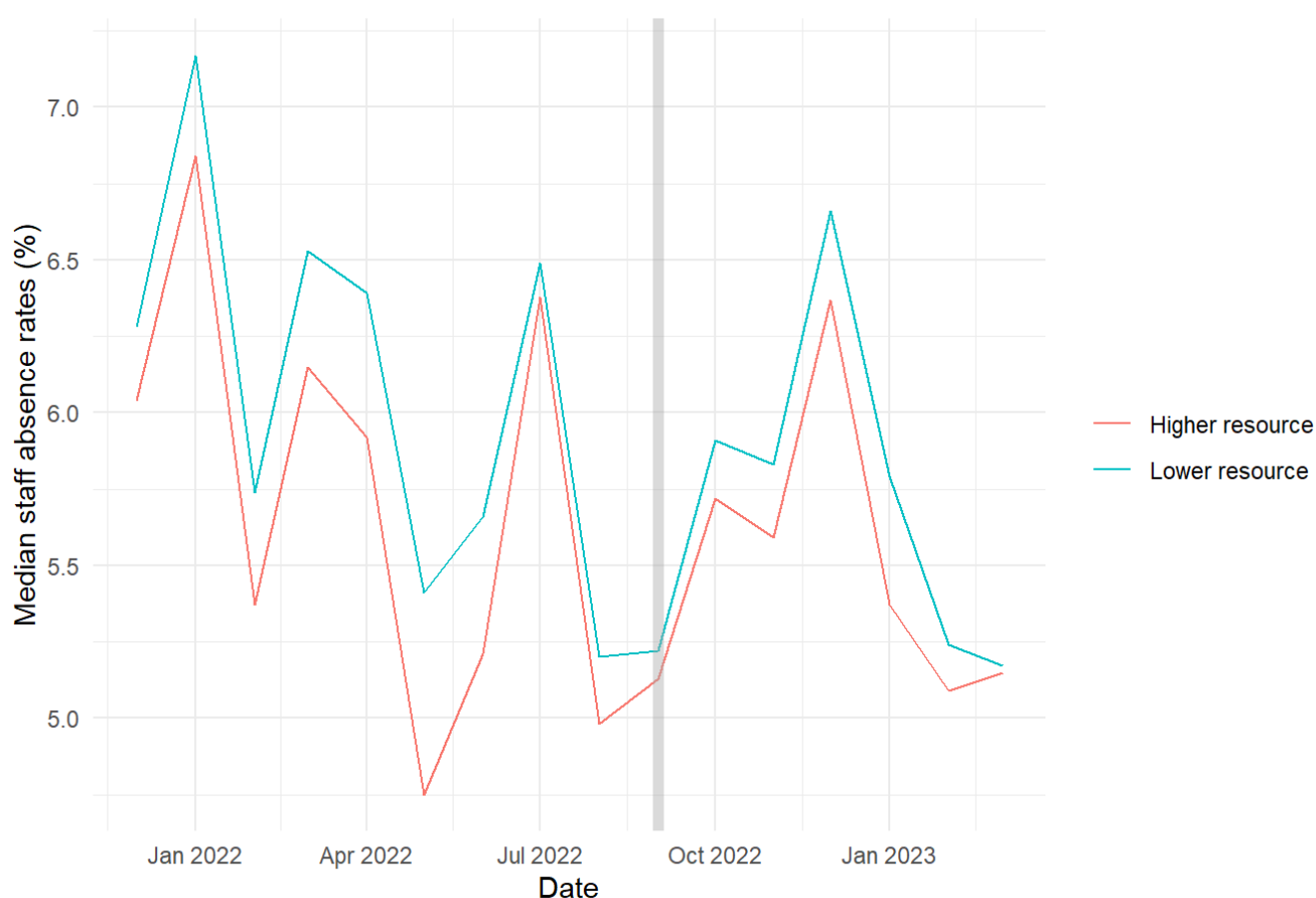
Table 13. Comparison of groups from qualitative and quantitative analysis

Quantitative analysis grouping	Survey grouping: more resources N=10	Survey grouping: fewer resources N=12
More kits allocated N=10	6	4
Fewer kits allocated N=10	3	7
Not included in analysis N=2	1	1

Note: two children's trusts were included in the qualitative survey grouping but not the quantitative analysis grouping.

The effect of more asymptomatic testing resources on key performance measures in the trusts in the qualitative analysis

Figure 33. Staff absence rates by qualitative survey group



Note: the grey vertical line indicates when national policy on asymptomatic testing changed (31 August 2022).

Those trusts providing more resources for asymptomatic testing had lower staff absences for every month in the analysis period, with absence rates being most similar in July 2022 when there was large increase in COVID-19 infections (Figure 33). There was generally a larger difference in staff absence rates before the asymptomatic testing policy change, with there being very little difference between the 2 groups after the policy change. The median percentage of beds occupied due to positive COVID-19 tests delaying discharge to a care home was zero for both groups, assuming all reports of zero delayed discharges were accurate.

Table 14. Average effect of more asymptomatic testing resources on NHS Trust performance measures for the trusts in the qualitative analysis

	Staff absence rates (%)	Beds occupied due to positive COVID-19 tests delaying care home discharges (%)
Average difference for all time periods	-0.06 (-0.28, 0.41)	0.00 (-0.47, 0.48)
Dec 2021	-0.04 (-0.38, 0.30)	0.01 (-0.91, 0.94)
Jan 2022	0.20 (-0.28, 0.68)	-0.03 (-0.49, 0.43)
Feb 2022	0.04 (-0.27, 0.36)	-0.04 (-0.33, 0.26)
Mar 2022	-0.19 (-0.50, 0.12)	-0.04 (-0.36, 0.28)
Apr 2022	0.08 (-0.28, 0.43)	-0.01 (-0.23, 0.21)
May 2022	-0.13 (-0.44, 0.18)	0.02 (-0.18, 0.23)
Jun 2022	-0.07 (-0.30, 0.16)	-0.02 (-0.26, 0.30)
Jul 2022	0.09 (-0.18, 0.36)	-0.01 (-0.19, 0.21)
Aug 2022	0.01 (-0.20, 0.21)	0.03 (-0.26, 0.33)
Sep 2022	0.02 (-0.24, 0.28)	0.02 (-0.26, 0.30)
Oct 2022	0.00 (-0.47, 0.47)	-0.02 (-0.33, 0.30)
Nov 2022	0.07 (-0.33, 0.46)	0.01 (-0.19, 0.21)
Dec 2022	-0.22 (-0.82, 0.38)	0.02 (-0.70, 0.75)
Jan 2023	-0.05 (-0.41, 0.30)	0.02 (-0.18, 0.22)
Feb 2023	0.21 (-0.18, 0.61)	-0.01 (-0.92, 0.91)
Mar 2023	0.38 (-0.12, 0.88)	-0.02 (-0.93, 0.89)

The estimated difference between trusts with more resources and their counterfactuals (that is the same trusts if they had been classified as lower resource trusts) is listed in Table 14 and displayed in Figure 34 and Figure 36 for staff absences and delayed discharges due to COVID-19, assuming all zero reports are true, respectively. The actual rates of staff absence and beds occupied due to delayed discharges of the high resource trusts and the estimated rates of their counterfactuals in Figure 35 and Figure 37 respectively. For both outcomes, there is no difference between the trusts with more resources and their counterfactuals at any time point, in contrast to the analysis including all 122 non-specialist acute trusts (Table 9). Although there is some difference in the rates of beds occupied between high resource trusts and their counterfactuals as seen in Figure 37, this difference is very small and so not easily seen on a larger scale, such as in Figure 36. This analysis could not be completed if assuming all zero reported delayed discharges are missing data due to sparse data.

Figure 34. Effect of more asymptomatic testing resources per staff member on staff absence rates for trusts in the qualitative analysis

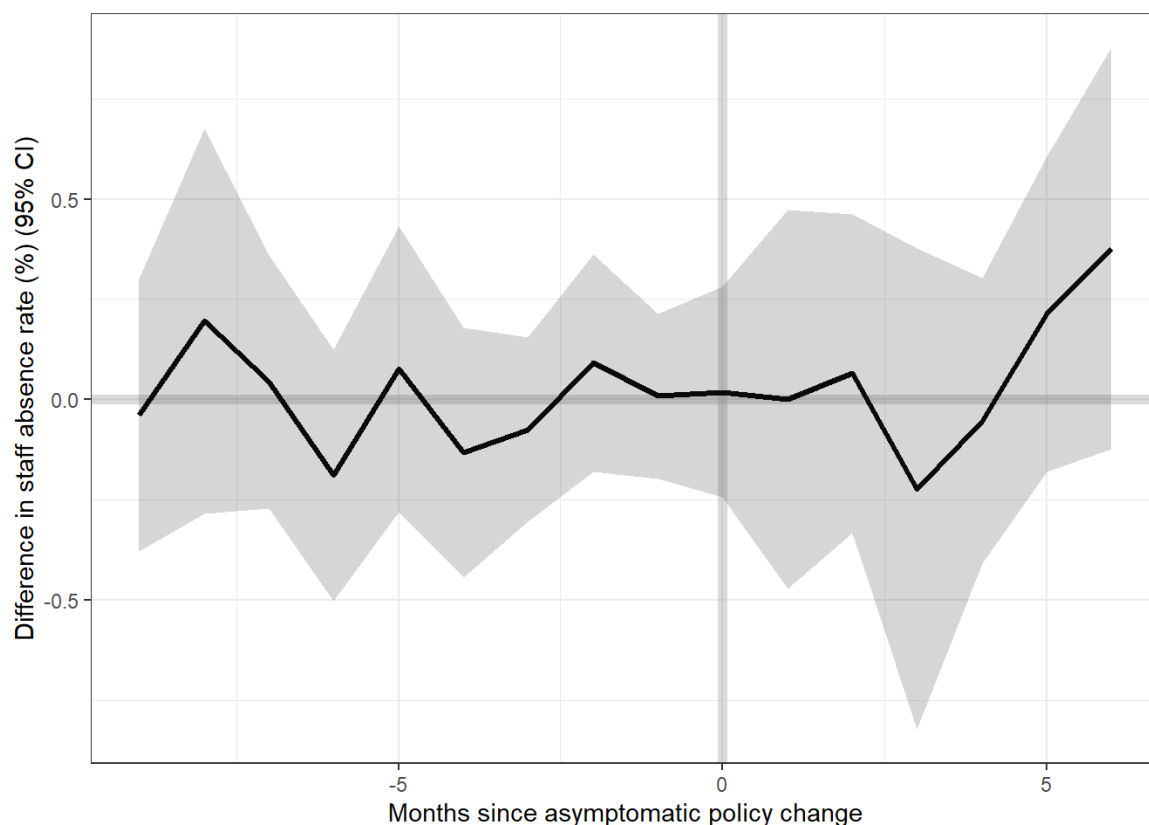


Figure 35. Actual and predicted staff absence rates for trusts who have more asymptomatic testing resources and their counterfactuals for trusts in the qualitative analysis

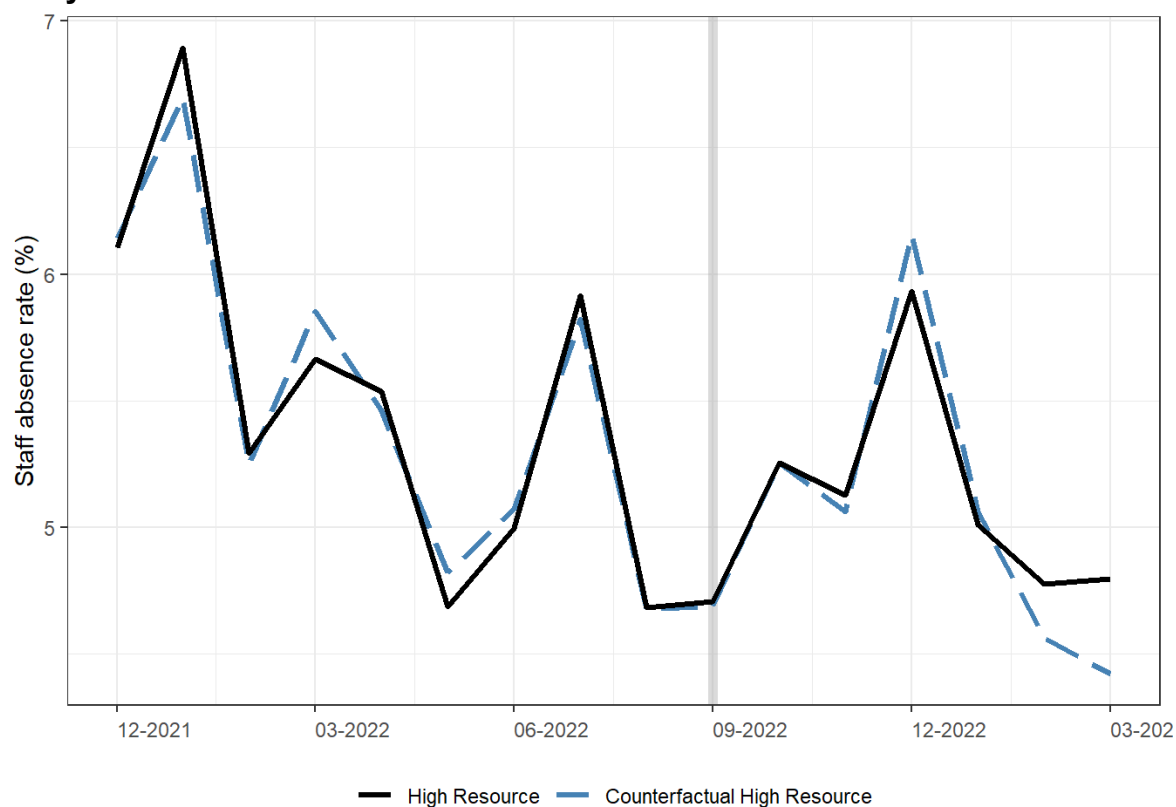


Figure 36. Effect of more asymptomatic testing resources allocation per staff member on beds occupied due to positive COVID-19 tests delaying care home discharges for trusts in the qualitative analysis

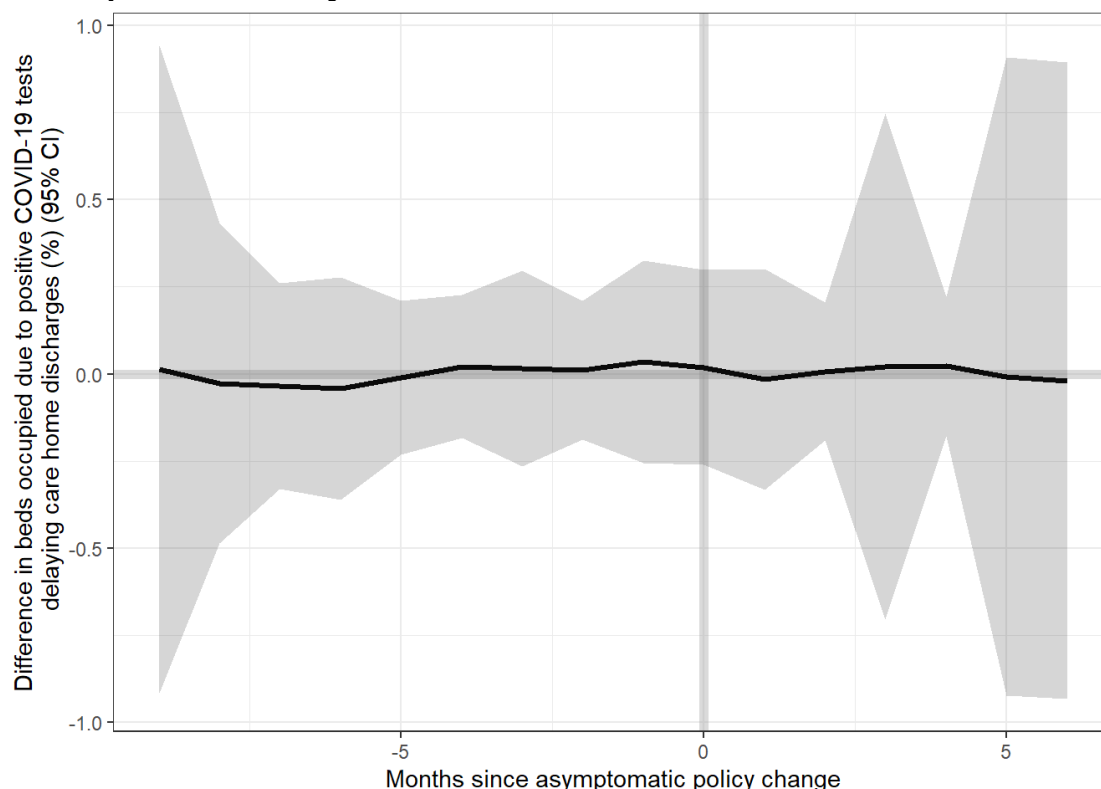
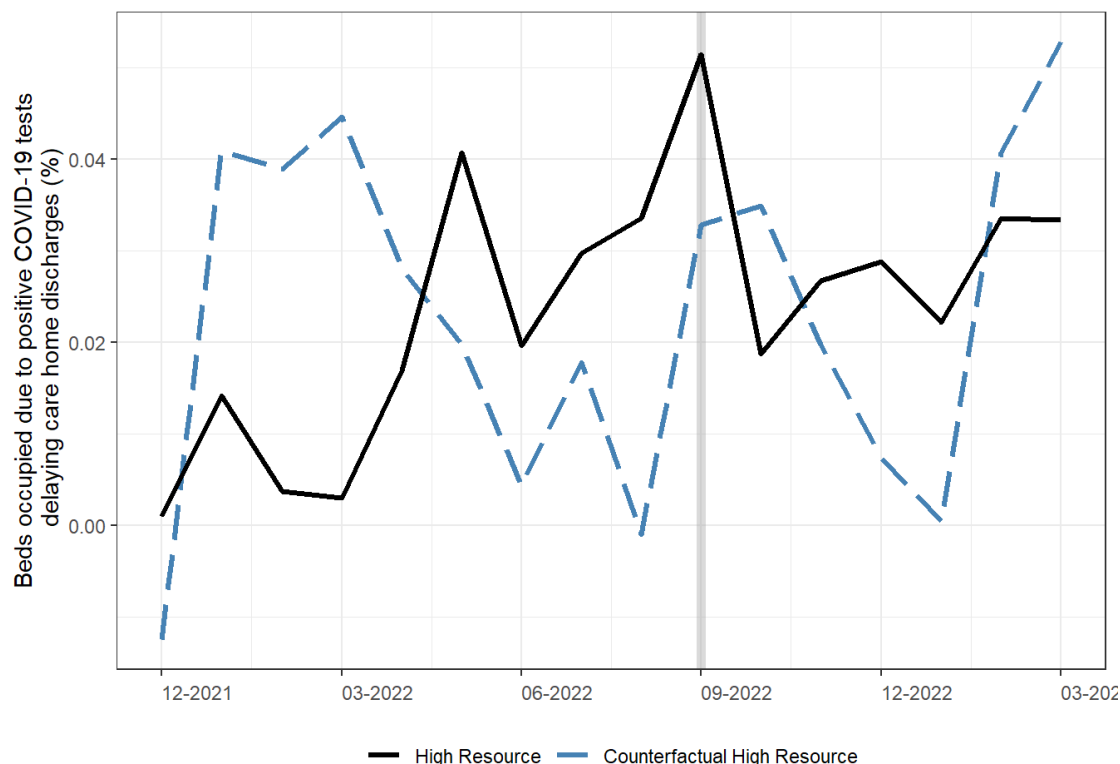


Figure 37. Actual and predicted beds occupied due to positive COVID-19 tests delaying care home discharges for trusts who have more asymptomatic testing resources and their counterfactuals for trusts in the qualitative analysis



Identifying predictors of survey score

An analysis was run using data from the 22 trusts which had completed the survey, in order to investigate whether variables about trusts could be used to indicate whether a trust was more likely to fit within a high resource group or low resource group based on survey scores.

There was evidence to suggest that trusts located in areas with higher proportions of minority ethnic residents had higher survey scores (14.86 per 1% increase (95% CI 2.24, 27.49), $p=0.02$) and a trend that small trusts had lower scores than large trusts (-4.83 (95% CI -9.72 , 0.06), $p=0.053$) (Table 15), where a higher survey score indicated higher resources provided to encourage asymptomatic COVID-19 testing. Kit allocation per FTE staff member was not identified as a predictor of survey score and therefore both models where kit allocation was a possible factor or not were the same.

Table 15. Predictors of survey score

	Change in survey score (95% CI): unadjusted models	Change in survey score (95% CI): adjusted model
Local residents from a minority ethnicity (per 1% increase)	16.15 (1.61, 30.69) $p=0.03$	14.86 (2.24, 27.49) $p=0.02$
Trust type (reference: large trusts)		
Small trusts	-5.29 (-11.23 , 0.65) $p=0.08$	-4.83 (-9.72 , 0.06) $p=0.053$
Medium trusts	-0.75 (-7.26 , 5.76) $p=0.81$	-1.73 (-7.13 , 3.68) $p=0.51$
Teaching trusts	-2.13 (-7.17 , 2.92) $p=0.38$	-2.55 (-6.61 , 1.50) $p=0.20$

Discussion

Summary of main results of the study

This study aimed to determine the impact of asymptomatic COVID-19 in NHS acute trusts throughout the year 2022 and the challenges faced in implementing policy. Specifically, the study planned to utilise the time-specific changes in COVID-19 asymptomatic testing guidance to investigate the impact of routine asymptomatic testing of healthcare workers, with a focus on effectiveness in containing transmission of infection, cost-benefit and reduction of the impact of COVID-19. This was to be investigated in the context of multiple local interpretations of the prevailing policy for patient testing. We also wanted to understand the facilitators and barriers to implementing different testing regimes that trusts encountered.

The performance data component of the study (Part A) aimed to determine the association between unbiased, readily available, key metrics of the trusts and their enacted asymptomatic testing policy using categories derived from 2 sources: trust LFD kit allocation as a proxy for uptake of asymptomatic testing (Part A) and local intelligence gathered in the survey and through interviews (Part B). 22 trusts participated in Part B, while the quantitative analysis included all acute non-specialist NHS trusts in England (N=122).

The qualitative data gained from surveys and interviews in Part B elicited variation in testing practice, offering some insights into local perception and implementation of testing policies. It was found, however, that LFD kit allocation used in Part A was not a good surrogate measure for the implementation of asymptomatic testing. Additionally, analyses of data around COVID-19-related delayed discharges were limited by a strong suspicion of an incomplete data return, and analyses of staff absences and patient mortality were limited by the data not specifying whether these were related to COVID-19.

For this approach to have been effective, there needed to have been a substantial difference in measured outcome data linked to changes in practice or differences in trust-related variables. However, the impact of this variation, when combined with imperfect measures of testing uptake and clinical and operational outcomes, was not observable as a measurable effect. In our study, we were not able to pinpoint reliable indicators of effective implementation of asymptomatic testing.

Survey and interview results

Most trusts adhered to both national and international guidelines on asymptomatic testing with variations depending on local circumstances and resource availability. Some trusts demonstrated significant ingenuity in adapting to these limitations by implementing mobile testing or repurposing existing space. Trusts had the discretion to allocate their funding as they saw fit; those that invested in additional staff and dedicated testing resources seemed to be

better equipped to adapt to changes effectively, while others repurposed existing staff to meet their needs.

Trusts reported significant challenges due to the physical limitations of their infrastructure, such as a lack of isolation facilities and appropriate air changes in rooms, which posed ongoing difficulties for infection control. Resource availability and external support were critical for trust operations, and the shortage of resources such as personal protective equipment underscored the need for rapid and substantial resource allocation to ensure the safety of both staff and patients.

Consistency of practice was impacted by difficulties in communication; trusts used a multi-channel approach to improve communications with their own staff. Trusts that reported having regular and well-structured COVID-19-related training sessions or programmes in place also reported fewer implementation challenges and higher testing accuracy. Many trusts collaborated, sharing good practice and learning from each other's experiences. Collaboration was identified as a key strategy to address communication challenges and align practices across trusts, particularly when the rapid pace of changing information made it challenging for trusts to keep all staff updated and compliant with the latest protocols.

According to the interviewed representatives of the trusts, staff generally accepted asymptomatic testing as beneficial. However, at staff level, trusts mostly believed that there was resistance to the implementation of guidance, scepticism about the effectiveness of testing, logistical challenges, and concerns about additional workload. Trusts that said they had fostered open communication, supported their staff's social and cultural identity, and provided mental health support also reported higher levels of cooperation and engagement in testing practices though these findings should be interpreted with caution as they were based on self-reported assessments rather than objective measures.

It was reported in interviews that mental health and wellbeing of staff was materially impacted by the demands of asymptomatic testing and the broader pandemic response. To address these challenges, psychological support for staff was deemed necessary. Creating a supportive environment where staff could express their views on asymptomatic testing without judgment was believed to be essential for managing resistance to asymptomatic testing and fostering a collaborative atmosphere.

To support the quantitative analysis of performance data, the survey results were used to divide the trusts into different groups in terms of their approach to asymptomatic testing. Both a theory-driven manual scoring approach and data-driven k-means partitioning produced the same 2 clusters from 19 trusts, which provided confidence that there was a meaningful difference between the groups. After adding late data from 3 additional trusts using manual scoring, the following groups were produced: Group 1 (N=12), who did less to encourage compliance, and Group 2 (N=10), who did more to encourage compliance.

Retrospective quantitative survey results

In the retrospective quantitative analysis, 122 acute trusts were categorised into those with a high and those with a low LFD allocation based on the number of LFDs ordered and the number of test results reported. Two categories of LFD allocation were chosen to align with the qualitative analysis and to provide broad groups that are likely to be generalisable for future pandemics, although analyses showed that 3 or 4-group classifications were possible and were better fits. The 4-group classification was the best fit out of those tested, but with only 4.9% of trusts in one of those categories, it is possible the model was over-fitting and therefore may not be informative for future recommendations. However, these 3 and 4-group classifications do indicate that there were more than 2 types of trust response to asymptomatic testing that were not explored.

The relationship between LFD kit allocation and staff absence was mixed. Initially in the months after September 2022 when national policy changed, there was some evidence that higher kit allocation was associated with lower staff absence rates. However, after several months there seemed to be a shift to higher staff absence rates. In addition, there was a trend towards higher mortality rates in trusts with higher kit allocations in 2023, which was the same time period of higher staff absences, however the evidence linking higher mortality rates with higher kit allocation was weak. There was no difference in mortality rates between trusts that had a higher allocation of kits per staff member and those trusts if they had a lower allocation following the change in asymptomatic testing policy.

There was no evidence that higher kit allocation was associated with delayed discharges due to COVID-19. However, data reporting of delayed discharges was potentially poor with 89 out of 119 trusts not having any reported delayed discharges in the time period following the change in local testing policy.

Failure to detect a difference in study outcomes between trusts with high and low kit allocations may be due to there being a much smaller difference in allocations across the trusts after the policy change compared to before the policy change. Although interviews did identify variations in trust that allowed for distinct categories, the categories derived using LFD kit allocations may not have been as distinct.

There was no evidence of an association between the key outcomes of staff absences and delayed discharges due to COVID-19, although higher regional COVID-19 positivity rates were associated with more delayed discharges. Although there may have been an association between COVID-19 related staff absences and delayed discharges, the reasons for staff absences were not collected and so any potential effect may have been minimised by other, unrelated staff absences.

Comparing the categorisations from the qualitative work and the quantitative work, kit allocations were not a reliable indicator of local testing in practice. However, there was no

evidence of a difference in staff absences or delayed discharges between the trusts when categorised based on resources allocated to asymptomatic testing as determined during the qualitative work. As only 22 trusts were included in this categorisation, this may be due to a lack of power, but the numerical differences were also small for most months.

A quantitative data analysis was performed on 122 acute non-specialist trusts to investigate whether hospital trusts can be classified according to their similarity, characterising sources of variation between trusts that could be considered confounding factors, such as patient outcomes, trust demographic characteristics, and local-level demographic characteristics. The optimal number of subtypes determined by the longitudinal k-means cluster analysis was 3. The time-varying characteristics followed similar patterns for each subtype cluster over the analysis period, with the exception of the percentage of paediatric and elderly patients.

The study also planned to explore whether operational performance of NHS trusts could be simplified into one variable based on multidimensional measures of trust performance. However, for the outcomes of COVID-19 mortality, overall mortality and bed occupancy rates, the first step models creating latent variables of each outcome would not converge, so this analysis could not proceed to the second stage of creating the overall latent variable.

Relevance to previous studies

Previous research has suggested that weekly asymptomatic testing could reduce staff absences by 0.4 to 0.8%,⁸ however the largest decrease in staff absence seen in the analysis of all trusts was 0.1% and 0.2% in the trusts recruited to the qualitative study, and for both groups there was an increase in staff absences in February and March 2023. One possible reason for this discrepancy is that even in the trusts that had lower kit allocations or provided fewer resources, staff were still testing, and some asymptomatic infections were still being detected.

Regular asymptomatic testing has been shown to reduce nosocomial infections among staff, who showed higher rates of infection than can be explained by community infection rates.²¹ This may reduce infections from staff to patients although this was not ascertained. Initially, it was hypothesised that lower staff absences would lead to fewer delayed discharges due to COVID-19 as there would be fewer infections passed from staff to patients, but no such association was detected. This is most likely to be due to the poor recording of delayed discharges. However, one study did report that infected patients were the main source of transmission to other patients (¹⁷) and there would potentially be other sources of infections that were not accounted for, such as from patients' visitors.

Strengths and limitations

The qualitative elements of this study offered valuable insights into how NHS trusts perceived and implemented testing policies, allowing for an in-depth exploration of experiences that quantitative data alone could not fully capture. Semi-structured interviews provided trust-level

perspectives, shedding light on the challenges, adaptations, and decision-making processes within individual organisations. The flexibility of open-ended discussions also enabled participants to share unexpected insights, revealing factors that may not have been considered in structured surveys or numerical analyses.

However, the qualitative aspect of the study also presented certain limitations. With only 22 trusts participating in the surveys, it is recognised that the findings may not be fully representative of all NHS trusts. Additionally, as the data relied on self-reported experiences, responses reflected participants' perceptions, which may not always align with objective measures. The lack of direct outcome measurement meant that the study could not quantify infection rates or establish causal links between policy changes and their impact. Furthermore, there is a possibility of selection bias, as trusts that chose to engage in the study may have had stronger views or more structured testing programs, potentially influencing the overall findings.

A strength of the quantitative analysis of performance data is that it included all acute NHS England trusts with very little missing data other than for the delayed discharges due to COVID-19. The results are therefore considered applicable for all NHS trusts in England and is likely to reflect NHS trusts in other parts of the UK.

There were several weaknesses of the quantitative analysis. Kit allocation was used as a surrogate for implementation of local trust testing policy as it was not possible to determine this for every trust through questionnaires or surveys. However, it was not found to be a good surrogate. One possible reason for this is that it was difficult to link individual LFD data to a trust and in some instances the data may not have been linked appropriately. Another reason could be that test kits ordered by trusts were used for a combination of patient and staff testing, with the balance unknown, and staff were increasingly expected to order their own test kits for home delivery, despite the impression gained from interviews being that it was common practice across trusts for staff to take test kits home for personal use.

Additionally, as described in the 'Summary of study design' section, the planned analyses for the quantitative study were adapted following receipt of the data, primarily due to the availability of data and the potential for more specific analyses based on that data. This introduces a potential risk of bias. However, the retrospective analysis objectives were only revised once the availability and integrity of the data were established, and they were shaped by pre-defined objectives aligned with the data constraints.

The data for COVID-19 related delayed discharges was unreliable, however it is unlikely that other measures available for analysis would have been any more robust. This measure was chosen as testing prior to discharge to a care home was mandatory and not dependent on local trust testing policy, so data was unlikely to be biased. Additionally, unlike, for example, delayed discharges for any reason, it could be directly attributable to COVID-19. While collecting data on delayed discharges may have been designed to be useful in informing NHSE of key areas of concern, it was not suitable for evaluation and knowledge generation without monitoring of data completion. Unfortunately, we found that it was not possible to distinguish trusts reporting zero

delayed discharges from those who failed to report anything at all; if this could have been determined, relevant statistical analyses could have been used to handle the missing data.

Analysis of the association between staff absences and delayed discharges was limited by the poor data and did not take into account a potential time delay in the effect of absences. A more complex statistical analysis would be needed to address this, but this was not practical given the data.

Conclusions

This study has demonstrated that it has been hard to find clear indicators of effective implementation of asymptomatic testing of healthcare staff in acute NHS trusts in England in 2022 to 2023 that resulted in an observable impact on clinical or organisational outcomes.

Our methodology did not address whether testing per se had an impact, but the effect of variability in implementation. There is evidence of an impact from variability in implementation from the qualitative element of the study, in particular. The trade-off between effort invested in implementation and its beneficial impact is key, and the quantitative analysis was unable to detect an impact within the timeframe of the study. It is not possible, however, to rule out longer term benefits of investing greater effort in implementation, or softer benefits not reflected in the measures we selected for the study.

We aimed to determine which indicators might be useful to enable decision-making about starting or stopping, or scaling up or scaling down, testing to inform policy in a future pandemic. It is anticipated that in a future pandemic, there would need to be testing of staff within healthcare settings, but that technology – both of the tests and the data capture – will have developed, and that this will play a key part in the armoury of the response. While the activity and performance data collected routinely by the NHS trusts during the COVID-19 pandemic may have been fit for operational purposes at that time, understandably it did not meet the needs of answering our research questions. Given the difficulty encountered in this study, it will be important to bear in mind what data will be collected and monitored in real time in a future pandemic, and how the response can be appropriately tempered.

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Appendix A. Explanation of changes to study design

Study design changes per the Statistical Analysis Plan (SAP)

Changes made to versions of the SAP are shown in Table 16.

Table 16. Changes to study design per SAP Version 2.0

SAP version	Date	Description of change
Changes made prior to final analysis, but after receipt of datasets		
V1.1	2 July 2024	- Specialist trusts excluded from dataset due to substantial differences in data availability in these trusts - Changes to handling of delays to discharge analysis due to constrained reporting timeframe in extant datasets - Clarification of roles of study team members
Changes made during final analysis in response to limitations of datasets once acquired		
V1.2	5 August 2024	- Specialist (children's trusts) excluded from analyses, but moved to sensitivity analyses - Additional sensitivity analysis added to consider one trust which merged with another trust during the time period of interest - Revised definition of delayed discharge outcome to reflect actual time period this outcome was collected during the pandemic period - EQ-5D-5L removed as an outcome due to inconsistent collection in the HES dataset - Measured confounders revised to reflect the datasets provided - Additional objective (5) added to link the part A (quantitative) and part B (qualitative) trust classification analyses together
V2.0	3 October 2024	- Primary outcome was changed from 'all cause delayed discharge' to 'delayed discharge to a care home due to a positive COVID-19 test' as this outcome is more relevant to the study hypothesis and this data had become available.

Updated objectives and outcome measures

The updated objectives and outcome measures per version 2.0 of the SAP are given in Table 17. This report is based on the updated objectives and outcome measures in the SAP.

Table 17. Updated objectives and outcome measures

No.	Objective	Objective outcomes
1.	Using latent class analysis, construct a variable that is indicative of implemented asymptomatic testing policy, allowing trusts to be classified into either ‘actively asymptomatic testing’ or ‘not asymptomatic testing’. Then, describe variation in asymptomatic COVID-19 testing policy used by NHS acute hospital trusts with respect to: i) policy mandated nationally and ii) policy enacted locally, with emphasis on the following fixed, meaningful time points: - December 2021 - April 2022 - September 2022 - March 2023	- Current mandated COVID-19 testing policy - Currently enacted COVID-19 asymptomatic testing policy
2.	Consider whether hospital trusts can be classified according to their similarity, characterising sources of variation between trusts that could be considered confounding factors	- Patient outcomes - Trust demographic characteristics - Local-level demographic characteristics
3.	Quantify ‘operational performance’ of NHS trusts throughout the pandemic period (December 2021 to March 2023). Consider whether multidimensional measures of trust performance can be reduced to a latent indicator of general trust performance	- Patient outcomes - Trust operational efficiency outcomes - Trust operational capacity outcomes

No.	Objective	Objective outcomes
4.	Determine the association between 'operational performance' of the trusts against enacted asymptomatic testing policy, after accounting for other important sources of between-site variation. Primary outcomes of interest include: – Staff absence rate – Delayed discharge rate – Mortality rate Secondary outcomes of interest include: - 'Operational performance' as defined in objective 3.	- Patient outcomes - Trust operational efficiency outcomes - Trust operational capacity outcomes
5.	Compare the 'actively asymptomatic testing'/'not asymptomatic testing' trust classifications derived from retrospective and prospective analyses to ensure assumptions about definitions in retrospective data are reasonable.	- 'Actively asymptomatic testing'/'not asymptomatic testing' trust classifications from objective 2. - 'Actively asymptomatic testing'/'not asymptomatic testing' trust classifications from part B.

Updated outcome variables

Variables linked to the updated objectives and outcome measured are listed below. Measured confounders are presented in the SAP.

Testing policy variables:

- current national level health-related policy status (reported monthly from Oxford Blavatnik School of Government COVID-19 Policy Response Tracker), ordinal outcome coded 1-4 – this outcome was chosen to infer the mandated COVID-19 asymptomatic testing strategy
- number of COVID-19 LFDs ordered by staff and elective care (taken from UKHSA LFD Dispatches dataset)
- number of COVID-19 LFDs ordered by NHS trusts (taken from UKHSA LFD Dispatches dataset)
- number of COVID-19 LFD tests reported to NHS trusts (taken from UKHSA LFD Dispatches dataset)
- number of COVID-19 LFD tests performed by NHS trusts at point-of-care (taken from UKHSA LFD Dispatches dataset)

The LFD dispatches outcomes were assumed to imply the actual COVID-19 asymptomatic testing strategy enacted at each trust (under the assumption that greater frequency of test kits ordered, relative to trust size, implies more 'aggressive' asymptomatic testing frequency).

Trust performance outcomes:

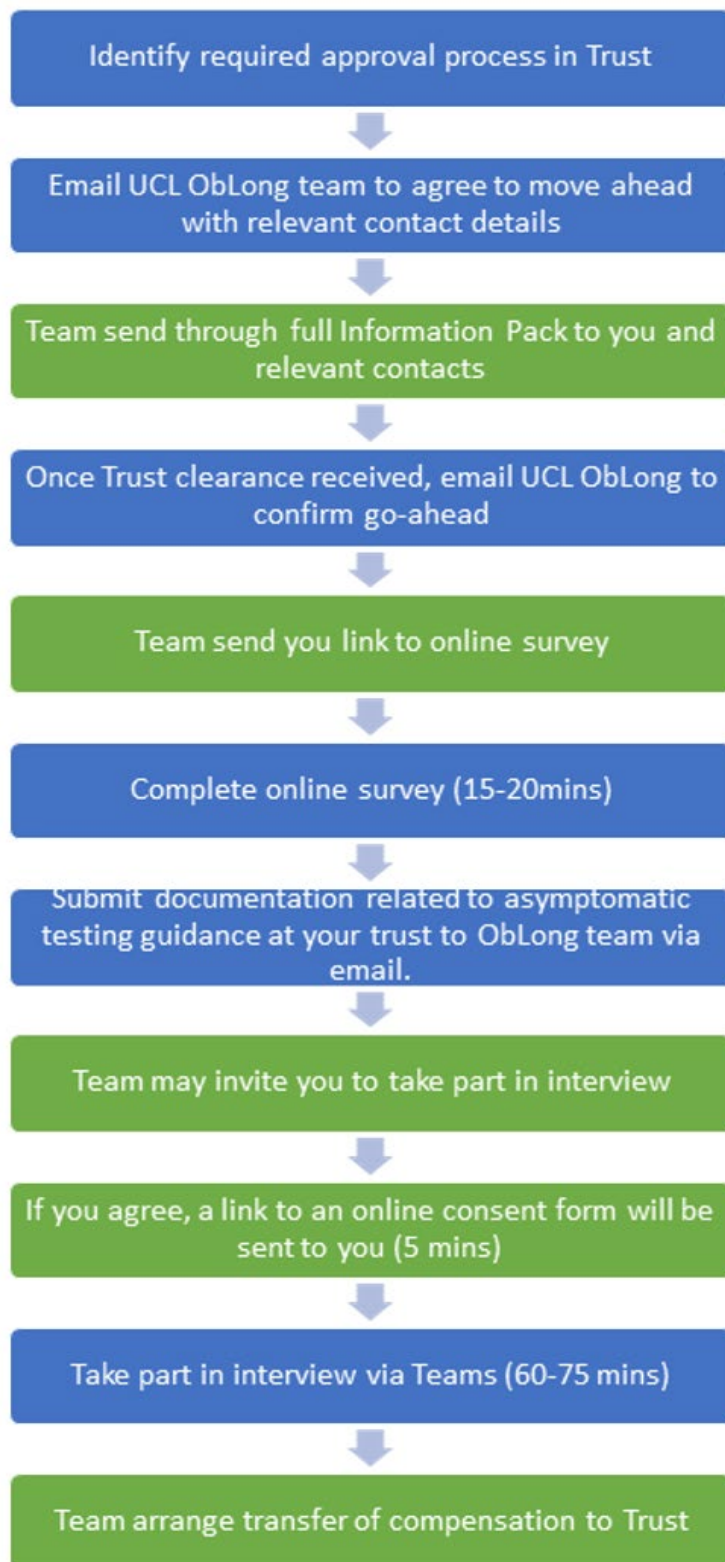
- staff absence rate (long and short term)
- bed occupancy rate
- ITU admission rate
- number of delayed discharges – all causes (April 2022 to March 2023 only)
- delayed discharges to a care home due to a positive COVID-19 test
- number of discharges to care homes

Patient-related outcomes:

- mean patient length of stay (time from admission to discharge, in days), per month
- mortality rate – all causes

Appendix B. ObLong study Part B recruitment process

Figure 38. ObLong study Part B recruitment process



Text version of Figure 38. ObLong study Part B recruitment process

First: Identify required approval process in trust.

Next: Email UCL ObLong team to agree to move ahead with relevant contact details.

Next: Team send through full information pack to you and relevant contacts.

Next: Once trust clearance received, email UCL ObLong to confirm go-ahead.

Next: Team send you link to online survey.

Next: Complete online survey (15 to 20 minutes).

Next: Submit documentation related to asymptomatic testing guidance at your trust to ObLong team via email.

Next: Team may invite you to take part in interview.

Next: If you agree, a link to an online consent form will be sent to you (5 minutes).

Next: Take part in interview via Teams (60 to 75 minutes).

Finally: Team arrange transfer of compensation to trust.

End of text version of Figure 28.

Appendix C. Survey responses categorised as 'Other – please provide details below'

This appendix lists all responses given for 'Other – please provide details' responses, where this option was available.

Responses to 'In January to March 2022 (before the end of the universal asymptomatic testing offer), how did you engage with the workforce to participate in asymptomatic testing?' (Figure 4)

"We advise staff to test themselves and initially they were asked to inform their manager and health at work of positive results."

"Mix of the above. For most areas we asked for staff to test, but the national system was impossible to get data from and not able to link to roles. In outbreaks we would check staff had undertaken LFDs or early 2022 still offered PCR testing to staff. Names were collected as part of an outbreak and samples/results cross checked. For our surgical wards LFD testing was more managed to protect elective patients who were still self-isolating before admission."

"We initially advised staff to test themselves using home lateral flow tests and inform us of positive and negative results (from November 2020 to March 2022) – positive results actively communicated with line manager by phone/email. Negative results reported by various methods but ultimately electronically. Patient facing staff on in-patient wards were particularly encouraged in October/November 2020 to participate. Early decision taken by medical director and supported by rest of the trust to 'encourage testing but not to actively enforce'. Uptake with negative reporting never great and we were led to believe that more testing than was being reported was going on but it was not felt to be in everyone's interests to penalise or pursue staff over this. It felt as though most of the asymptomatic testing will have tailed off by January 2022 with the possible exception of the CEV ward where such testing was actively encouraged by one consultant in particular on this ward."

Responses to 'Between April to August 2022 had there been significant change to your approach to engaging with the workforce to participate in asymptomatic testing? Please select the option that closest matches your approach' (Figure 5)

“Mix of above. For clinical areas, testing to release was introduced, that required more careful monitoring. We did have a mechanism where critical staff where services may fall, there was a risk assessment for some staff that was on a case by case basis with input from Occupational Health and Infection Prevention and Control. For nonclinical areas, there was limited checks from April onwards.”

“The staff result form received feedback it was too long. This was adjusted to make it quicker to use. Messaging remained consistent that it was encouraged to be done. Requirement for asymptomatic testing limited to staff working with vulnerable patients from April 2022 onwards.”

“Pause of asymptomatic testing except in immunocompromised. Day 3, 6 weekly screens stopped. Cessation of weekly screen of dialysis and neonates. Admissions to be permitted to outbreak wards/exposed bays, without need for senior exec approval. COVID positives to be managed on base ward in a cohort bay/side-room, unless requiring respiratory support/treatment or are immunocompromised.”

Responses to 'In 2022, how, if at all, did you remind staff of guidance on asymptomatic testing? Please select all that apply' (Figure 6)

- webinars were held, IPC ICS study days, strategic command meetings, site meetings, divisional meetings
- start of the week
- safety huddle messaging, discussed at silver control meetings
- encourage staff via team meetings etc
- COVID silver or gold meetings, heads of department meetings, bed meetings
- circulation of updated SOPs

Responses to 'What is your perception of workforce practice in relation to local guidance in 2022? Please select the option that closest matches the experience of your trust' (Figure 7)

“I cannot say with any honesty we knew the level of staff testing away from outbreaks and elective surgical wards. The national system for putting results of LFDs was pretty awful, and impossible to get any meaningful data from. We always suspected that most staff who tested did not record results. Also, staff were fully responsible to ordering, and so unclear who was ordering, and how much.”

“In early 2022 we were reaching exhaustion with efforts to improve compliance and a sense of improved outcomes had started to question its necessity. While asymptomatic testing was national guidance, we would have preferred better compliance but had reached acceptance that this was not going to be possible in our organisation. By the time asymptomatic testing for staff was withdrawn only about 2% of staff were submitting results each week.”

“By this point in pandemic – general feeling was that regular asymptomatic testing of staff using lateral flow devices was impractical and staff tolerance and compliance was waning. We had experienced multiple outbreaks and challenging waves of Covid where asymptomatic testing of staff had seemed to have little preventative effect. Looking back through emails the feeling I get is that other topics were given greater attention (that is vaccination, dealing with system wide pressures created and exacerbated by Covid, staff wellbeing etc etc). Furthermore, as restrictions on visiting were quite rightly relaxed – staff testing became more illogical as the virus could easily get into the hospital/ward by various other means.”

“It is unlikely that staff were testing and reporting at a high level, though we had assurance that staff working with vulnerable patients were testing more than reporting. Encouragement to test was required in some outbreak settings. Otherwise, we were happy with the level of testing.”

Responses to 'In 2022, how did you monitor and evaluate asymptomatic workforce testing practice at your Trust, if at all? Please select all options that apply' (Figure 8)

“Staff asymptomatic testing was primarily monitored and evaluated through SAG and led and reported on by the H@W team.”

“As before, we monitored staff testing in outbreaks and elective surgical wards but did not do any other areas. To note, as an organisation we employ 18,000 staff, with a mix of permanent, students, bank/locum and honorary contract.”

“I'm not aware that we did formally monitor but if surveillance identified increases in cases in a specific area, would review staff testing processes.”

Responses to 'In 2022, how was asymptomatic testing for patients enforced and monitored at the trust? Please select all options that apply' (Figure 9)

“Business Intelligence (BI) team.”

“Elective admissions were screened at pre-op prior to surgery.”

“Testing of patients did change through 2022 considerably. At the end of 2021 we undertook audits and also had external audit (and recommendations) to the processes. Start of 2022 we were still testing day 0, 3, 5 and weekly. This changed through the year to admission testing only to eventually only testing if symptomatic. Exception was high risk areas which continued testing (haematology, oncology and rena).”

“Pre August 2022 – drive through facility for elective admissions. Checked prior to admission by the operational team that this was undertaken. Results received from other trusts/pillar 1 facilities could be accepted (text message/email/letter as proof). The patient results system has dedicated icon on it that transferred to the ward view boards for rounding.”

“Test results linked to electronic whiteboard – all staff able to see the results, so could see all inpatient had been tested. However, the admission, days 4, 5 etc could only be assessed through audits.”

"Elective patients required to attend trust asymptomatic patient PCR pre-admission testing 72 hours prior to admission. Emergency/unplanned inpatient admissions required to have rapid PCR results before placement into inpatient beds. All inpatients tested by PCR every two days."

“All emergency admissions generally isolated (our EAU is comprised entirely of 45 side rooms with en suite facilities) until Covid result back. Elective surgical patients encouraged to test before attending but then our two elective surgical wards contain only single room en suite accommodation, so admissions isolated and re-screened on admission (surgical team wanting this due to worry about operating on Covid patients – this practice ended towards

late 2022). Results recorded in Nerve Centre which we had set up to include a Covid status tool. IPC and patient flow teams use this to track cases and ensure they are isolated – ideally promptly and for appropriate timeframe. Ward teams also very good at looking for results and acting accordingly. Downside of isolating prior to results is that at times of pressure and during widespread outbreaks this created a bottle neck in EAU. Clinicians also fed back that patients end up being nursed away from specialty wards resulting in prolonged length of stay and sometimes unintended harm.”

“Patients asked to show us the test result.”

“We had dedicated COVID-19 cohort ward(s) and worked closely with the Patient Flow Team on patient placement. All patients’ electronic records were flagged with COVID-19 results, and these were updated in light of additional test results. This remains in place. We introduced IPC on call to support patient placement.”

“Test results were monitored by IPC in wards with hospital onset cases, and absent/missing results were not identified in this period. Over testing (mainly repeats) was perhaps more of an issue, with cost implications and sometimes leading to confusion which delayed step-down from isolation.”

Responses to 'How long did you continue with asymptomatic testing? Please select the options that are the closest match for your trust' (Figure 12)

“Staff asymptomatic testing already ceased in effect. Universal patient asymptomatic testing ceased in May 2023. We took the decision based on local epidemiology, opinion and bed pressures to continue through the winter months of 2022.”

Appendix D. Survey questions used for manual scoring and scoring method used

The questions listed below are those selected from the Part B survey questions for use in manual scoring. Question 4(A) and 4(E) were counted as 2 separate sub-questions, making a total of 6 questions used for manual scoring.

The full set of Part B survey questions and response options are detailed in Section 10 of the protocol.

Question 2: Local guidance development

A. Did you have local guidance on asymptomatic testing of staff at your trust?

(1 point for 'Yes')

B. Did you have local guidance on asymptomatic testing of patients at your trust?

(1 point for 'Yes')

D. Did you have any other local guidance regarding asymptomatic testing (for example, for visitors or birth partners)?

(1 point for 'Yes')

Question 3: Communicating guidance

A. How was guidance on asymptomatic testing of staff and patients communicated to trust staff in 2022? Please select all that apply. **(1 point for each selected)**

- i. Internal newsletter
- ii. Trust intranet
- iii. Email to all staff
- iv. Posters on wards or staff rooms
- v. Staff meetings
- vi. Other

Question 4: Enforcing guidance for staff asymptomatic testing

A. In January to March 2022 (before the end of the universal asymptomatic testing offer), how did you engage with the workforce to participate in asymptomatic testing? Please select the option from the broad categories below that closest matches your approach. You can give further details in the free text box. If you cannot answer this at trust-wide level because of the differing nature of services provided, please focus your answer on staff working in general medicine and care of the elderly. **(Points were cumulative across options: 0.25 points for option 1, 0.5 points for option 2, 1 point for option 3, points assessed on a case-by-case basis for option 4)**

- i. We initially advised staff to test themselves but did not ask to be informed/only asked to be informed of positive results.
- ii. We followed up regularly to remind staff to follow guidance to test themselves (and report if required).
- iii. We required staff to test themselves and for all results to be reported to the trust (for example staff who did not participate knew they could face a disciplinary process).
- iv. Other (please provide details below).

E. In 2022, how, if at all, did you remind staff of guidance on asymptomatic testing? Please select all that apply. **(1 point for each selected, excluding option 1 and on case-by-case basis for option 9)**

- i. No reminders sent
- ii. Internal newsletter
- iii. Trust intranet
- iv. Email to all staff
- v. Posters on wards/staff rooms
- vi. Line-manager follow up
- vii. Staff meetings
- viii. Staff engagement
- ix. Other (please provide details below)

Question 5: Acceptability of asymptomatic staff testing

C. In 2022, how did you monitor and evaluate asymptomatic workforce testing practice at your Trust, if at all? Please select all options that apply. **(Points were cumulative across options: 0 points for option 1, 0.25 points for option 2, 0.25 points for option 3, 1 point for option 4 and 1 point (on a case-by-case basis) for option 5)**

- i. We did not undertake any monitoring or evaluation of practice.
- ii. We collected test results provided by staff in a database.
- iii. We ran engagement sessions to understand drivers and barriers to testing.
- iv. We conducted audits or other evaluation.
- v. Other (please provide details below).

Question 6: Enforcing guidance for patient asymptomatic testing

A. In 2022, how was asymptomatic testing for patients enforced and monitored at the Trust? Please select all options that apply. **(Points were cumulative across options: 0.25 points for option 1, 0.5 points for option 2, 0.5 points for option 3, 0.25 points for option 4, 0.5 points for option 5, 0.25 points for option 6, 0.5 points for option 7 and 0.5 points for option 8)**

- i. Elective patients encouraged to register test results with gov.uk prior to attending

- admission approved without test results.
- ii. Elective patients required to register test results with gov.uk prior to attending; admission only approved with test results.
- iii. Emergency/unplanned inpatients tested on admission (or as soon as practical).
- iv. Patient results recorded in medical notes.
- v. Patient results recorded in dedicated data management system.
- vi. Infection control team responsible for monitoring across hospital.
- vii. Ward-based responsible officer(s) for monitoring.
- viii. Other (Please provide details).

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