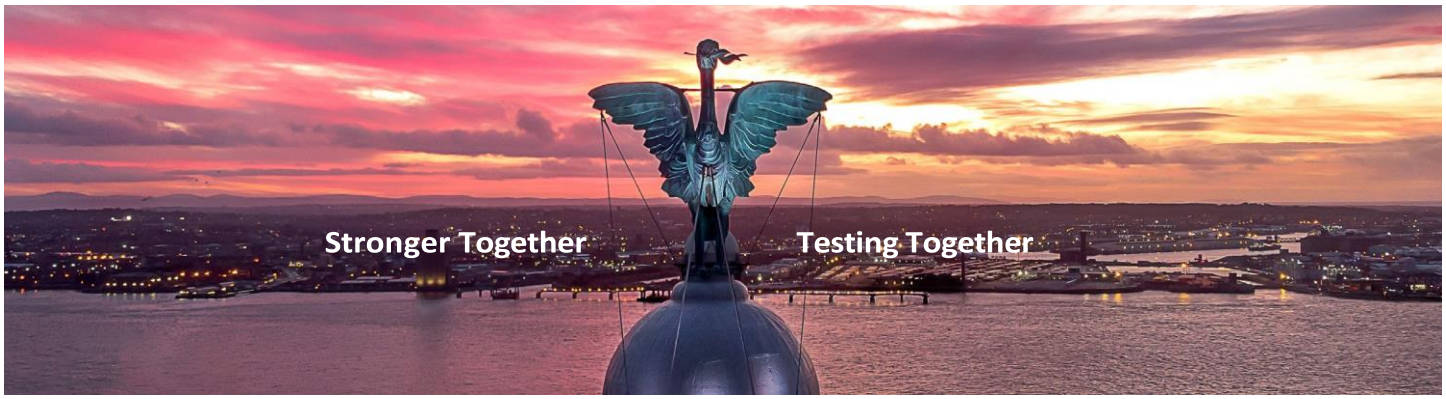



# Liverpool Covid-19 Community Testing Pilot

Interim Evaluation Report | 23 December 2020



## This Report

This is an interim report from an evaluation led by the University of Liverpool into the Liverpool pilot of community open-access testing for the Covid-19 virus SARS-CoV-2 among those without symptoms. The evaluation was invited by the joint local and national command of the pilot and sponsored by the Department of Health and Social Care (DHSC).

This report presents early findings to help policymakers with similar approaches to Covid-19 testing. A more detailed report will follow in early in 2021. Inputs to the report have been combined from the pilot delivery partners and the evaluation group:

Pilot delivery partners: Liverpool City Council; NHS Test and Trace (DHSC); Army (8 Engineer Brigade); NHS Liverpool Clinical Commissioning Group; Merseycare NHS Trust; Cheshire & Merseyside Health & Care Partnership; Merseyside Local Resilience Forum; Liverpool Charity and Voluntary Services (LCVS).

Evaluation partners: The University of Liverpool; Public Health England; Joint Biosecurity Centre; Office for National Statistics (ONS); NHS Test and Trace; Scientific Advisory Group for Emergencies (SAGE) and its contributing universities.

# Contents

# Executive Summary

The City of Liverpool and national agencies partnered to pilot community open-access SARS-CoV-2 testing for people without symptoms of Covid-19, living or working in the city. This was part of Liverpool's Covid-19 resilience and recovery efforts, with an emphasis on reopening of activities key to social fabric and the economy, while controlling transmission of the virus. An evaluation, led by the University of Liverpool provides these interim findings:

Testing most of a UK city's population for Covid-19 on a 'mass' voluntary basis is not feasible. However, targeted testing has potential as part of an intelligence-led local public health intervention.

The pilot team developed SMART (systematic, meaningful, asymptomatic, repeated testing), an alternative approach to mass testing. The key elements of SMART are test-to-protect (vulnerable individuals and settings), test-to-release (sooner from quarantine), and test-to-enable (safer return to key activities for social fabric and the economy).

During the pilot 25% of 498,000 residents took up lateral flow tests (LFTs) and 36% took up LFT or polymerase chain reaction (PCR) tests, identifying 897 individuals as positive via LFT and 2,902 via PCR.

The Innova SARS-CoV-2 antigen lateral flow device sensitivity was lower than expected (based on the preceding validation studies) at 40% but identified two thirds of cases with higher viral loads (~Ct<25). In addition, the time and scale gained from a low-cost, no-lab test can provide a useful additional Covid-19 control measure with targeted and clearly explained use.

The speed of design and implementation of the pilot was challenging, but drew upon, and further strengthened, the local networks and collaborations delivering Liverpool's Covid-19 responses.

Military involvement was well-received by the public and by local operational teams.

A combined NHS, local authority, and public health intelligence system updated every 30 minutes, underpinned communications and testing operations.

Local knowledge and targeted communications, including tackling misinformation, were essential.

Awareness of the pilot was high and attitudes towards it were generally positive. Collective identity and social responsibility were key motivators of testing uptake.

LFT uptake in the most deprived areas was half that in the least deprived areas – 16.8% vs. 33.4% – and test positivity was double in the most vs. least deprived areas (1.0% vs. 0.5%).

Digital exclusion was a substantial barrier to LFT uptake, more than deprivation alone.

Younger people, particularly males, were harder to reach than older people.

Fear of not having adequate support to isolate was a major barrier to taking up testing.

No firm conclusions can yet be drawn about the effects of a negative test on risk behaviours but there were no alarming indicators in survey results.

Supplementary mailing of home test PCR kits resulted in only 8.3% completion so was quickly aborted.

Half of secondary school pupils took up testing, impacted by negative media from outside Liverpool.

Asymptomatic case and contact identification rose in Liverpool during the pilot period while the corresponding rates in neighbouring Manchester fell.

Currently, there is no clear evidence that the introduction of 'mass' testing in Liverpool impacted on Covid-19 cases or hospital admissions. Yet a third of Liverpool's current detection of infected individuals is via LFT, picking up those without symptoms who would previously have not been tested. Longer term impacts will be reported later.

Large-scale, intelligence-led, targeted, and locally driven community testing for SARS-Cov-2, in concert with other control measures and vaccination, can support Covid-19 resilience and recovery.

# The Pilot

## Background

The Department of Health and Social Care (DHSC) approached Liverpool City leaders on 31 October offering Covid-19 testing for everyone living or working in Liverpool, regardless of whether they had symptoms. The initial offer to test 75% of the asymptomatic population in two weeks with military assistance was renegotiated by the city to a serial testing approach, with value seen in having access to large-scale, flexible testing for coronavirus control and socio-economic recovery. Preparations started on 1 November. Pre-publication information on the testing device (Innova SARS-CoV-2 lateral flow) that had already been purchased nationally was made available. The pilot plan was agreed on 5 November as national lockdown started, and testing commenced on 6 November as a collaboration between NHS Test & Trace, Liverpool City Council, NHS Liverpool Clinical Commissioning Group, the Army (8 Engineer Brigade), Cheshire & Merseyside Health & Care Partnership and Liverpool Charity and Voluntary Services, with evaluation led by The University of Liverpool with NHS Test and Trace, Public Health England (PHE), the Joint Biosecurity Centre (JBC) and Office for National Statistics (ONS).

## Approach

The pilot was originally called MAST (mass, asymptomatic, serial testing). As the pilot developed, partners brought forward plans for a more targeted approach, from 3 December. The name was changed to SMART (systematic, meaningful, asymptomatic, repeated testing) to better reflect the refined model.

SMART has three components:

1) 'test-to-protect' vulnerable people and settings (for example, people living in care homes);
2) 'test-to-release' contacts of confirmed infected people sooner from quarantine than the stipulated period (for example, key workers in quarantine); and
3) 'test-to-enable' careful return to restricted activities to improve public health, social fabric, and the economy (for example, visits to care homes or sports events).

## Goals

Partners set a mission to:

> "To identify the virus, wherever it is in the City, and empower local communities to suppress its transmission while being supported well when they need to isolate or quarantine. At the same time, to identify those who are needlessly self-isolating and empower them to return to usual activities."

The goals were:

1) saved lives and improved health outcomes for the City's residents;
2) saved livelihoods and businesses, protecting the City's economy and social fabric; and
3) sooner and safer reopening of the City as a whole.

## Governance

Partners established a Gold/ Silver/Bronze Command-and- Control system: Gold set the direction and was responsible for the pilot; Silver led the delivery and coordination of the pilot; Bronze provided operational control for the pilot, in collaboration with the Army. Bronze, Silver and Gold teams met daily to review situations, assess risks, make decisions, and deploy operations.

This Command-and-Control has delegated mandates from the Mayor of Liverpool and Liverpool Local Authority Chief Executive Officer, Merseyside Local Resilience Forum (LRF), Merseyside Test & Trace Cell, Cheshire & Merseyside Testing Cell, and Cheshire & Merseyside Health & Care Partnership Combined Intelligence for Population Health Action (CIPHA) Governance Board. The Command-and-Control structure sits within North West region's Incident Coordination Centre (ICC).

Military support maintained a parallel operational governance to the Command-and-Control structure, under a formal MACA (Military Aid to the Civil Authorities) protocol. Military representatives were embedded in the MAST Command-and-Control at all three levels.

A STAC (Science and Technical Advice Cell) was established on 6 November, meeting twice weekly (as part of the Merseyside Local Resilience Forum governance structure) and reporting into the Command-and-Control system. STAC members were drawn from PHE, DHSC, NHS Test and Trace, University of Liverpool, University of Oxford, and Liverpool City Council. All testing operations conformed to NHS Test and Trace Clinical Framework Standard Operating Procedure, and queries about it were directed via STAC.

Figure 1: Command-and-Control Structure


## Multi-agency Working

In March 2020 the Local Resilience Forum system, managed centrally by the Ministry of Housing Communities and Local Government, was operationalised in response to Covid-19. Strategic and Tactical Coordination Groups were stood up, and supporting cells created. These brought together representatives from local organisations responsible for service planning and delivery. Local Authorities, such as Liverpool City Council, also activated their own Covid-19 coordination groups. This is how Liverpool City Council responded quickly to the approach from DHSC outlined above.

Pilot planning was overseen by Liverpool City Council Covid-19 Strategic Coordination Group with DHSC ahead of the Command-and-Control system being activated on 6 November.

The DHSC, as pilot sponsor, provided the initial directive to the military unit (8 Engineer Brigade) to establish 48 new asymptomatic testing sites (ATS) in the City of Liverpool using pre-purchased Innova lateral flow devices. Two military staff were seconded to DHSC to act as liaison. The role of the DHSC during the pilot was to approve the location of test sites, provide financial indemnity for site operators, approve costings, and establish an evaluation steering group.

Approximately 2,000 personnel from 8 Engineer Brigade arrived on Merseyside by 2 November and established an operational headquarters at HMS Eaglet in Liverpool. Liverpool City Council's Assistant Director for Supporting Communities was designated as military liaison officer, leading local negations over ATS and linking the military into the Command-and-Control structure.

Six initial ATS were in Liverpool City Council premises as these could be approved quickly. Military personnel took responsibility for the buildings and set up the testing infrastructure (signage; registration desks; testing booths; queueing systems) on 5 November for start the next day. The selection and confirmation of the second and third phases of further sites for ATS required more complex negotiation with site owners and DHSC. The process was informed by combined intelligence from the CIPHA system and analytic expertise from military, City Council and University partners.

Following a briefing on Thursday 8 November for secondary school headteachers to prepare for testing at schools, an opt-in consent process was agreed. However, one school (not at the briefing) misunderstood their school would begin testing on the following Monday and sent an opt-out letter to parents on the Friday. Although this was recalled and replaced with an opt-in letter on Sunday, it fuelled negative discussion on social media, which damaged uptake of testing at schools.[1] Rates of consent varied considerably by school. An average of 52.6% of pupils at participating secondary schools (31 out of 33) were tested. A total of 32,411 tests (84% pupils; 16% staff) were done at schools.

## Data

Each person tested was asked questions and a record was created for getting result back to them, and for monitoring the programme. Registration involved linking individuals to test kits via a unique identifier (bar coded). For PCR, swabs were sent to laboratories and results returned around 24 hours later. LFTs were processed (see LFT Process) at the testing sites and results sent approximately 30-60 minutes later by text message or email, including the required actions depending on whether the result is positive or negative. The national guidance for positive individuals was the same for LFT and PCR and did not change over the pilot. A supplementary local text message for LFT positives was added on 23 November to overcome logistical challenges with confirmatory PCR described later.

Test results flowed from NHS Test and Trace, via NHS Digital, into the regional combined NHS, local authority care and public health data/intelligence system CIPHA, which was established across Cheshire & Merseyside in May as a Covid-19 response from the NHS Out of Hospital and Hospital Cells with NHSX support. CIPHA aligns with NHS Covid Phase 3 directions on local integrated care data and is designed to support multi-agency working in the Cheshire & Mersey Health & Care Partnership.

Dashboards were established by CIPHA for the pilot, providing reports updated every 30 minutes on testing by sites and socio-demographic groups. In addition to on-line dashboards, summaries were emailed three times per day to the Command-and-Control members and field teams and used to inform the evolution of the testing site network.

## Community Engagement and Communications

The aim to engage the city's whole population in the pilot drove DHSC's estimate of 48 test sites (20 bays testing 6 people per hour from 07:00 to 19:00 each day to generate a capacity of 69,120 tests – around 14% of the population per day).

A communications plan was developed and delivered by Liverpool City Council. This employed multi-media strategies and was updated in response to data on testing uptake, feedback from the military

[1] https://twitter.com/allysonpollock/status/1325049755693670400

on engagement at ATS, analysis of social media and commissioned surveys. An interactive map of ATS was deployed to show waiting times at sites.

Discussion at Gold/Silver/Bronze command levels translated into communications plans for informing residents of uptake (daily press releases via the Liverpool Express website; regular media appearances by the Director of Public Health and other senior stakeholders).

In the third week of the pilot, Liverpool City Council liaised with Liverpool Charity and Voluntary Services organisation to target specific neighbourhoods with low attendance at ATS. A funding request for community involvement in co-creating testing engagement, incentives, and support, including tackling inequalities, was submitted to DHSC, and will be used in the next phase of the pilot.

## Timeline of the Pilot

The first three phases of the pilot reported here are: negotiation and preparation from 31 October to 5 November; initial deployment of MAST (mass, asymptomatic, serial testing) from 6 November to 20 November; and development of the SMART (systematic, meaningful, asymptomatic, repeated testing) approach, preparing to introduce SMART components from 3 December:

October

- (14) The new three-tier system of Covid-19 restrictions begins in England; with Liverpool City Region in Tier 3, the highest level of restrictions at the time
- (31) Government offers Liverpool mass testing with military assistance

November

- (1) Liverpool City Council Covid-19 Strategic Coordination Group with Mersey Resilience Forum accepts in principle but with the freedom to develop a more targeted approach
- (2) Military arrive in Liverpool to establish test sites
- (3) Liverpool accepts a MAST; an emergency response is stood up
- (5) National lockdown; a communications drive begins in Liverpool on MAST
- (6) Six ATS open for LFT testing (alongside mobile units for symptomatic PCR testing, which were already operating); QA teams for dual LFT PCR swabbing mobilised
- (7) 16 ATS open for LFT testing
- (10) First meeting of DHSC convened Evaluation Steering Group; schools-based testing starts
- (11) Capacity increased: 37 community ATS plus schools; home PCR kits delivered (one-off, unsolicited mailing to sample households); local evaluation group established
- (13) First meeting of the University of Liverpool evaluation group
- (20) Re-configuration of resources: 15 popular ATS kept; other resources were redeployed to smaller ATS in low uptake areas
- (23) System for confirmatory PCR system changed from national communication and delivery of a home test kit to swabbing at one designated local testing site (with outreach swabbing if needed) and an invitation message tailored to the local area

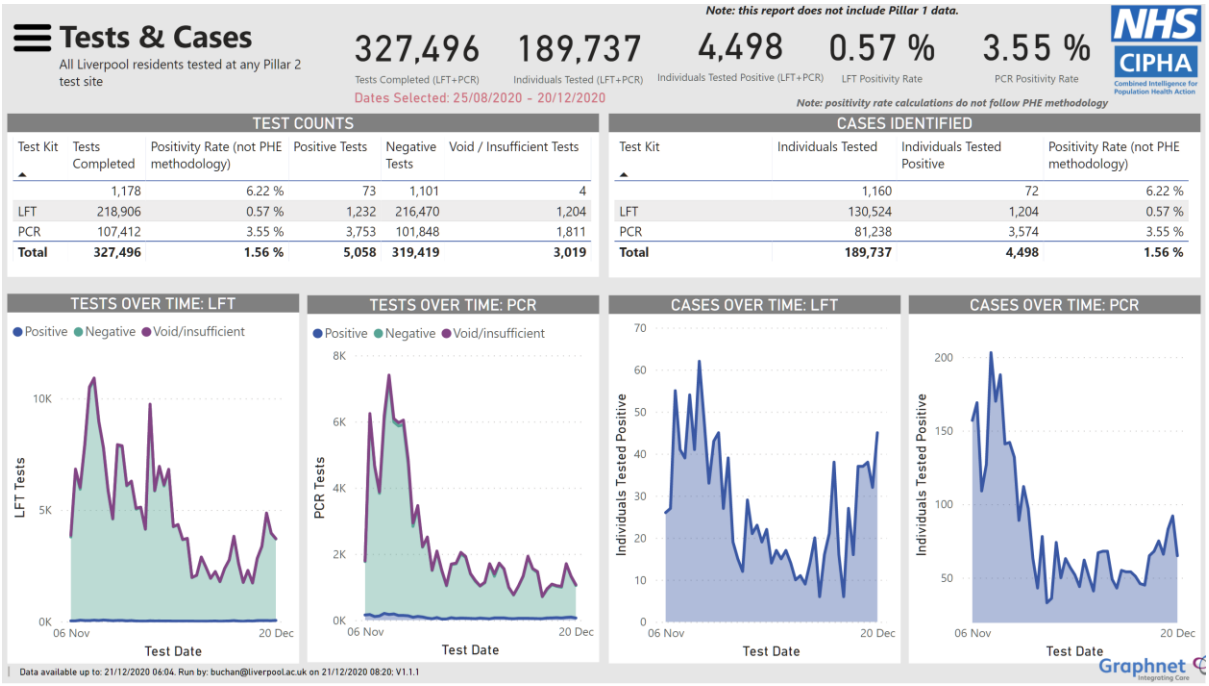
December

- (2) Liverpool moved into Tier 2
- (3) Handover of management of ATS from military to Liverpool City Council contractors; targeting becomes more focused as the pilot moves to Liverpool Covid-SMART (Systematic Meaningful Asymptomatic Repeated Testing)
- (3) Liverpool Covid-SMART care home visiting pilot begins; test-to-release for some key workers is announced and the communications plan shifts priority to “test before you go” for implementation over the coming weeks as the population returns to high transmission risk settings such as hairdressers

## Current numbers

At the time of this report the test numbers for Liverpool City residents since the start of the pilot are shown in Figure 2. The PCR numbers include both symptomatic and asymptomatic uses, as a large postal drop of home PCR kits was made from 11 to 16 November and not repeated:

Figure 2: Summary testing dashboard for the City of Liverpool (0.5m population)

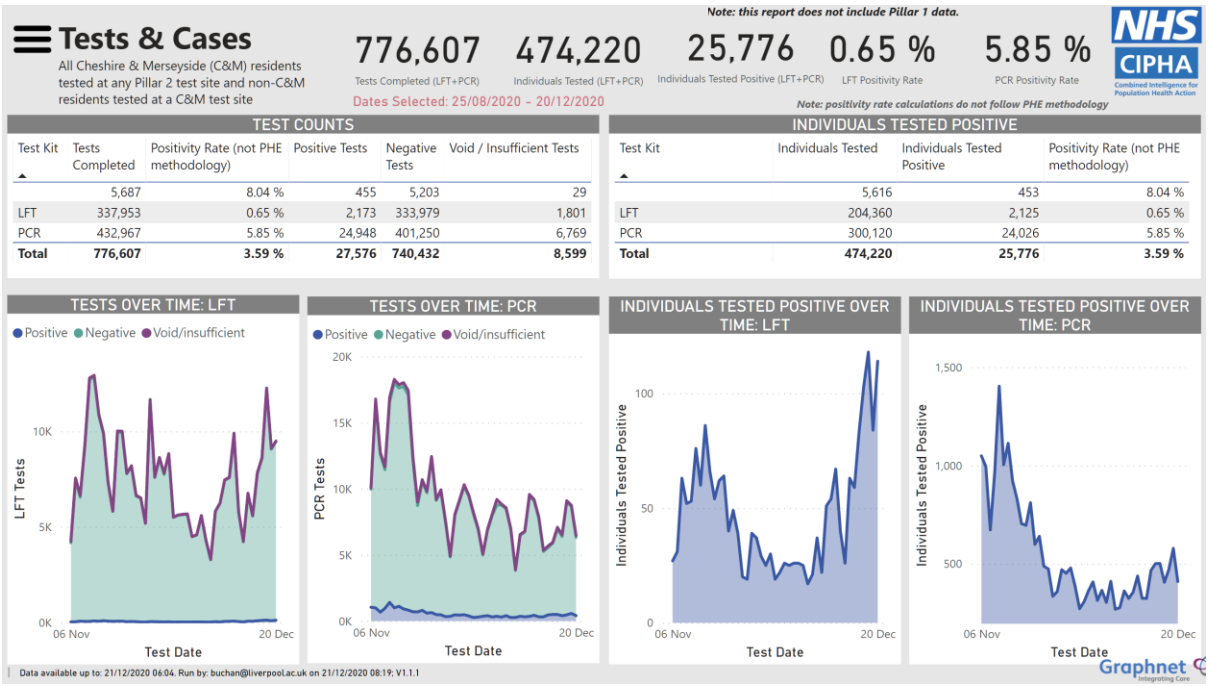



| Test Kit | Tests Completed | Positivity Rate (not PHE methodology) | Positive Tests | Negative Tests | Void / Insufficient Tests |
|---|---|---|---|---|---|
| | 1,178 | 6.22 % | 73 | 1,101 | 4 |
| LFT | 218,906 | 0.57 % | 1,232 | 216,470 | 1,204 |
| PCR | 107,412 | 3.55 % | 3,753 | 101,848 | 1,811 |
| **Total** | **327,496** | **1.56 %** | **5,058** | **319,419** | **3,019** |

| Test Kit | Individuals Tested | Individuals Tested Positive | Positivity Rate (not PHE methodology) |
|---|---|---|---|
| | 1,160 | 72 | 6.22 % |
| LFT | 130,524 | 1,204 | 0.57 % |
| PCR | 81,238 | 3,574 | 3.55 % |
| **Total** | **189,737** | **4,498** | **1.56 %** |

Equivalent numbers for the wider Cheshire & Merseyside region, where people working in Liverpool may live, are shown in Figure 3.

Figure 3: Summary testing dashboard for Cheshire and Merseyside (2.6m population)




| Test Kit | Tests Completed | Positivity Rate (not PHE methodology) | Positive Tests | Negative Tests | Void / Insufficient Tests |
|---|---|---|---|---|---|
| | 5,687 | 8.04 % | 455 | 5,203 | 29 |
| LFT | 337,953 | 0.65 % | 2,173 | 333,979 | 1,801 |
| PCR | 432,967 | 5.85 % | 24,948 | 401,250 | 6,769 |
| **Total** | **776,607** | **3.59 %** | **27,576** | **740,432** | **8,599** |

| Test Kit | Individuals Tested | Individuals Tested Positive | Positivity Rate (not PHE methodology) |
|---|---|---|---|
| | 5,616 | 453 | 8.04 % |
| LFT | 204,360 | 2,125 | 0.65 % |
| PCR | 300,120 | 24,026 | 5.85 % |
| **Total** | **474,220** | **25,776** | **3.59 %** |

## Evaluation Framework

The DHSC, as sponsor for the pilot, established an Evaluation Steering Group with inputs from SAGE, NHS Test and Trace, ONS, PHE, JBC, and academic specialists. The University of Liverpool was invited to lead the evaluation on 10 November. A framework was adopted for evaluating principal components of operational systems, biological meaning, behavioural responses, and public health impacts. The full report will extend to the social and economic impacts.

1. **SYSTEMS**: Develop nationally generalisable systems for:
    a. establishing pathways - identifying who to test, communicating the need for a test, taking the test, carrying out the test, communicating the result to the person tested and to others who need to know, and ensuring that appropriate next steps happen
    b. combining intelligence from NHS, local authority, and public health data sources for promoting and optimising access to testing for specific groups
    c. multi-agency mutual aid to coordinate communications, public health responses and economic recovery activities
    d. delivering strong community engagement
    e. providing clear, impartial, and accurate information to the community, which explains the purpose of testing in this context
    f. assessing the indirect effects of the pilot on other systems such as welfare support and clinical pathways

2. **BIOLOGY**: To evaluate:
    a. the performance of the Innova LFT in context of use
    b. the uptake and utility of PCR tests to confirm positive results from LFTs
    c. repeated testing for test-to-protect (the vulnerable); test-to-release (from quarantine; isolation) and test-to-enable (safe return to usual activities)

3. **BEHAVIOURS**: Understand the factors determining:
    a. uptake of tests on first and subsequent occasions, by socio-demographic groups
    b. acceptance of the testing programme by the public in general and by specific vulnerable groups
    c. drivers for accessing or declining testing for an individual and those they care for
    d. responses to a positive test result
    e. responses to a negative test result
    f. effective and ethical incentives for participation
    g. public trust, understanding, and cooperation

4. **PUBLIC HEALTH**: Identify the public health impacts on:
    a. uptake overall and by gender, age, geographical area, deprivation, ethnicity, occupation, high risk and vulnerable groups
    b. tackling inequalities in the uptake of testing and its effects
    c. virus transmission during the pilot and beyond
    d. protecting vulnerable groups
    e. contact-tracing of cases and their contacts
    f. the proportion of the population who isolate or quarantine
    g. compliance with isolation, and consequently transmission
    h. unintended consequences, such as a potential reduction in Covid-safe behaviours after a negative test

This was a rapid evaluation of a developing pilot with after-action, continuous learning at the forefront. It was not always possible to examine and mitigate systematic biases from data collection.

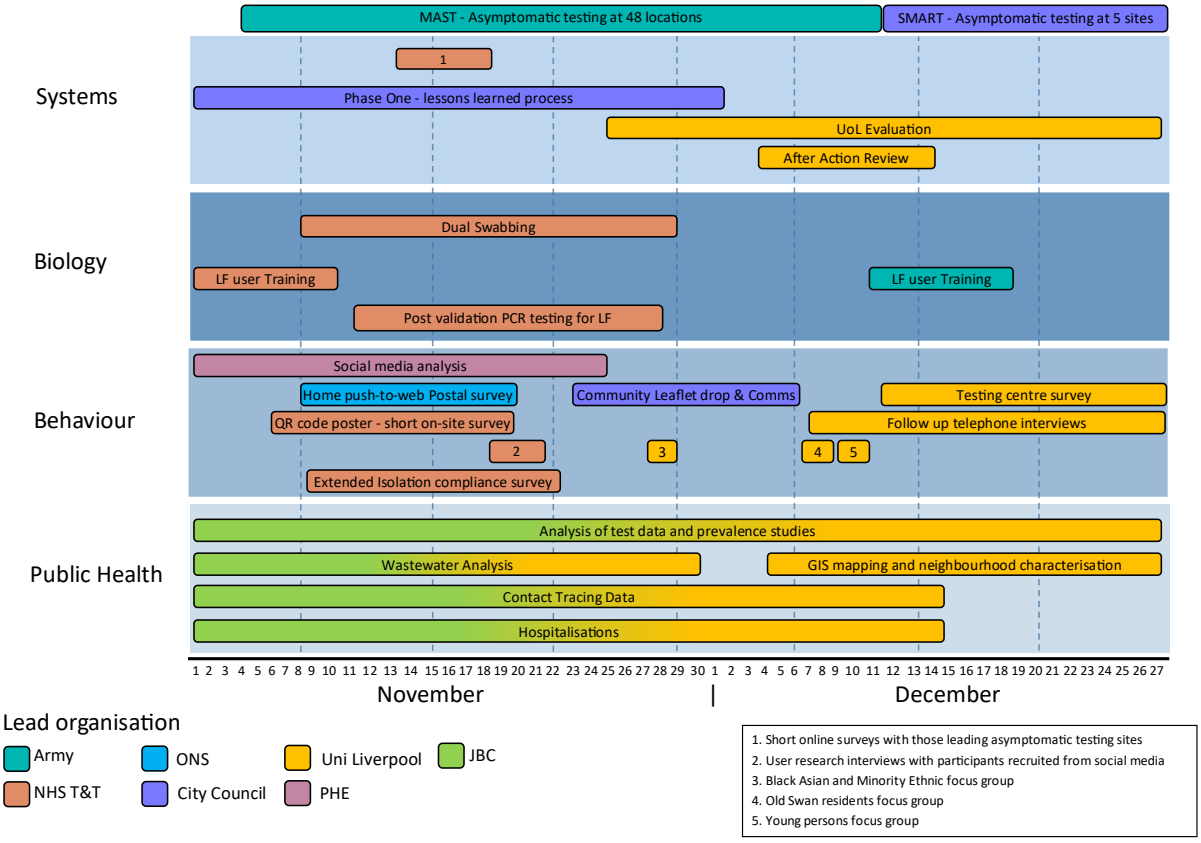
Qualitative and survey work on the ground was targeted at explaining differences in test uptake therefore it should not be interpreted as representative of the general population. The ONS survey work was undertaken to generate a representative sample.

The timing of the pilot meant that it was not possible to design a priori, sophisticated control comparisons or establish randomised testing patterns to build strong causal inferences on impacts of the testing on public health outcomes or behavioural processes.

This evaluation used routinely collected data and field observations, which might be replicated in other localities. The framework is intended for formative use in guiding implementations of similar testing in other localities, and for providing immediate summative policy evidence.

The timeline of the evaluation is shown in Figure 4:

Figure 4: Overview of activity by Lead Organisation and theme during November—December 2020



## Ethics and Approvals

This work was invited as a service evaluation not research. DHSC/NHS Test and Trace wrote confirming the status as service evaluation and liaised with the Medicines and Healthcare Devices Regulatory Authority (MHRA) over the use of the Innova lateral flow device in this post-validation pilot service.

Whether MAST/SMART was 'a screening process' or 'an emergency public health intervention during an extraordinary event' was discussed by the evaluation team and with DHSC.[1,2] A distinction was drawn between identification of cases of noncommunicable disease dispersed in the community and primarily impacting the person tested (e.g., cervical cancer), and identification of cases of a highly infectious disease that by its nature amplifies within a community with wider societal impacts. It was agreed without dissent that MAST and SMART were urgent public health interventions subject to the legal and ethical provisions of a health protection activity and Covid-19 specifically.

With reference to the Health Research Authority decision tool, the secondary analysis of data provided in a health protection activity is not classified as research, and so does not require research ethics committee review.[3]

The quality assurance sample of dual LFT and PCR swabs was run as quality management of the service of NHS Test and Trace, with the data provided to the evaluation team for secondary analysis of data provided in a health protection activity.

Where additional information required interactions that were not a routine part of the pilot service, local research ethics committee approvals were obtained.

[1] Wilson, James Maxwell Glover, Jungner, Gunnar & World Health Organization. Principles and practice of screening for disease. World Health Organization 1968. https://apps.who.int/iris/handle/10665/37650

[2] Dobrow MJ, Hagens V, Chafe R, Sullivan T, Rabeneck L. Consolidated principles for screening based on a systematic review and consensus process. CMAJ. 2018;190(14):E422-E429. doi:10.1503/cmaj.171154

[3] http://www.hra-decisiontools.org.uk/research/docs/DefiningResearchTable_Oct2017-1.pdf [accessed 17DEC2020]

# Systems

## Sources and Methods

The governance and operational systems were evaluated using material created by the Command-and-Control structure, and with reference to individual discussions with key stakeholders.

## Multi-agency working

### Governance and establishing operations

The speed with which the pilot was established (seven days from agreement to opening of first ATS) created logistical challenges. The initial DHSC estimate of 48 geographically spread sites had to be revised with reference to local intelligence on Liverpool's neighbourhoods and practical issues such as site ownership and access.

The governance structure was responsive to the fast-moving process. Verbal agreements were accepted for some actions to enable site set-up. The Command-and-Control action logs were not fully operational until 11 November and governance frameworks were not finalised until 13 November. The military command logged every operational decision within their own system.

Local organisations were already working together effectively and efficiently through the Cheshire & Merseyside joint Covid-19 cells across the two constituent LRFs. The governance and operational structures for the pilot therefore drew on existing knowledge and networks. The co-chairs of the Gold/Silver/Bronze levels were drawn from different organisations, resulting in smooth identification and solution of emerging issues.

### Adapting operations according to intelligence

An early adaptation was the rapid deployment of clinical staff from local NHS organisations to the ATS to ensure compliance with the clinical standard operating procedures and surveillance of attendees for vulnerable and potentially symptomatic individuals. The initial queues at the ATS on 6 and 7 November were effectively managed by the Council, who used their external stewarding contractor to supply additional staff.

At the start, existing Mobile Testing Units (MTUs) for symptomatic testing were managed separately from the pilot ATS. This was quickly identified as a discoordination risk, so the two systems were integrated at local level via Bronze Command, with clearer signage for the three out of 37 community venues where there were both types of testing available. The communications plan was adapted to clarify the purpose of each type of site, their location, and opening hours.

The DHSC approvals was streamlined by bringing the Senior Regional Coordinator North West into the local Command-and-Control structure (from the second week) and identifying DHSC staff to act as conduits. This enabled operational issues to be quickly addressed, including facilitating the use of local telephone numbers for follow-up PCR test bookings for positive LFT cases, and alerting DHSC to a communications failure on the postal drop of PCR kits to Liverpool households.

NHS Test and Trace introduced a home PCR test delivery to addresses which were more than 800m from a testing site. This was centrally directed, and the local authority were advised of the postal districts chosen by Deloitte. The provision of home PCR test kits was preceded by a letter with guidance sent by NHS Test and Trace up to two days in advance of the home test kits being delivered by Amazon. Three home test kits were sent in each parcel, with a total of 85,062 kits being delivered

to 28,354 households over 4 'Sprints'. The postal districts were L16, L25, L12, L24 and L14, but did exclude addresses which were within the radius of a testing centre.

As the home test kits had to be submitted through post boxes, to mitigate Royal Mail post boxes being overwhelmed, Liverpool was asked to provide 'collection points' for the test kits for the day of delivery and the day following the delivery. At the busiest point 12 vans were provided in the identified areas to collect kits from residents between 08:30 and 17:00 and were then taken to a single point to transfer to Royal Mail who then delivered them to a Lighthouse laboratory.

Of the 85,062 kits delivered, 8,914 (10.5%) were registered by residents and 7,024 (8.3%) results were provided. Of the kits registered 3,428 were collected over the four sprints by the collection vans, all other completed kits would have been submitted via the post boxes. In response to the low registration numbers, a change was made centrally from 17 November to only send a letter to household occupiers informing them of how to request a home test kit.

### Sustainability and knowledge transfer

The decision to continue LFT testing beyond the agreed period of military support placed a considerable strain on local partners to finalise procurement processes with external contractors. This involved proceeding at risk, with parallel negotiations with DHSC on the costing and agreement of a devolved budget; taking over equipment leases and liaison with the military command to produce guidance for the incoming staff. The sustainability plan was submitted and private sector providers in place by 30 November for a start date of 3 December. Supply chain assurance (for LFTs and waste management) was a key issue for the transition period.

Mobilisation of a pilot for visitor testing in twelve Liverpool care homes (using multiple LFTs and a PCR test) was complicated by the announcement of a national pilot. There was a delay in the supply of kits, and public confusion over which care homes were included – nationally vs locally selected.

Liverpool City Council managed a 'Lessons Learned' process, in collaboration with military personnel in the format of 7-, 14- and 21-day reviews. A summary was published on Resilience Direct on 7 December and disseminated via a workshop for Local Resilience Forum partners.

## Digital Access, Dataflows, and Intelligence

Digital registration proved to be a key determinant for attendance and 'flow rate' through the ATS. The initial plan for pre-registration online was abandoned after it proved impractical to manage alongside the walk-in option. Individuals presenting at ATS were asked to self-register on their personal devices. However, some ATS reported up to 40% of attendees did not have suitable devices or the ability to operate them, and military personnel were required to complete the registration process on their own devices.

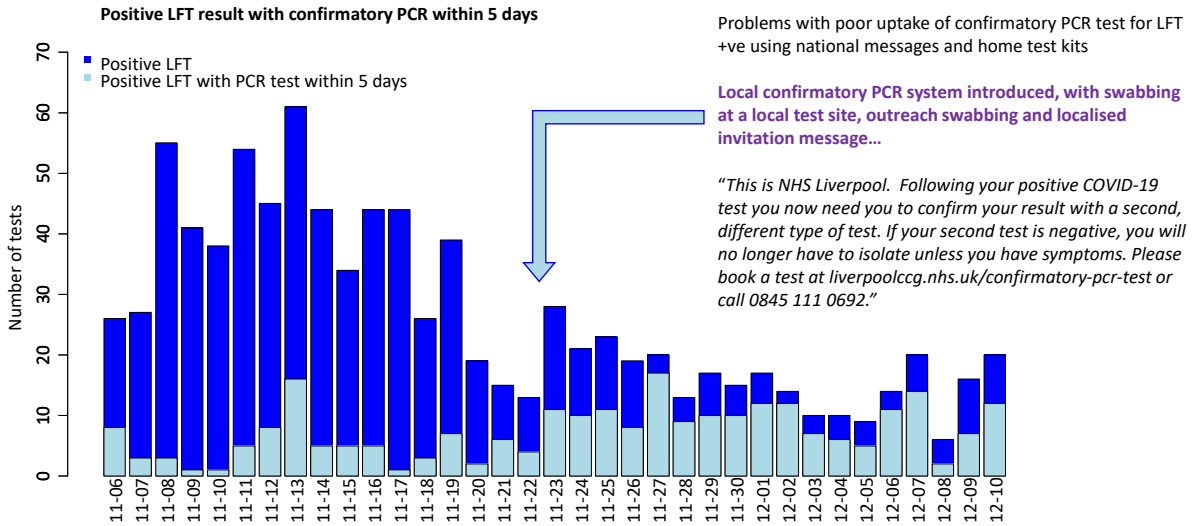
Dataflows from national and local systems into a combined intelligence facility, CIPHA, were important as a single source of truth for agile command-and-control. Cheshire and Merseyside had been negotiating access to near-real-time Pillar 2[4] data since September. The Pillar 2 test result dataflows were granted on 5 November. Analysts from NHS Liverpool Commissioning Group, Merseycare and The University of Liverpool joined an extended CIPHA team to inform and evaluate the pilot by working on anonymised data extracts from the information system provider Graphnet.

CIPHA was also used under NHS Information Governance to guide testing workflows, including intercepting positive LFT results to offer a local confirmatory PCR service when it became apparent

[4] www.gov.uk/government/publications/coronavirus-covid-19-testing-data-methodology/covid-19-testing-data-methodology-note

that uptake of the national system was low. A digital workflow from NHS Test and Trace via CIPHA to NHS Liverpool was put in place on 23 November, offering a local testing site dedicated to confirmatory PCR testing, and rapid sample processing at Liverpool Clinical Laboratories, which quickly improved confirmatory PCR uptake from 19% to 79% (from 6 November to 22 November 140/736 individuals receiving positive LFT results received a PCR test within 5 days, from 23 November to 12 December these numbers were 184/234).

Figure 5: Change in uptake, following local intervention, of PCR testing within 5 days of a positive LFT




CIPHA dashboards, including maps and socio-demographic summaries, showed wide variation in uptake across the City, not all in the expected patterns of NHS and social care utilisation inequities. Geospatial analysis was refined to include 15-minute walking times to ATS and consideration of Covid-19 prevalence, deprivation, and digital exclusion. This highlighted significant areas that were not well-served, and enabled the roll-out of temporary sites, and the closure of some sites with unviable attendance.

## Communications and community engagement

Consultation with residents (via surveys and focus groups) identified that the MAST pilot taxonomy was not well understood. 'Asymptomatic' and 'serial' proved especially challenging terms to communicate. There was insufficient attention to briefing those attending for testing that they should return within five to seven days for another test.

Misinformation may have affected public confidence and uptake. Misinformed issues included perception of the risk of infection at test sites, suspicion around Government use of data collected (especially 'DNA'), and the need to have physical contact with centre staff. The communications team responded through a page on Liverpool City Council website, daily stakeholder emails; Facebook messages targeted by postcodes and regular press briefings and contact with ward councillors and community leaders. Public figures from the football and entertainment communities provided short influencer videos which were disseminated via social media channels.

Distribution of leaflets via pharmacy prescriptions bags was first discussed on 19 November. Targeted initiatives such as this would have been beneficial earlier in the pilot.

Following the planned review on 19 November the programme was re-branded as 'SMART' (Systematic Meaningful Asymptomatic Repeat Testing) – and colloquially 'smart'. This acknowledged the emerging scientific evidence on the sensitivity of LFTs and responded to analysis that specific

population sectors that were less likely to engage with testing. It facilitated the development of three target-based plans for the use of LFTs:

1. Test-to-protect (the vulnerable, for example testing households of care home visitors and supplementing weekly PCR testing of care home staff with LFT between PCR tests)
2. Test-to-release (from quarantine, for example daily LFT enabling key workers to return from quarantine sooner to work)
3. Test-to-enable (abeyance of restrictions affecting health, social fabric, and economy, for example enabling care home visiting or attendance at sports events)

Community engagement proved challenging in the absence of an existing city-wide voluntary plan. Although the Liverpool Charity and Voluntary Services (LCVS) had some capacity to act as a liaison service, and knowledge of charities and neighbourhood groups, it proved impractical to mobilise these at such short notice to provide a community activation service. Liverpool City Council began a leafleting drop to targeted neighbourhoods on 20 November, after the main publicity drive, missing the opportunity for a critical mass of 'push-pull' communications.

Discussions around deploying third party vehicles as testing centres (Red Cross; St John's Ambulance; Arriva buses) were hindered by health and safety/protocol/sign-off concerns so did not proceed. These would have been a very effective route into the hardest-to-reach communities that have poor digital engagement.

Focus groups and surveys suggested the community reception of the military personal was very positive and welcoming.

# Biology

## Objectives, Sources and Methods

This part of the evaluation focused on quality assurance (QA) of the Innova SARS-CoV-2 antigen lateral flow device and testing process. Asymptomatic individuals attending ATS between 8 and 29 November were asked to participate in a QA process[5] and given the opportunity to opt out. This sample of around 6,000 attendees received a pair of Innova SARS-CoV-2 antigen lateral flow (LFT) and reverse transcription polymerase chain reaction (PCR) tests. Two supervised, self-administered swabs, first LFT, then PCR, were taken at the same appointment within minutes. The PCR test used was the standard test used in Lighthouse Laboratories. The results were sent from NHS Test and Trace to CIPHA and analysed by an independent team at the University of Liverpool.

The primary analysis compares classifications of SARS-CoV-2 infection status made by Innova LFT and PCR from supervised, self-swab sample collection at general population scale. The secondary analysis investigates the influence of viral load, inferred from PCR cycle threshold (Ct) values, on the paired LFT classifications.

Accuracy parameters (sensitivity, specificity, and predictive values) were estimated, and 95% confidence intervals were generated using the Clopper-Pearson method. Analyses were carried out in R (version 3.6.1 or later) and by a second statistician using SAS software (version 9.4). A description of the analyses and data checks were recorded in the statistical analysis plan.

## Findings

The QA dataset consists of data from n = **5,869 individuals** from 48 ATS in Liverpool. A comparison of the LFT results recorded on site and the paired QA PCR results is shown in Table 1. PCR results included 5.8% voids (343/5,869) and LFT results included 0.4% voids (22/5,869). Accuracy of LFT assessed against PCR, excluding void results, showed:

**Sensitivity** (true positive rate) = **40.0%** (28.5% to 52.4%; 28/70)
**Specificity** (true negative rate) = **99.9%** (99.8% to 99.99%; 5,431/5,434)
**Positive predictive value** (post-test likelihood of PCR +ve = **90.3%** (74.3% to 98.0%; 28/31)
**Negative predictive value** (post-test likelihood of PCR -ve = **99.2%** (99.0% to 99.5%; 5,431/5,473)

Predictive values depend on the prevalence in the asymptomatic population, which changes over time. We considered 1.3% prevalence of SARS-CoV-2 infection among asymptomatic individuals using this dataset, which is consistent with ONS estimates for the period. Comparison of the LFT site and QA results showed 5,862 concordant and 7 discordant samples (99.9% concordance).

Table 1: Comparison of LFT site results and PCR results

| | | PCR result | | |
|---|---|---|---|---|
| | | Negative | Positive | Void |
| LFT result (site) | Negative | 5,431 | 42 | 341 |
| | Positive | 3 | 28 | 2 |
| | Void | 18 | 4 | 0 |

[5] DHSC. Innova lateral flow antigen testing device: Mass testing quality assurance. Protocol: LFD003, version 1.04

Table 2 shows the accuracy measures of the LFT for the different cycle threshold (Ct) range of values from the PCR test, based on (i) the combined average of existing gene Ct score and (ii) the *N gene* alone, given that the N gene RT-qPCR results reflect more the Innova LFT SARS-CoV-2 target antigen. The average was calculated over existing values for the N gene, S gene and ORF1ab, such that if a particular gene had a missing value, the average was calculated over the remaining Ct scores. Figure 6 shows the proportion of LFT positives and the cumulative sensitivity according to categories of PCR N gene Ct values, which are used to infer higher viral load with lower Ct values. N gene reflects the antigen that the Innova device detects but is less representative of overall viral load, therefore the more usual mean of N gene, S gene and ORF1ab Ct values is shown in Figure 7.

Table 2: Comparison of LFT site results and PCR results, by Ct levels, with cumulative sensitivity estimates and corresponding 95% confidence intervals (CI), after excluding voids

| | | Mean Ct (N gene, S gene, ORF1lab) score from PCR test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **30-35** | **25-30** | **20-25** | **<20** | | 35-40 (void) | 30-35 (void) | n/a (void) | -ve |
| LFT site | -ve | 18 | 11 | 10 | 3 | | 8 | 5 | 328 | 5,431 |
| | +ve | 1 | 1 | 12 | 14 | | 0 | 0 | 2 | 3 |
| | void | 0 | 0 | 2 | 0 | | 0 | 0 | 0 | 18 |
| Sensitivity (95% CI) | | 5.3 (0.1,26.0) | 8.3 (0.2,38.5) | 54.5 (32.2,75.6) | 82.4 (56.6,96.2) | | | | | |
| Cumulative Sensitivity (95% CI) | | **40.0** (28.5,52.4) | **52.9** (38.5, 67.1) | **66.7** (49.8, 80.9) | **82.4** (56.6,96.2) | | | | | |
| | | | | | | | | | | |
| | | N gene score from PCR test | | | | | | | | |
| | | **30-35** | **25-30** | **20-25** | **<20** | n/a (+ve) | 35-40 (void) | 30-35 (void) | n/a (void) | -ve |
| LFT site | -ve | 16 | 15 | 6 | 3 | 2 | 4 | 6 | 331 | 5,431 |
| | +ve | 1 | 3 | 12 | 12 | 0 | 0 | 0 | 2 | 3 |
| | void | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 18 |
| Sensitivity (95% CI) | | **5.9** (0.1,28.7) | **16.7** (3.6,41.4) | **66.7** (41.0,86.7) | **80.0** (51.9,95.7) | | | | | |
| Cumulative Sensitivity (95% CI) | | **41.2** (29.4,53.8) | **52.9** (38.5, 67.1) | **72.7** (54.5,86.7) | **80.0** (51.9,95.7) | | | | | |

Figure 6: Proportion of LFT positives according to PCR viral load using N gene values. Green bars show the 95% confidence intervals of the cumulative sensitivity of LFT to detect Ct <20, <25, <30 and <35, with the axis on the right

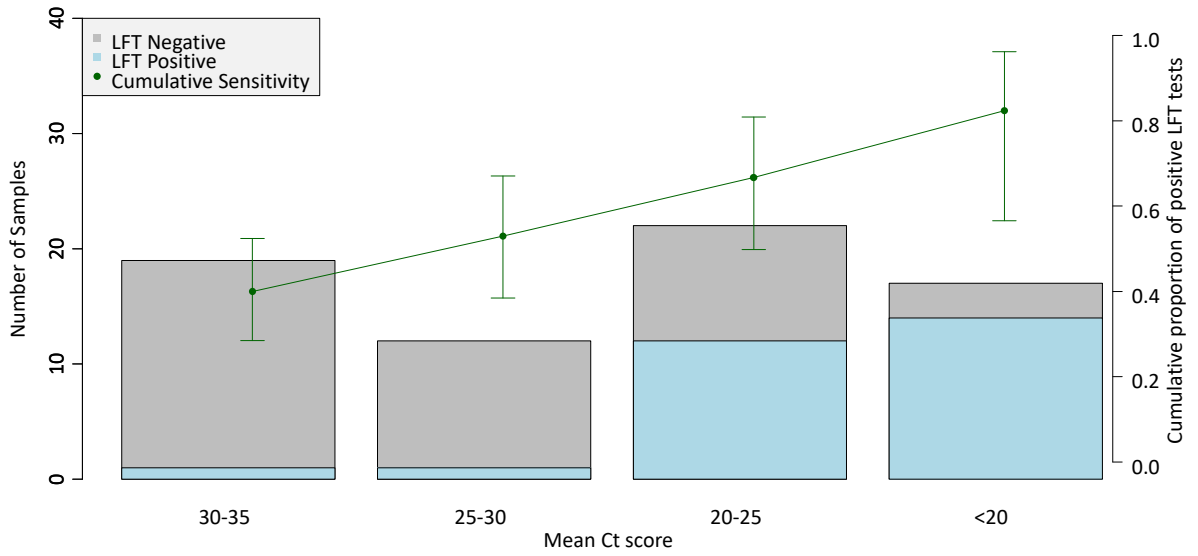
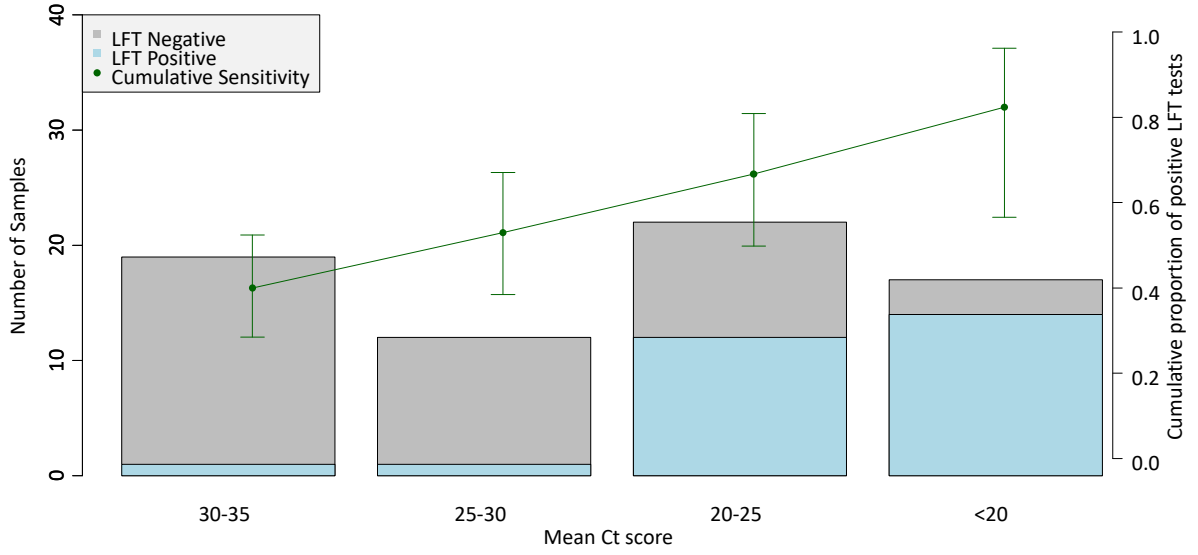



Figure 7: Proportion of LFT positives according to PCR viral load using mean of available N gene, S gene and ORF1ab values. Green bars show the 95% confidence intervals of the cumulative sensitivity of LFT to detect Ct <20, <25, <30 and <35, with the axis on the right.



## Variation in device build

Manufacturer's Quality Control (QC) certificates and batch certification were not provided for the lateral flow devices used in the Liverpool pilot. These may have been retained centrally. At least four different LFT builds were provided for use in the pilot. The shape and size of the sample windows varied between LFT devices. There is a concern that build could affect performance of the LFTs. When asked about this, the NHS Test and Trace team report "Each batch of Innova devices underwent QC testing using antigen control sets provided by Innova. This testing was performed centrally by Intertek before the batch was released for use. Reports are produced on an exceptions basis, with quarantine of specific lots or products that fail QC tests to prevent them entering circulation."

Figure 8: Examples of device build differences and reading issues


Test performance may have varied with build quality, temperature in transport, swabbing, device use, result reading, labelling and data entry. It was later learned that the batch numbers of tests can be traced by the logistics team from the QR code on the (images of) devices. However, the batch numbers were not recorded against individual test. Good practice is to include batch numbers in QA datasets and to link the batch number with a QC certificate for the corresponding batch.

## Re-reading of test device images

Photographs of the used devices were taken to classify test results to support the development of an artificial intelligence enabled image recognition algorithm. The photographs were reassessed by a member of the NHS Test and Trace data management team, who was blinded to the original on-site assessment. Any reappraisal results that differed from the original on-site assessment were assessed by a second reviewer, blinded to the previous results. Training material included reference photographic examples for a variety of results (strong positives, weak positives, negatives, artefacts, etc.). Following re-appraisal, an increment in sensitivity (53.4%, 41.4 to 65.2), same specificity (99.9%, 99.8 to 99.98), and similar positive predictive value (90.7%; 77.9 to 97.4) and negative predictive value (99.4%; 99.1 to 99.6) were obtained after excluding voids. Table 3 shows the sensitivity for the different Ct groups using the reappraised dataset.

Post-hoc analysis by NHS Test and Trace identified that of the 16 non-concordant re-appraised results, 13 were in the first seven days, three in the next seven days, and none in the last three days: Figure 9. Numbers are too small to make firm conclusions; it is possible operators improved with experience, but the incidence of positive cases declined over time leaving fewer discordant data to study. NHS Test and Trace is revising the training materials for ATS and recommending that LFDs are read independently by more than one operator where possible.

Figure 9: Change over time in reappraisal of on-site LFT results across the QA sampling period

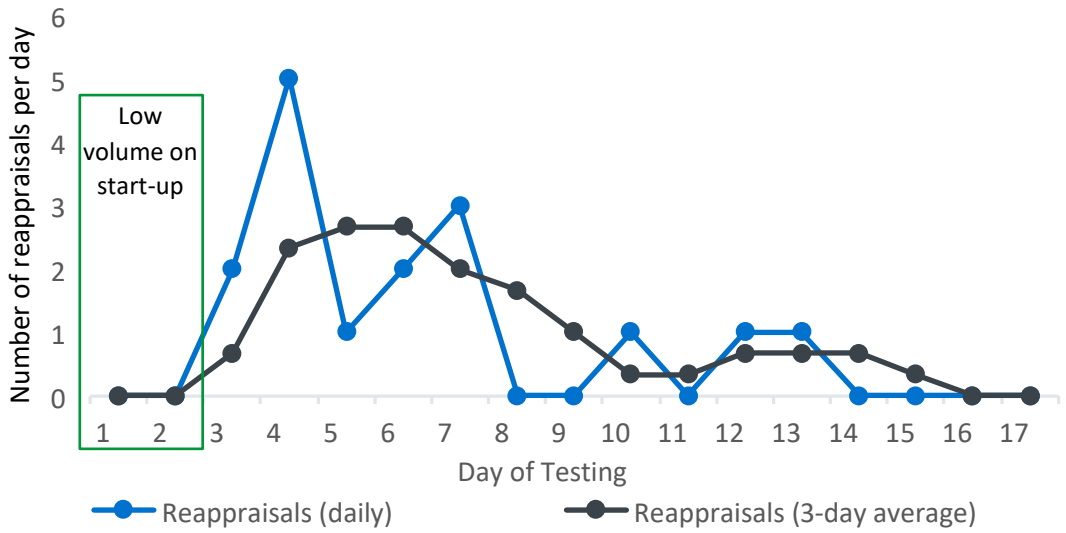



Table 3: Comparison of LFT and PCR results using the reappraised dataset, by Ct levels (mean and N gene), cumulative sensitivity estimates and 95% confidence intervals, after excluding voids

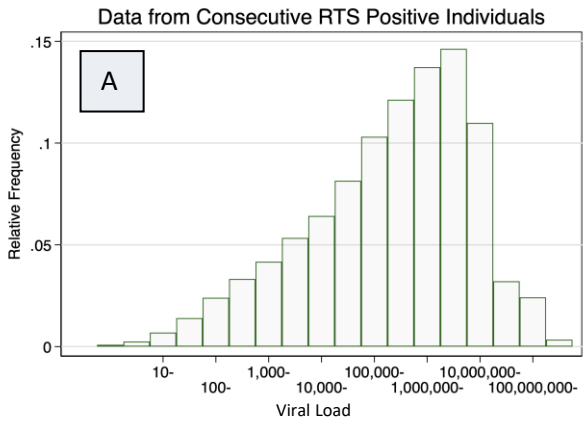
| | | Mean Ct (N gene, S gene, ORF1lab) score from PCR test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **30-35** | **25-30** | **20-25** | **<20** | | 35-40 (void) | 30-35 (void) | n/a (void) | -ve |
| LFT site | -ve | 18 | 9 | 5 | 2 | | 8 | 5 | 328 | 5,426 |
| | +ve | 1 | 3 | 18 | 17 | | 0 | 0 | 2 | 4 |
| | void | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 22 |
| Sensitivity (95% CI) | | **5.3** (0.1,26.0) | **25.0** (5.5,57.2) | **78.3** (56.3,92.5) | **89.5** (66.9,98.7) | | | | | |
| Cumulative Sensitivity (95% CI) | | **53.4** (41.4, 65.2) | **70.4** (56.4, 82.0) | **83.3** (68.6, 93.0) | **89.5** (66.9,98.7) | | | | | |
| | | | | | | | | | | |
| | | N gene score from PCR test | | | | | | | | |
| | | **30-35** | **25-30** | **20-25** | **<20** | n/a (+ve) | 35-40 (void) | 30-35 (void) | n/a (void) | -ve |
| LFT site | -ve | 16 | 11 | 3 | 2 | 2 | 4 | 6 | 331 | 5,426 |
| | +ve | 1 | 7 | 17 | 14 | 0 | 0 | 0 | 2 | 4 |
| | void | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 22 |
| Sensitivity (95% CI) | | **5.9** (0.1,28.7) | **38.9** (17.3,64.3) | **85.0** (62.1,96.8) | **87.5** (61.7,98.4) | | | | | |
| Cumulative Sensitivity (95% CI) | | **54.9** (42.7, 66.8) | **70.4** (56.4, 82.0) | **86.1** (70.5,95.3) | **87.5** (61.7,98.4) | | | | | |

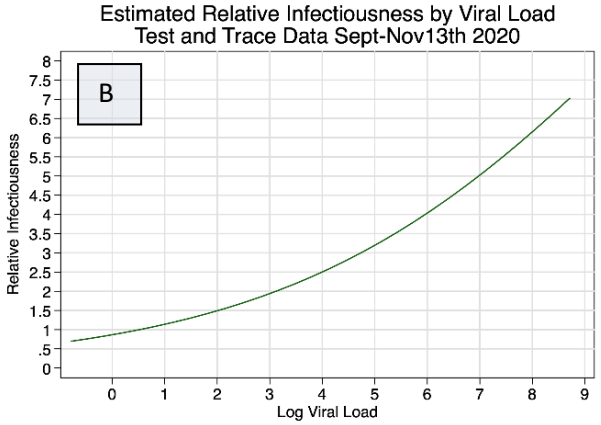
## Related Findings

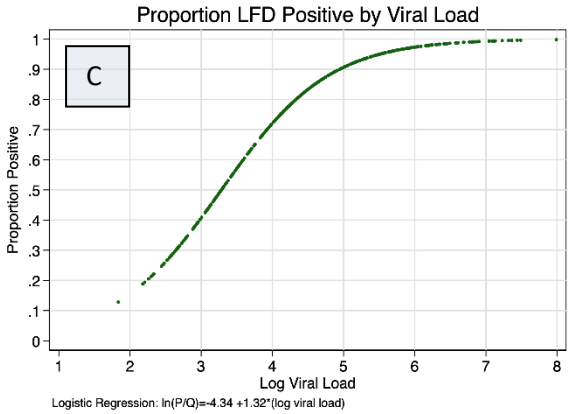
In a recent study from Oxford (T. Peto et al.) commissioned by DHSC, but not yet published, Ct levels from samples taken from cases at Regional Testing Centres (RTS) have been used to infer infectiousness to transmit to known/traced contacts. The study included both symptomatic and asymptomatic subjects, and the relative effect on infectiousness of increasing viral load was similar in both groups of subjects. The asymptomatic individuals were drawn from the contacts of cases.

All the viral loads were measured by Lighthouse Laboratories inferring similar Ct vs viral load relationships, with Log10 viral load calculated as 12-0.328*Ct. A preliminary interpretation of these results by the Oxford team is that a cycle threshold Ct < 25 picks up most substantially infectious individuals. Figure 10 outlines the Oxford study findings and overlays them onto the Liverpool Innova LFT QA analysis.

Figure 10: Series of analyses of paired LFT and PCR results from cases and contacts tested via regional test centres (RTS) – pre-publication work from T. Peto et al.



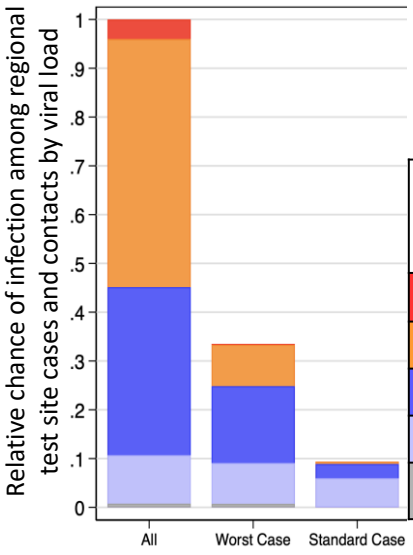




Population Proportion of Infectivity = A*B

Population Proportion of infectivity missed by LFT = A*B (1-C)

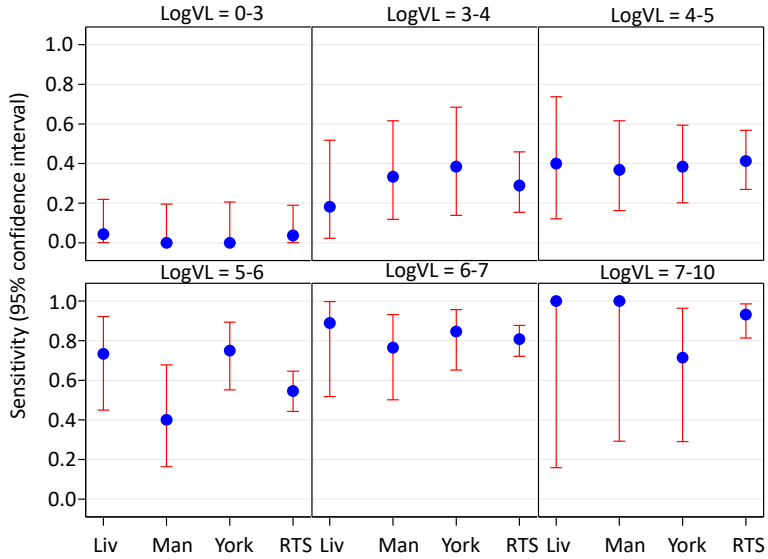
Assumes: infectiousness measured before test date

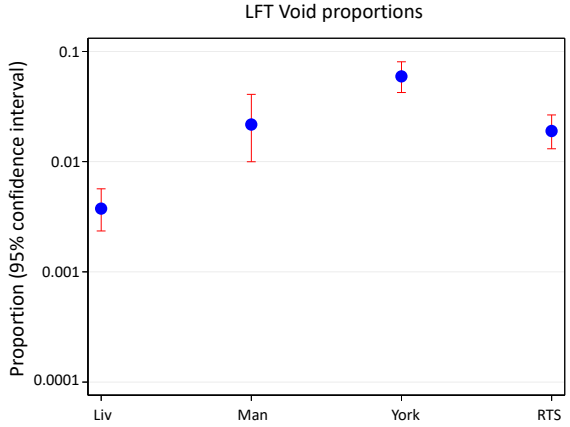


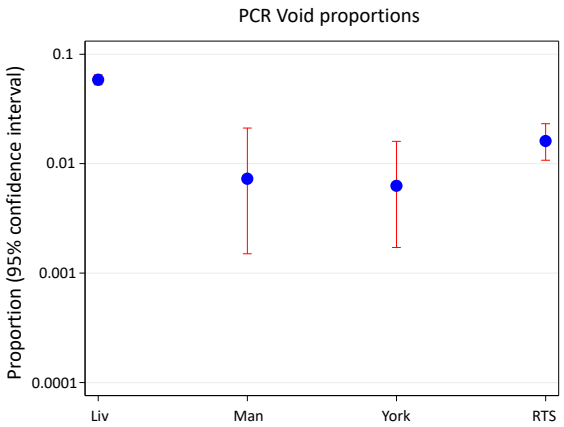

| | Viral load RNA copies/ml | Log viral load | Innova Liverpool detection % | Approximate Ct | |
|---|---|---|---|---|---|
| | | | | Porton | Glasgow |
| | >100M | 8-10+ | ~100% | <14.9 | <12.2 |
| | 1-100M | 6-8 | ~90% | 14.9-21.5 | 12.2-18.3 |
| | 10K-1M | 4-6 | ~40% | 21.5-28.1 | 18.3-24.4 |
| | 100-10K | 2-4 | ~20% | 28.1-34.6 | 24.4-30.5 |
| | <100 | 0-2 | ~10% | >34.6 | >30.5 |

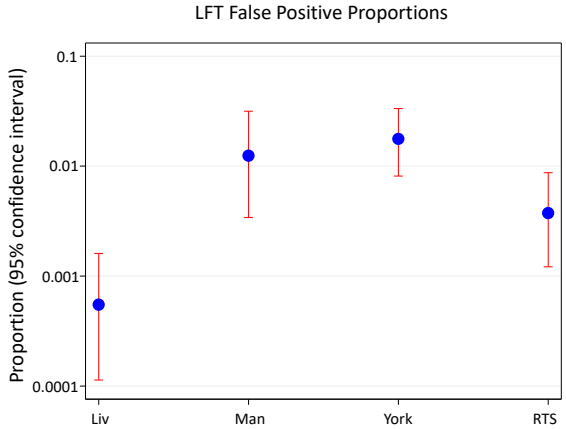
Other QA analyses are taking place with the Innova LFT device in the UK. Figure 11 reflects reasonable consistency of sensitivity and some heterogeneity (Liverpool LFT false positive and void proportions are lower than the regional test site and York/Manchester drive-in self-swab sites) most likely due to different contexts of use and possibly due to device batch effects.

Figure 11: Comparison of Innova lateral flow performance across real-world applications, with T. Peto et al. Liv = Liverpool SMART pilot QA sample (n = 5,869); Man = Manchester drive in self-swab QA (n = 403); York = York drive in self-swab QA (n = 599) – pending data assurance; RTS = DHSC Regional Test Site paired LFT + PCR reference study (n = 1704). LogVL: $Log_{10}$ viral load = 12-0.328*Ct.



## Discussion

The sensitivity of the Innova LFT in the Liverpool QA analysis was 40%, indicating that three fifths of PCR positive individuals were missed by the Innova device when used for supervised self-swabbing of the asymptomatic public. The 95% confidence interval for the sensitivity of LFT based on our data indicates that the test is likely to detect at least a third and at most half of the PCR positive cases.

PCR is a highly sensitive test for identifying SARS-CoV-2 infected individuals and is known to be more sensitive than LFT. A substantial proportion of the individuals detected with PCR will no longer be infectious,[6] however, when the result is communicated, the message from NHS Test and Trace currently states only that they have tested positive, without giving further detail. The Ct value of a positive PCR is understood to be associated with infectiousness, but further work is required to understand whether this is sufficiently accurate for informing individuals. If the ongoing Oxford research studies of viral load vs PCR Ct are overlain on the Innova LFT QA analysis, assuming portability of the findings between the different testing contexts, it may be possible that the Innova LFT detected at least two thirds of the substantially infectious individuals in the Liverpool pilot.[7] Given that the relationship between Ct values and infectiousness is not well characterised, and that transmission via asymptomatic infected individuals is not well understood, we cannot draw a firm conclusion about the proportion of infectious asymptomatic individuals the Innova LFT detects.

Yet PCR detection is also subject to loss of sensitivity in terms of swabbing, with substantial and largely unexplained heterogeneity between studies in sensitivity to detect positive individuals who might have been detected with a different swab sample. A recent systematic review identified 34 studies with PCR false negative rates ranging from 2% to 58%.[8] In our study, however, given that most LFT positives are a subset of PCR positives, we do not expect one-time re-swabbing to result in a substantial improvement in LFT sensitivity.

There is concern about variation in LFT device build quality and lack of QA certification by batch of test used. Yet the ten to 15 times lower cost and the whole test-to-result time gain with LFT over PCR (< hour compared with 1-3 days) may afford greater Covid-19 control utility than PCR alone.[7] An economic evaluation is not provided here as the devices for the pilot were pre-purchased, but the relative costs of administering LFT vs. PCR might usefully be studied.

In conclusion, Innova LFT is a helpful tool for finding asymptomatic cases of SARS-CoV-2, and in particular cases with a higher viral load. However, given its low sensitivity, caution should be exercised in how the device is applied, particularly in vulnerable settings where the consequences of infection are severe. Here, LFT should not be used as a direct replacement for PCR but as an additional tool for SARS-CoV-2 transmission control and risk mitigation. Repeated LFT may improve sensitivity but optimal series of tests for particular uses needs further study. Combinations of LFT and PCR testing also need investigation. The Liverpool Covid- SMART care home visiting protocol is testing the performance of two Innova LFT at different swabbing sites within 24 hours, the first accompanied by an evaluation PCR. Results of this initiative are due to be reported in early 2021.

[6] Mina MJ, Parker R, Larremore DB. Rethinking COVID-19 test sensitivity—a strategy for containment. New England Journal of Medicine, 2020

[7] DHSC. COVID-19 Self-Test Kit - Rapid Antigen Test Device Exceptional Use Authorisation Request Technical Summary, submitted to MHRA on 14 December 2020.

[8] Arevalo-Rodriguez I, Buitrago-Garcia D, Simancas-Racines D, Zambrano-Achig P, Del Campo R, Ciapponi A, et al. (2020) False-negative results of initial RT-PCR assays for COVID-19: A systematic review. PLoS ONE 15(12): e0242958.https://doi.org/10.1371/journal.pone.0242958

# Behaviours

## Sources and Methods

### QR code poster survey (ONS short survey completed on site)

Posters were displayed at ATS inviting those being tested to complete a short online survey by scanning a QR code with their smartphone. The survey asked participants' immediate reactions to the testing process. This approach carries bias: only those with smartphones could take part and it was a self-selecting sample. The findings must be used cautiously and combined with other evidence. A total of 232 completed surveys were submitted between 6 and 20 November.

### Push-to-web postal survey (longer survey to be completed at home)

A random sample survey within the postal districts of Liverpool was used to collect information from those who had been tested and those who had not. Invitation letters were sent to 60,000 households, which directed respondents to an online ONS survey. Up to four adults from each house could respond and gave insight into people's motivations and barriers to being tested. A total of 5,059 completed surveys were submitted between 12 and 30 November. Based on the number of unique households in the sample, the response rate is 6.8%. The findings reported below are based on unweighted data.

### Extension of the isolation compliance survey

A sample of people who tested positive (from LFT or PCR) in Liverpool were invited to take part in a telephone survey at the end of their quarantine period. This aimed to measure isolation compliance and identify the factors that have influenced their behaviour (including attitudes to the risk from Covid-19, their employment status, and their receipt of benefits). The survey instrument was developed with input from a range of colleagues across the programme, including from PHE, as well as members of SPI-B. The data is still be analysed and the findings from this element will be included in the final evaluation report.

### Short online surveys with those leading asymptomatic testing sites

A short online survey was sent to the 47 asymptomatic testing site leads. The sites were all staffed by military personnel. The survey covered workflows, site setup, what worked well and what could have worked better. There were 43 completed survey responses between 13 and 19 November and provided insight into the operational perspective of setting up and delivering the testing programme.

### Interviews with those who have and have not taken part in testing

Interviews were conducted with those who have and have not taken part in the testing to understand their motivations and perceptions of the testing approach.

- 10 semi-structured phone interviews at pace, sampled opportunistically via social media, to understand people's perceptions of having been tested.
- In-depth qualitative research with disengaged residents in Liverpool, starting 10 November, over-sampling disadvantaged groups, including those in high-risk occupations, shift workers and those in unstable employment (e.g., gig economy), focusing on understanding barriers to participation in testing.
- Three separate focus groups (BAME [Black, Asian and Minority Ethnic] = 7; Old Swan = 5; Young People = 3) with those living in areas of high and low levels of uptake.

Future work will include follow-up interviews. Respondents to the postal survey were asked for their consent to be contacted for a follow-up phone interview. Interview participants will be selected from this pool according to a sampling frame to ensure a spread of age, sex ethnicity, and geographic location. These interviews will be reported later.

### Media and social media analysis

A rapid thematic analysis was undertaken of local narratives from local community media and social media sites in Liverpool. This captured local narratives surrounding the pilot, particularly from people unlikely to engage in testing or other standard evaluation techniques such as surveys and interviews. Data was collected from publicly accessible sources of community narratives, including social and online media sites, such as online comments sections from a local newspaper (the Liverpool Echo), the Liverpool City Council Facebook page and a local community social media group.

### Testing site attendance survey

An online questionnaire was launched on Monday 30 November, promoted via Liverpool City Council social media channels. With a total of 398 responses reviewed on Wednesday 9 December, the survey asked participants' immediate reactions to the testing process. While this approach carries bias (i.e., only those with access to the online link could take part), it has provided an initial snapshot of people's experiences. To address this gap the questionnaire has remained active, and a QR codes linking to the survey have been displayed via various channels (e.g., posters, flyers, adverts) and team have been deployed to sites to collect responses from individuals at location while they wait for results of their test.

## Findings

This section sets out the interim findings of the evaluation as they relate to behavioural responses to the pilot and the factors that may underpin those behaviours. The section starts by describing people's awareness and understanding of the pilot, before going on to explore the reasons people gave for taking part and how those who did and did not take part differed in terms of attitudes and characteristics. The section then describes experiences of the testing process, people's responses to a negative test results and intentions for future participation in testing. The section draws on data from the social media analysis, the ONS Liverpool-wide survey, QR poster and UoL online surveys, and qualitative research with a range of residents who did and did not participate in testing.

### Awareness, understand and attitudes

A key question for the pilot was whether people in Liverpool would accept the invitation to take part in testing. First, people needed to be aware of the pilot – quantitative and qualitative evidence indicated this awareness was high. The ONS survey indicated that 94% of people who participated in the pilot said they knew a great deal or a fair amount about the pilot. This figure was 83% for those who did not take part in the pilot but intended to, and 79% for those not intending to take part.

The qualitative research indicated that the public had heard about the pilot via a range of channels, including worth of mouth, seeing test sites, social media, and local and national news media. For some, national media was described as raising the overall awareness of the pilot while local media provided finer details, such as site locations and opening times. However, there were also people who felt the information provided through those channels was not sufficient and that they had to actively seek out details about how to participate through the gov.uk website or local sources, such as the council website or local media websites.

The qualitative research also indicated clear understanding of the pilot's aim to offer testing to all people in the City whether they had symptoms or not. But there was less clarity among some about the purpose of testing. There were questions raised about communication and a feeling among some of 'Covid overload'. There was some criticism from BAME participants about insufficient access in languages other than English.

There was some confusion about the differences between LFT and PCR and the role of confirmatory PCR testing. There were some concerns about LFT accuracy. There were also questions about the testing process, whether it was unpleasant, how long the process would take, how to book, who administered the test, and how quickly the results would be communicated.

There were notable differences in attitudes to the pilot. The ONS survey indicated that those who took part in the pilot held more positive attitudes to it than those who did not, with 96% having a fairly positive or very positive attitude compared with 65% for those who did not take part and did not intend to. Those who intended but had not yet participated in the pilot were closer in attitude to the group who had participated than those who did not intend to participate, with 88% having a fairly or very positive attitude to the pilot. These divergent views were reflected in the comments on social media, as the illustrated in Table 4 below.

Table 4: Approximate breakdown of number of comments coded as positive, negative, and neutral in terms of their appraisal of mass testing

| Data Source | Positive | Negative | Neutral |
|---|---|---|---|
| Liverpool Echo | 30 | 81 | 108 |
| Facebook | 153 | 123 | 196 |
| Twitter | 88 | 191 | 126 |
| **Total** | **217** | **395** | **430** |
| **%** | **21%** | **38%** | **41%** |

Participants in the qualitative research said that the pilot was a focus of conversations in the community, and some felt these were occasionally tense. There were questions about why Liverpool had been picked, and though the high rate of infection in the city was recognised, there could still be concern or resentment over the perception that Liverpool may have been being 'punished' for bad behaviour or used as a 'guinea pig'. However, the 'guinea pig' label was not always interpreted negatively, with one participant remarking that it was sensible to trial mass testing in Liverpool because "if you can get Scousers to do something then you can get anyone to do it".

The speed the pilot was set up was a concern for some, as was the army turning up 'unannounced'. For others, the presence of the army reinforced the sense that the situation was serious and made them wonder whether testing was going to be mandatory. However, there was general good will expressed toward the army presence, which reinforced positive attitudes to the pilot.

### Motivations and barriers to participation

Decisions to participate in the pilot reflected various motivations and expectations. A sense of shared identity with other Liverpool residents and an ethical imperative to take part was apparent across quantitative and qualitative strands. In the ONS survey, 85% of those who took part said they did so because it was the 'right thing to do' and 80% to 'help Liverpool beat the virus' (with 'civic duty' chosen by 31% of respondents to the online survey of residents). Social media analysis echoed this, with

people expressing pride in the city and seeing the pilot as an opportunity for Liverpool to set an example for the rest of the county. Linked to this, several participants in the qualitative research said that part of their motivation to take part was to demonstrate that Liverpool did not have as high levels of the virus that had been supposed. For some, community responsibility was not linked so strongly to social identity and instead was couched in terms of a desire to protect friends, families and local hospitals and NHS workers. Some people related this to the specific mechanism of surveillance ('keeping track of the virus') and to prevent people who were asymptomatic from unknowingly spreading the virus. Reinforcing the sense that taking part in the pilot had a strong pro-social motivation is the geo-spatial analysis, which indicated that there was only a very moderate association between with walking distance to any given testing centre and the chances someone would participate, indicating that convenience or inconvenience did not override other drivers.

Alongside the obvious pro-social motivations, not unexpectedly there were more pragmatic considerations of the potentially benefits of taking part were stated as motivations for participation in the pilot. At one level this was expressed as the possibly of 'returning to normality', or at least entering a lower tier following the end of the second national lockdown, and the concomitant boost this would give the local economy. More immediate personal benefits were also anticipated by some, such as providing peace of mind (selected by 60% of those who participated in the pilot according to the ONS survey) or hope that it would enable people to see family again, including being able to help out with things such as childcare.

For those who did not participate in the pilot, the most cited reasons in the ONS survey were not experiencing coronavirus symptoms (47%), concerns about catching the virus at a test centre (32%) and not feeling taking the test would have much impact (17%). The qualitative research indicated that for some, not taking part reflected a failure to grasp the purpose of testing, with people questioning why they would need to get a test if they felt well, did not have symptoms and did not think they had it or were likely to catch the virus. This attitude could be underpinned by a belief that they were already following social distancing and lockdown rules, and therefore limiting contact with others, and were not close to someone who might be considered vulnerable. In addition, where someone in an individual's bubble had tested negative, some people assumed that there was no need for them to get tested as well.

For some, there were specific concerns about the potential adverse consequences of taking part, both due to the personal restrictions that would be the result of a positive test and city-wide restrictions if a high number of positive cases were identified. There were also concerns over a loss of family income while isolating or even fear of losing one's job. The anxiety over isolating was heightened for those in small family homes or who did not have any outdoor space. These concerns could be expressed as a feeling of being overwhelmed by the implications of a positive test – 'I can't face it' – which could lead people to try and 'self-manage' the risk by not getting a test but avoiding seeing people in case they were positive.

Alongside these more personal reasons for not taking part, there were also barriers related to wider perceptions and concerns about testing and the role of the Government. At one level there was uncertainty about whether the tests involved extracting DNA and what this might be used for. At another level, the concerns had morphed into a wholesale breakdown in trust about the testing process that was expressed in claims that people were knowingly being given false positive tests in order to make them isolate. For others, the concern was less about individual tests and more related

to a feeling that testing was being 'imposed' on the City in a way they felt was typical of the relationship between Liverpool and Government, tapping into an established narrative of marginalisation and disenfranchisement.

### Differences between those who did and did not take part

Alongside the explicit reasons given for participating or not, analysis of how the characteristics and attitudes of those who did and did not take part differed can provide further insight into the potential drivers of participation. However, due to the cross-sectional nature of the data, it is important to be cautious in drawing any causal inference from the data and the differences may be better interpreted as markers or predictors of participation. What was clear was that there were clear geographic and associated socio-economic patterns in terms of participation. The lowest uptake was in the north of the City, in areas characterised by densely populated deprived communities where social renting was more common. The highest rates of uptake were in the areas characterised by lower levels of poverty, higher incomes, and higher levels of educational attainment. The more deprived areas had lower test uptake and higher SARS-CoV-2 positivity. Overall, positivity rates were three times higher for the most deprived quintile compared to the least deprived.

Considering digital exclusion, using the Internet User Classification of areas[9], the highest test uptake was found in areas classified as 'e-veterans' (i.e., affluent groups who use the web for shopping and information seeking). By contrast, those least likely to receive a test were in areas classified as 'e-withdrawn' (i.e., deprived neighbourhoods with little engagement with internet including poor access to smart phones). However, there was equally low uptake and high positivity in the area classified as 'youthful urban fringe' (i.e., inner city dweller with high use of internet especially social media including young populations and students and ethnically diverse areas). The social gradients and digital exclusion effects were stronger for PCR than for LFT uptake, with PCR characterised by much higher uptake in the most affluent fifth of the population and among 'e-veterans'.

In terms of attitudes, the ONS survey indicated that the views and beliefs implied by the explicit reasoning given by people for taking part or not in the pilot were reflected in the patterns seen in the responses to the survey. As indicated in Table 5 below, compared with those who participated, those who had not and did not intend to participate in the pilot were less likely to trust government information and more likely to feel the risks of coronavirus are exaggerated, less likely to believe the government is putting the right measures in place to protect the public, and less likely to feel that isolation is effective or that their behaviour generally has an impact on the virus spreading. These differences in attitudes echo the impression from the qualitative research that not taking part in the pilot was associated with people who were more sceptical of government and perceived themselves has having less of a stake in society. Interestingly, the attitudes of those who intended to participate in the pilot but had not done so when they responded to the survey tended to sit in the middle of people who had participated and those who were not going to. This indicates that the drivers or markers of participation sit on a continuum rather than being a simple dichotomy and echo the social epidemiology findings.

[9] https://data.cdrc.ac.uk/dataset/internet-user-classification

Table 5: Attitudes of those who did and did not take part in the pilot

| Attitude | Participated | Intend to participate | Not participating |
|---|---|---|---|
| Those who **disagree or strongly disagree** that information from the government about coronavirus can be trusted | 26% | 26% | 36% |
| Those who **disagree or strongly disagree** that the government is putting the right measures in place to protect the public | 30% | 31% | 41% |
| Those who **agree or strongly agree** that the risks of coronavirus are being exaggerated | 5% | 10% | 18% |
| Those who are **not at all or not very confident** that self-isolating is an effective way to prevent the spread of coronavirus | 2% | 2% | 11% |
| Those who **disagree or strongly disagree** that their personal behaviour has an impact on how coronavirus spreads | 9% | 12% | 18% |

### Experiences of the testing process

Overall, almost all people who took part in testing reported being very or fairly satisfied (94%) according to the ONS survey. However, this does not mean that there were no concerns about the process. There was some annoyance about having to pre-book tests and then register again at the site and there was a perception of mixed messages in terms of whether identity documents were required or not. Once at the sites, according to the ONS survey most (60%) people reported that they had to queue for less than 30 minutes, but a small proportion (2%) had to wait over 90 minutes. The majority reported that the time taken to participate was much or slightly quicker than expected (73%), and people who took part in the qualitative research also generally described the process as being smooth and efficient though those who had experienced longer waiting times said it would make them less likely to participate again in the future.

There were some concerns about the on-site signage, with suggestions that instructions could be more prominent and comments that the amount of text could be overwhelming, particularly for those for whom English was not their first language. There were concerns over what was perceived as a lack of a clear queuing system, especially as some sites did not have separate queues for those who had pre-booked slots and those who did not, and in one focus groups individuals complained of being 'moved like cattle'. There were also concerns that social distancing was not always adhered to and that the public stood too close to one another. There were some concerns that symptomatic and asymptomatic members of the public might mix in a queue, despite the ATS being intended/directed for use only by those without Covid-19 symptoms. Some people raised questions over shelter if weather conditions turned for the worse.

In the ONS survey, test instructions were rated as easy or very easy by 79% of respondents with another 16% describing them as neither easy nor difficult. Taking the test was felt to be slightly more difficult, with 12% describing it as difficult or very difficult, 21% neither easy nor difficult and the majority, 66%, describing it as easy or very easy. Despite challenges, site staff were almost universally

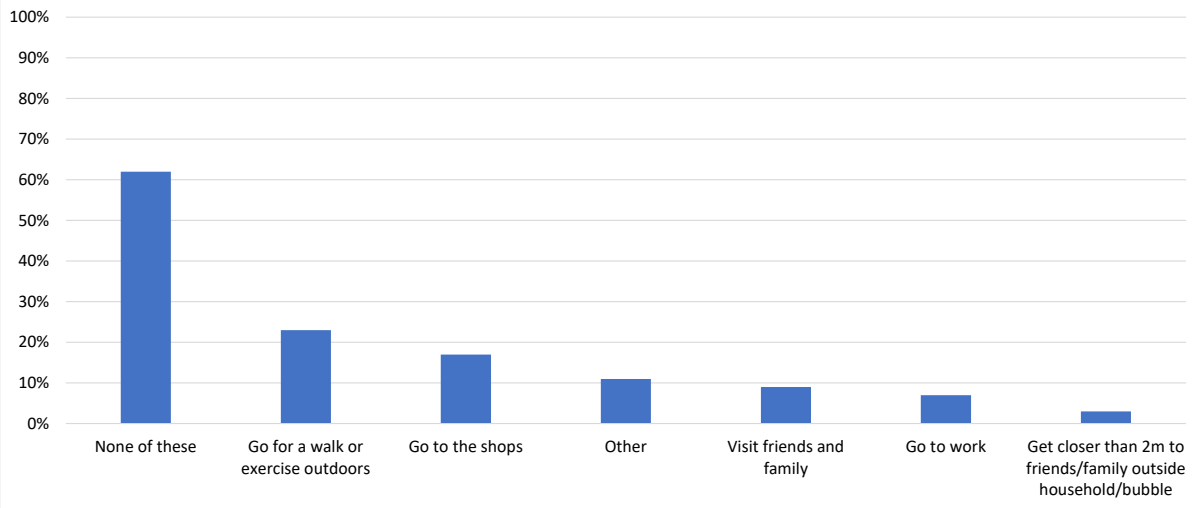
praised, with only 6% of respondents in the ONS survey dissatisfied (either fairly or very), and people in the qualitative research describing both military and civilian staff as 'professional' and 'friendly'.

### Responses to test results

Of respondents in the ONS survey who participated in the pilot, only 1% tested positive, and almost all of those who did so reported that they immediately self-isolated (95%) and most told either family, friends, or their employer. Across all strands of the research there was little evidence of confusion about the appropriate steps to take in response to a positive test.

Of those who tested negative, in the ONS survey most (62%) said that the result would be unlikely to cause them to change their behaviour. However, 23% reported being more likely to go out for a walk or exercise after receiving a negative result, with 17% saying they would be more likely to go to the shops, 9% more likely to visit friends and family and 7% more likely to go to work (see Figure 12). A few respondents reported that a negative result would make them more likely to do something not listed (like go to a hospital appointment).

Figure 12: Did having a negative test result make you more likely to do any of the following?




When asked if they would get tested for coronavirus every week if the city-wide testing were extended to make this possible, a little less than half (43%) said they definitely would with a further 36% saying they probably would. This perhaps reflects the fact that people were generally satisfied with the testing process and indicates that testing could initiate a virtuous circle with participation increasing the chances of future participation.

# Public Health

## Sources and Methods

### Combined routine surveillance data

The data used here are from the NHS, local authority, and public health (including Pillar 2) dataflows combined in CIPHA, and existing prevalence studies (ONS infection survey and REACT) and the Zoe app. Data on hospitalisation were used to identify the total number of confirmed positive Covid-19 admissions for all NHS Trusts in Liverpool. Data on infection rates and testing patterns were used to investigate the early epidemiological effects of introducing the pilot

### Wastewater

Wastewater was sampled for SARS-CoV-2 material infected individuals shed into their stools, regardless of whether they have symptoms. The reported data are the number of virus' nucleocapsid gene copies (N1gc) detected in wastewater samples which are collected daily. The data are designed to give a geographically stable reflection of changes in the numbers of people infected.

## Findings

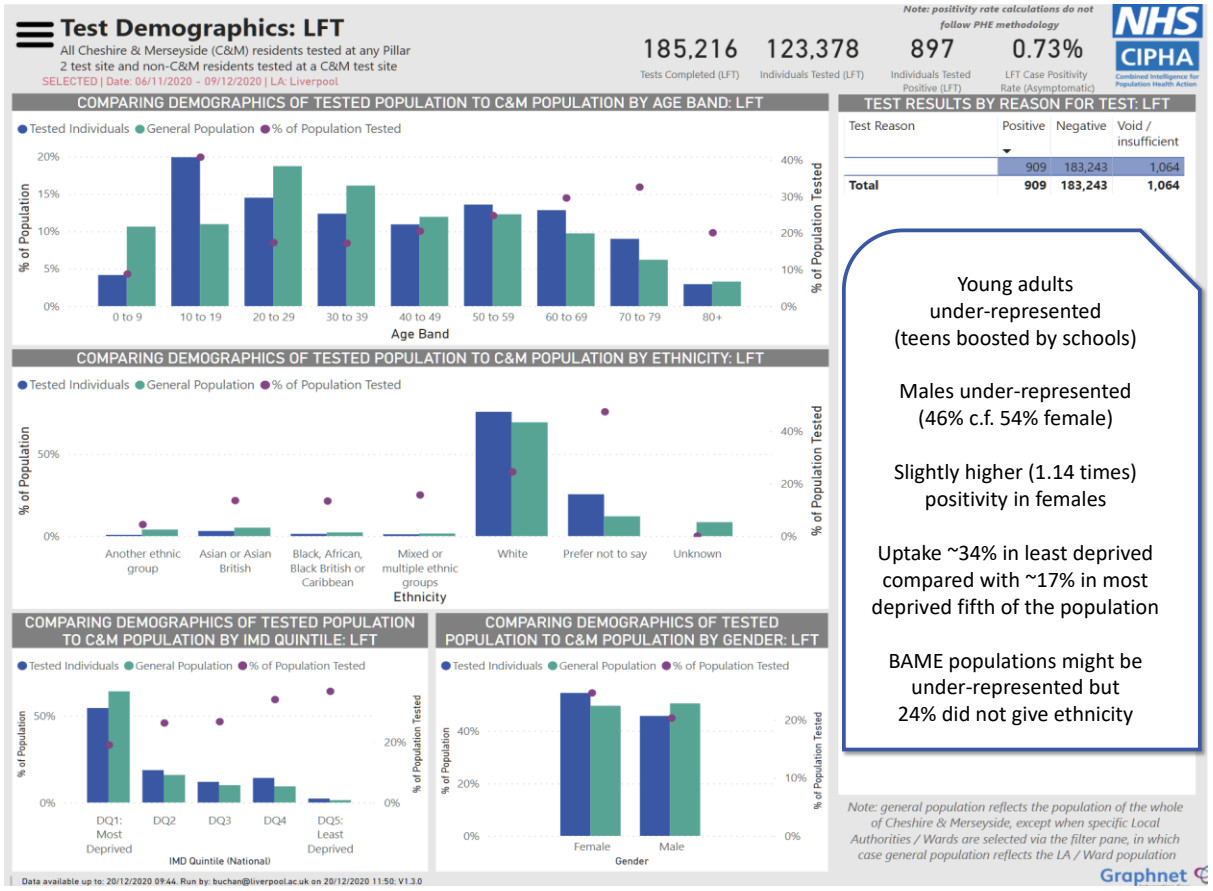
### Summary

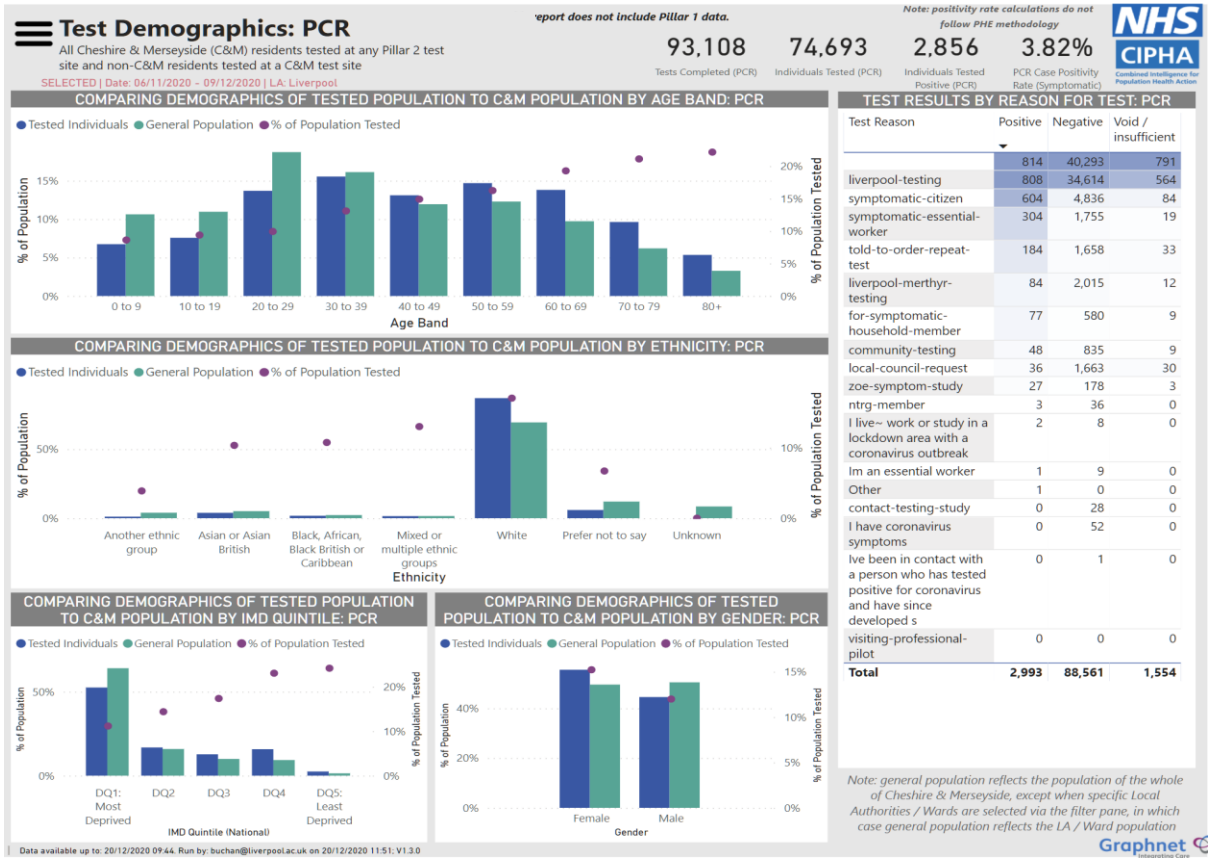
- From 6 November to 9 December 25% of the Liverpool population took up LFT and 36% took up either LFT or PCR 897 positive individuals were identified by LFT and 2902 by PCR.
- The 897 individuals identified by LFT were not aware they were carrying SARS-CoV-2, they received notification to self-isolate and contact tracing was applied.
- Between a fifth and a third of all SARS-CoV-2 cases detected in Liverpool week by week since 6 November have been via LFT, most recently 30% from 11-17 December.
- Asymptomatic case and contact identification rose in Liverpool between 6 November and 9 December while the corresponding rates in neighbouring Greater Manchester region fell.
- LFT and PCR uptake was lower in more deprived areas, where test positivity was higher.
- LFT and PCR uptake was lower in men than women.
- LFT uptake was lower in younger compared with older age groups.
- Digital exclusion (proxy measure via area-based Internet User Classification) was a strong predictor of poor uptake of LFT and PCR.
- 1km longer walk distance to ATS was associated with 5% reduction in LFT uptake, after controlling for age, deprivation, and digital exclusion.
- At present, there is no clear evidence that that the introduction of MAST led to a change in Covid-19 case incidence or hospital admissions in Liverpool.

### Uptake of testing by demographic and social groups

Uptake of testing (the proportion of the population tested) has occurred unevenly with lower uptake generally found in more disadvantaged groups as illustrated below. The figures below show that uptake of both LFT and PCR was around half in the most deprived fifth of the population compared with the least deprived fifth and that test positivity rates almost mirrored the uptake pattern with the highest positivity being in the most deprived, lowest uptake areas. Uptake was 22% in the white population compared with 15% in the BAME population, but a quarter of participants did not declare their ethnicity, so no firm conclusions can be drawn. Males were less likely than females to take up testing, as were young adults compared with older adults.

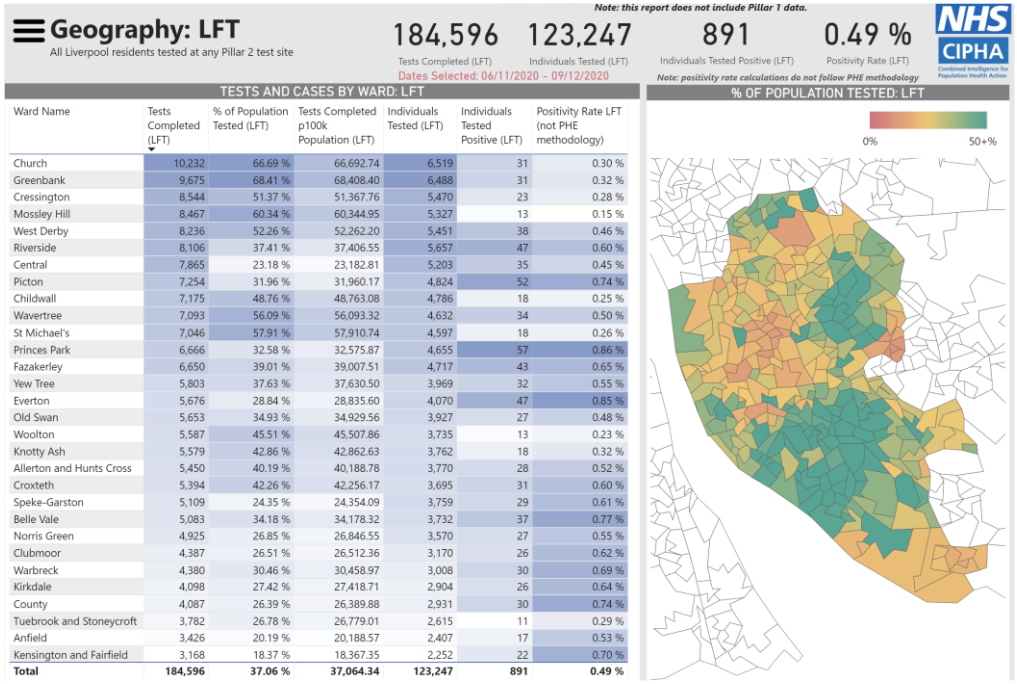
Figure 13: Dashboards for LFT and PCR uptake, purple dots refer to the right-hand axis of percentage of the population segment taking up testing.




Digging beneath the socio-demographic patterns of testing uptake and positivity there is a highly heterogeneous spatial distribution for LFT, but much less so for PCR. Some equally deprived neighbourhoods, next door to each other, displayed very high and very low LFT uptake as illustrated in the maps below:

Figure 14: Thematic maps of LFT and PCR uptake by lower layer super output area (LLSOA) and ward, in dashboards used to guide the pilot, plus annotations on spatial patterns



**Geography: LFT**

All Liverpool residents tested at any Pillar 2 test site

*Note: this report does not include Pillar 1 data.*

| 184,596 | 123,247 | 891 | 0.49 % |
|---|---|---|---|
| Tests Completed (LFT) | Individuals Tested (LFT) | Individuals Tested Positive (LFT) | Positivity Rate (LFT) |

Dates Selected: 06/11/2020 - 09/12/2020

*Note: positivity rate calculations do not follow PHE methodology*

NHS CIPHA

Combined Intelligence for Population Health Action

TESTS AND CASES BY WARD: LFT

| Ward Name | Tests Completed (LFT) | % of Population Tested (LFT) | Tests Completed p100k Population (LFT) | Individuals Tested (LFT) | Individuals Tested Positive (LFT) | Positivity Rate LFT (not PHE methodology) |
|---|---|---|---|---|---|---|
| Church | 10,232 | 66.69 % | 66,692.74 | 6,519 | 31 | 0.30 % |
| Greenbank | 9,675 | 68.41 % | 68,408.40 | 6,488 | 31 | 0.32 % |
| Cressington | 8,544 | 51.37 % | 51,367.76 | 5,470 | 23 | 0.28 % |
| Mossley Hill | 8,467 | 60.34 % | 60,344.95 | 5,327 | 13 | 0.15 % |
| West Derby | 8,236 | 52.26 % | 52,262.20 | 5,451 | 38 | 0.46 % |
| Riverside | 8,106 | 37.41 % | 37,406.55 | 5,657 | 47 | 0.60 % |
| Central | 7,865 | 23.18 % | 23,182.81 | 5,203 | 35 | 0.45 % |
| Picton | 7,254 | 31.96 % | 31,960.17 | 4,824 | 52 | 0.74 % |
| Childwall | 7,175 | 48.76 % | 48,763.08 | 4,786 | 18 | 0.25 % |
| Wavertree | 7,093 | 56.09 % | 56,093.32 | 4,632 | 34 | 0.50 % |
| St Michael's | 7,046 | 57.91 % | 57,910.74 | 4,597 | 18 | 0.26 % |
| Princes Park | 6,666 | 32.58 % | 32,575.87 | 4,655 | 57 | 0.86 % |
| Fazakerley | 6,650 | 39.01 % | 39,007.51 | 4,717 | 43 | 0.65 % |
| Yew Tree | 5,803 | 37.63 % | 37,630.50 | 3,969 | 32 | 0.55 % |
| Everton | 5,676 | 28.84 % | 28,835.60 | 4,070 | 47 | 0.85 % |
| Old Swan | 5,653 | 34.93 % | 34,929.56 | 3,927 | 27 | 0.48 % |
| Woolton | 5,587 | 45.51 % | 45,507.86 | 3,735 | 13 | 0.23 % |
| Knotty Ash | 5,579 | 42.86 % | 42,862.63 | 3,762 | 18 | 0.32 % |
| Allerton and Hunts Cross | 5,450 | 40.19 % | 40,188.78 | 3,770 | 28 | 0.52 % |
| Croxteth | 5,394 | 42.26 % | 42,256.17 | 3,695 | 31 | 0.60 % |
| Speke-Garston | 5,109 | 24.35 % | 24,354.09 | 3,759 | 29 | 0.61 % |
| Belle Vale | 5,083 | 34.18 % | 34,178.32 | 3,732 | 37 | 0.77 % |
| Norris Green | 4,925 | 26.85 % | 26,846.55 | 3,570 | 27 | 0.55 % |
| Clubmoor | 4,387 | 26.51 % | 26,512.36 | 3,170 | 26 | 0.62 % |
| Warbreck | 4,380 | 30.46 % | 30,458.97 | 3,008 | 30 | 0.69 % |
| Kirkdale | 4,098 | 27.42 % | 27,418.71 | 2,904 | 26 | 0.64 % |
| County | 4,087 | 26.39 % | 26,389.88 | 2,931 | 30 | 0.74 % |
| Tuebrook and Stoneycroft | 3,782 | 26.78 % | 26,779.01 | 2,615 | 11 | 0.29 % |
| Anfield | 3,426 | 20.19 % | 20,188.57 | 2,407 | 17 | 0.53 % |
| Kensington and Fairfield | 3,168 | 18.37 % | 18,367.35 | 2,252 | 22 | 0.70 % |
| **Total** | **184,596** | **37.06 %** | **37,064.34** | **123,247** | **891** | **0.49 %** |

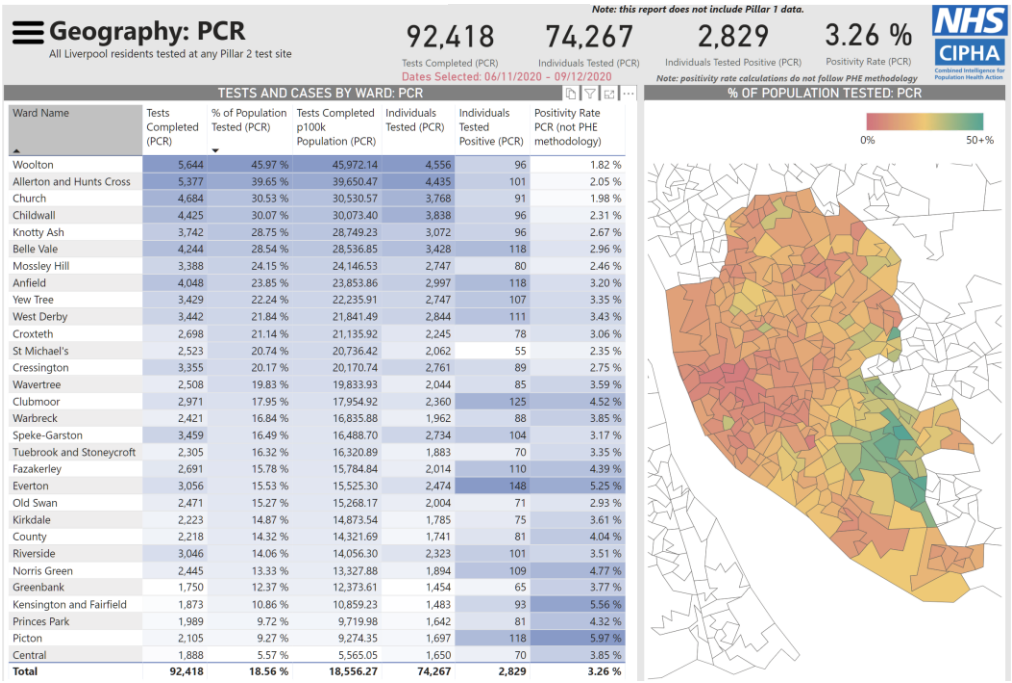
% OF POPULATION TESTED: LFT

0% 50+%

High variation in LFT uptake by small areas (LLSOA)

…hidden within larger area (ward) summaries 18%-67% uptake

…over a month of evolving delivery of community testing



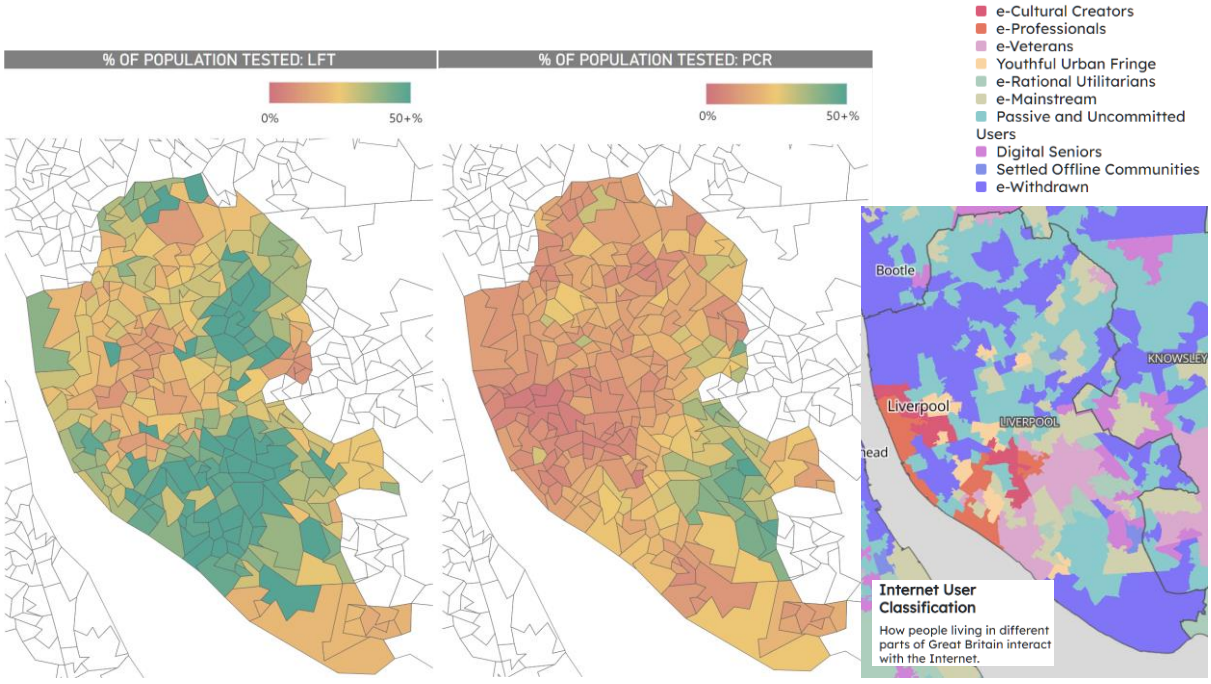

| Ward Name | Tests Completed (PCR) | % of Population Tested (PCR) | Tests Completed p100k Population (PCR) | Individuals Tested (PCR) | Individuals Tested Positive (PCR) | Positivity Rate PCR (not PHE methodology) |
|---|---|---|---|---|---|---|
| Woolton | 5,644 | 45.97 % | 45,972.14 | 4,556 | 96 | 1.82 % |
| Allerton and Hunts Cross | 5,377 | 39.65 % | 39,650.47 | 4,435 | 101 | 2.05 % |
| Church | 4,684 | 30.53 % | 30,530.57 | 3,768 | 91 | 1.98 % |
| Childwall | 4,425 | 30.07 % | 30,073.40 | 3,838 | 96 | 2.31 % |
| Knotty Ash | 3,742 | 28.75 % | 28,749.23 | 3,072 | 96 | 2.67 % |
| Belle Vale | 4,244 | 28.54 % | 28,536.85 | 3,428 | 118 | 2.96 % |
| Mossley Hill | 3,388 | 24.15 % | 24,146.53 | 2,747 | 80 | 2.46 % |
| Anfield | 4,048 | 23.85 % | 23,853.86 | 2,997 | 118 | 3.20 % |
| Yew Tree | 3,429 | 22.24 % | 22,235.91 | 2,747 | 107 | 3.35 % |
| West Derby | 3,442 | 21.84 % | 21,841.49 | 2,844 | 111 | 3.43 % |
| Croxteth | 2,698 | 21.14 % | 21,135.92 | 2,245 | 78 | 3.06 % |
| St Michael's | 2,523 | 20.74 % | 20,736.42 | 2,062 | 55 | 2.35 % |
| Cressington | 3,355 | 20.17 % | 20,170.74 | 2,761 | 89 | 2.75 % |
| Wavertree | 2,508 | 19.83 % | 19,833.93 | 2,044 | 85 | 3.59 % |
| Clubmoor | 2,971 | 17.95 % | 17,954.92 | 2,360 | 125 | 4.52 % |
| Warbreck | 2,421 | 16.84 % | 16,835.88 | 1,962 | 88 | 3.85 % |
| Speke-Garston | 3,459 | 16.49 % | 16,488.70 | 2,734 | 104 | 3.17 % |
| Tuebrook and Stoneycroft | 2,305 | 16.32 % | 16,320.89 | 1,883 | 70 | 3.35 % |
| Fazakerley | 2,691 | 15.78 % | 15,784.84 | 2,014 | 110 | 4.39 % |
| Everton | 3,056 | 15.53 % | 15,525.30 | 2,474 | 148 | 5.25 % |
| Old Swan | 2,471 | 15.27 % | 15,268.17 | 2,004 | 71 | 2.93 % |
| Kirkdale | 2,223 | 14.87 % | 14,873.54 | 1,785 | 75 | 3.61 % |
| County | 2,218 | 14.32 % | 14,321.69 | 1,741 | 81 | 4.04 % |
| Riverside | 3,046 | 14.06 % | 14,056.30 | 2,323 | 101 | 3.51 % |
| Norris Green | 2,445 | 13.33 % | 13,327.88 | 1,894 | 109 | 4.77 % |
| Greenbank | 1,750 | 12.37 % | 12,373.61 | 1,454 | 65 | 3.77 % |
| Kensington and Fairfield | 1,873 | 10.86 % | 10,859.23 | 1,483 | 93 | 5.56 % |
| Princes Park | 1,989 | 9.72 % | 9,719.98 | 1,642 | 81 | 4.32 % |
| Picton | 2,105 | 9.27 % | 9,274.35 | 1,697 | 118 | 5.97 % |
| Central | 1,888 | 5.57 % | 5,565.05 | 1,650 | 70 | 3.85 % |
| **Total** | **92,418** | **18.56 %** | **18,556.27** | **74,267** | **2,829** | **3.26 %** |

PCR pattern different to LFT; dominated by high uptake in

Concentrated in areas with older and more affluent populations

Considering digital exclusion, we use an area-based indicator, the Internet User Classification (IUC)[10], which is displayed alongside LFT uptake in Figure 15. IUC categorises small areas into 10 groups based on how people interact with the Internet - in approximate decreasing order of Internet use (e-Cultural Creators, e-Professionals, e-Veterans, Youthful Urban Fringe, e-Rational Utilitarians, e-Mainstream, Passive and Uncommitted Users, Digital Seniors, Settled Offline Communities, e-Withdrawn).

Figure 15: Maps of LFT and PCR uptake compared with Internet User Classification of areas




Tabulating LFT uptake and positivity by IUC shows a strong effect of digital exclusion but an inconsistent effect of digital inclusion (low uptake and high positivity in Youthful Urban Fringe class).

[10] https://data.cdrc.ac.uk/dataset/internet-user-classification

Table 6: Lateral flow test uptake and positivity by area-based classification of Internet usage

| Internet User Class | Population | Tested | Tests | Positive | %Tested | %Positive |
|---|---|---|---|---|---|---|
| e-Cultural Creators | 36,317 | 7,783 | 10,893 | 42 | 21% | 0.39% |
| e-Professionals | 28,908 | 7,825 | 11,418 | 46 | 27% | 0.40% |
| e-Veterans | 37,305 | 15,843 | 24,616 | 58 | 42% | 0.24% |
| Youthful Urban Fringe | 28,591 | 5,378 | 7,730 | 43 | 19% | 0.56% |
| e-Rational Utilitarians | 8,716 | 3,114 | 4,747 | 11 | 36% | 0.23% |
| e-Mainstream | 56,822 | 16,790 | 24,978 | 99 | 30% | 0.40% |
| Passive and Uncommitted Users | 127,834 | 30,793 | 43,116 | 235 | 24% | 0.55% |
| Digital Seniors | 8,436 | 2,179 | 3,235 | 16 | 26% | 0.49% |
| Settled Offline Communities | 2,734 | 814 | 1,245 | 4 | 30% | 0.32% |
| e-Withdrawn | 162,379 | 29,297 | 39,748 | 277 | 18% | 0.70% |

**Highest uptake and 2nd lowest positivity: 'e-Veterans'** (affluent groups who confidently use the web for shopping and information seeking).

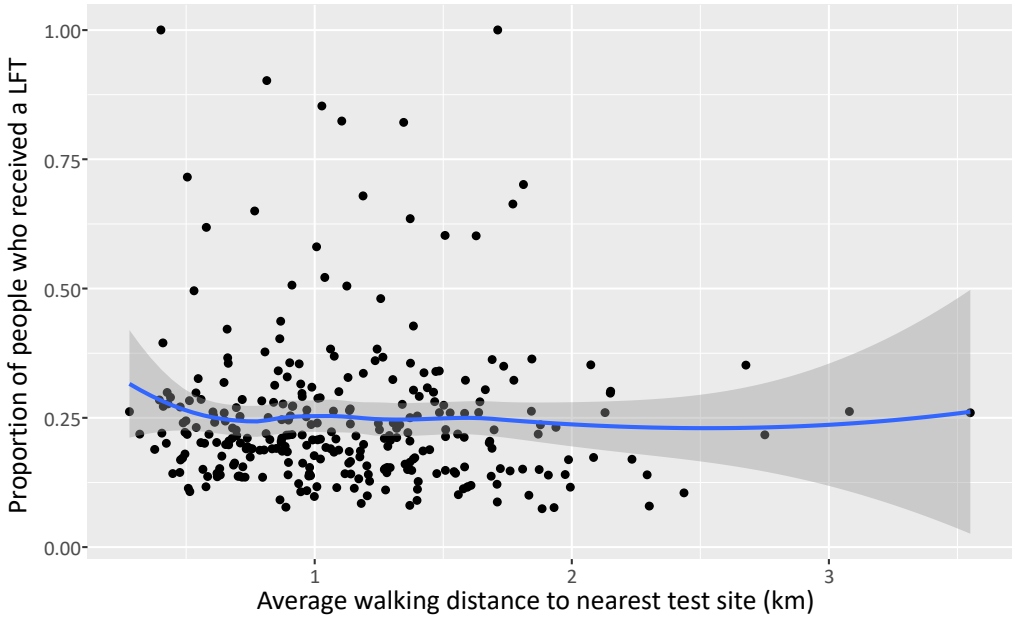
**Low uptake and high positivity despite digital access in 'Youthful Urban Fringe'** (inner city dwellers with high use of internet especially social media, includes young populations including students and ethnically diverse areas).

**Lowest uptake and highest positivity**: '**e-Withdrawn**' (deprived neighbourhoods with little engagement with the internet including poor access to internet technologies or smart mobile phones)

All IUC groups had lower uptake than e-Veterans (represents affluent families, usually located within low-density suburbs, with populations of mainly middle-aged and highly qualified professionals). Uptake was lowest and test positivity was highest in the areas characterised as e-Withdrawn, where people are least confident in using Internet technologies. The Youthful Urban Fringe group was an outlier with low uptake and high positivity despite high Internet confidence.

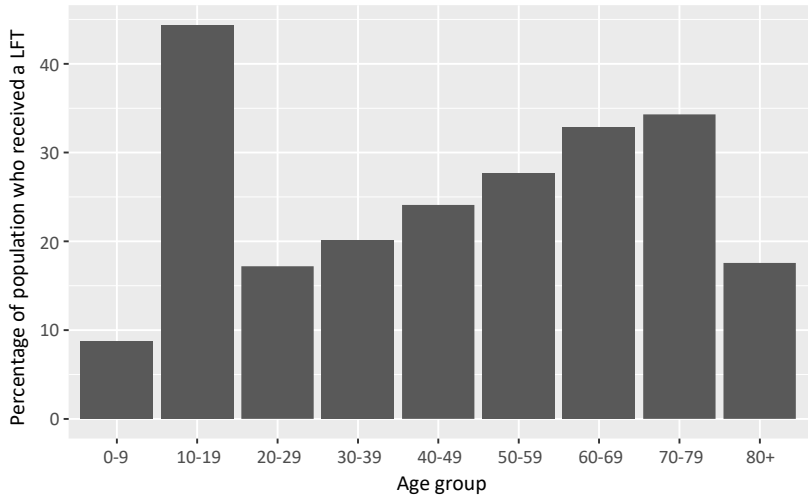
Average distance to testing centres was also negatively associated with test uptake, uptake fell by 5% (95% CI: 3% to 10%) for each 1km extra walking distance, after controlling for age, deprivation and digital exclusion with the model shown in Figure 18.

Figure 16: Plot of lateral flow test uptake by average walking distance from centroid of lower layer super output area to asymptomatic testing site



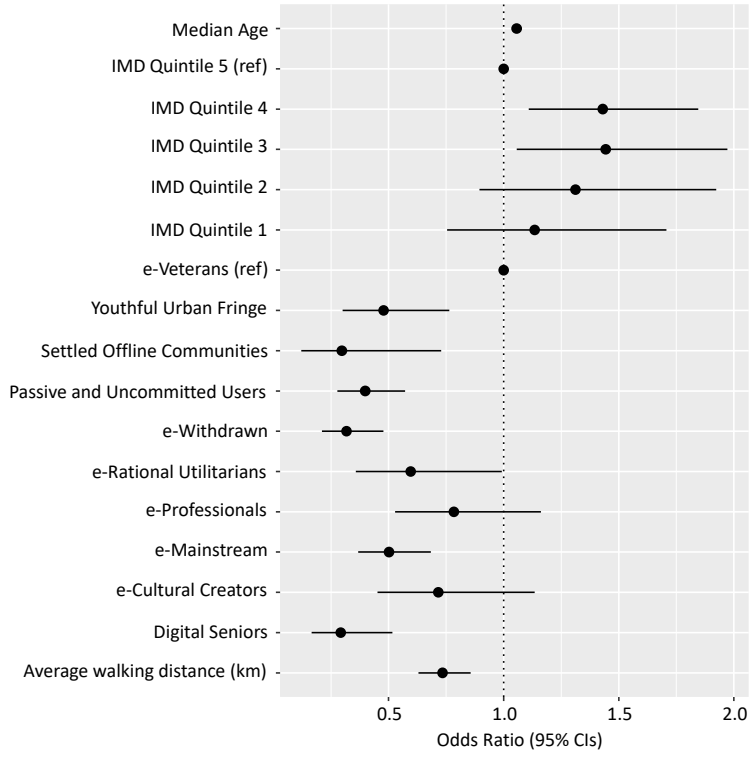
Median age was positively associated with LFT uptake such that areas with older populations tended to have higher uptake, reflecting the age distribution of LFT uptake generally. Teens were an outlier due to testing in schools (32,411 tests on a student to staff ratio of ~5 to 1); colleges and universities:

Figure 17: Proportion of Liverpool City population by age group taking up lateral flow tests




Combining predictors of LFT uptake in one regression model, the strong association with deprivation fades into the more consistent explanation of uptake variation by digital access/exclusion (as proxied by Internet User Classification) after controlling for mean age in the area and walking distance to ATS. Deprivation and digital inclusion are highly correlated. Ongoing work is exploring further the association of digital inclusion with LFT uptake within the context of deprivation.

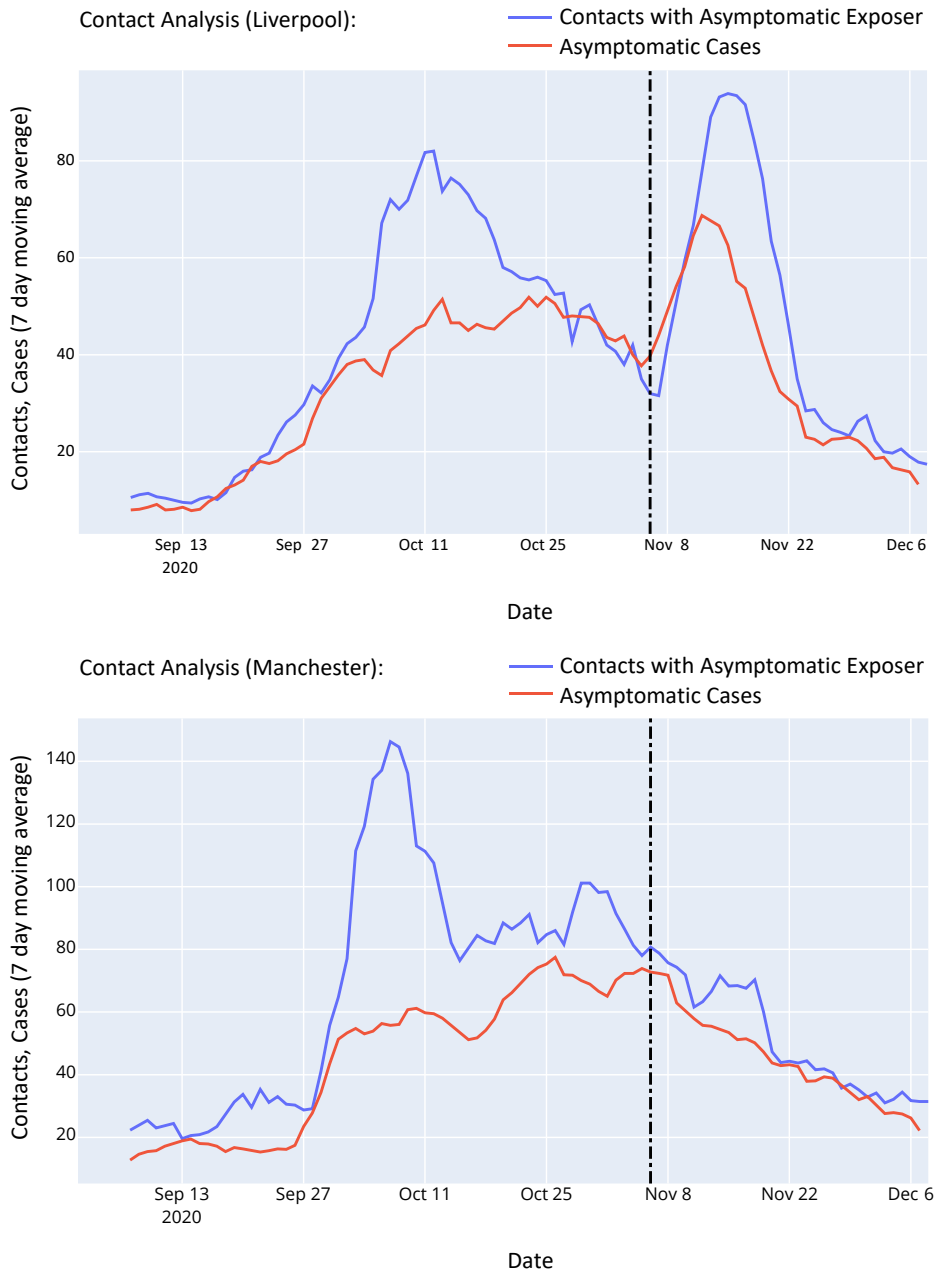
Figure 18: Quasibinomial logistic regression model of lateral flow uptake proportion by lower layer super output area, exploring the relative influence of area-based measures of deprivation, digital exclusion, median age and walking distance to testing site.



## Contact tracing of cases and their contacts

The testing programme in Liverpool led to a marked increase in asymptomatic cases and their contacts being traced. Contact tracing data in Liverpool shows a spike both in asymptomatic index cases (orange line) and contacts with exposure to asymptomatic cases (blue line) that have been reached by contact tracers. All contacts of asymptomatic cases identify potential, and otherwise unknown, chains of transmission that will potentially be broken early where there is compliance with self-isolation. This same pattern is not seen Manchester[11] where community testing was not available and both non-symptomatic index cases and their contacts continued to decline after 6 November.

Figure 19: Asymptomatic index cases and contacts reached by tracers in Liverpool and Manchester

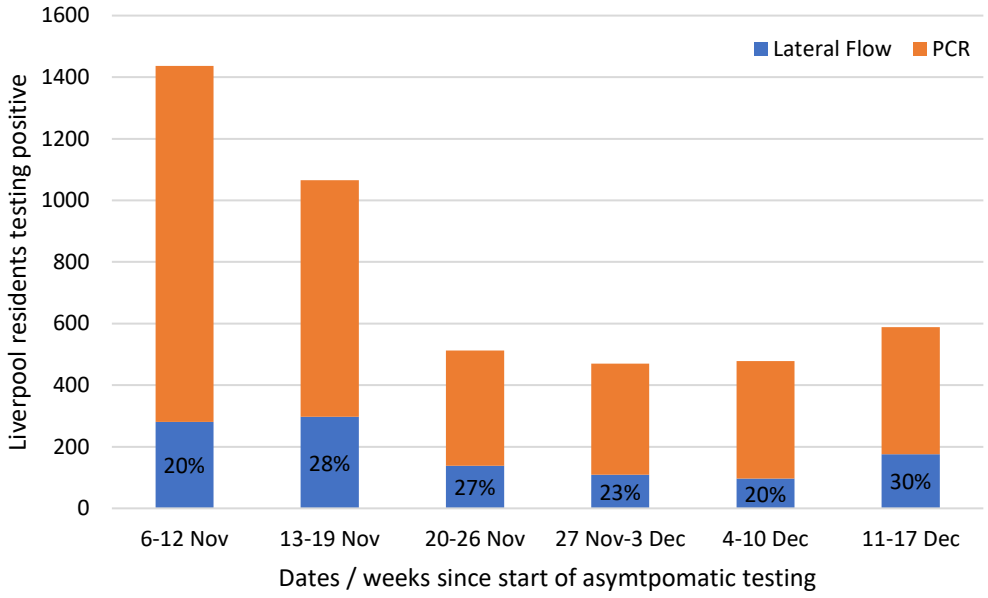



[11] Manchester has been identified as the area most like Liverpool based on a number of metrics (e.g., age, gender, ethnicity, number of tests, positive cases)

## Trends in case detection via lateral flow and PCR

In the initial four weeks of the pilot LFT accounted for between a fifth and a third of all cases detected via Pillar 2 in Liverpool, and this has been sustained in the SMART testing service with the most recent week (11-17 December) seeing 30% of cases detected via LFT as shown in figure 20.

Figure 20: Numbers of Liverpool City residents identified as SARS-CoV-2 positive via LFT or PCR




## Prevalence of SARS-CoV-2 infection

There are several different approaches to estimate prevalence, which are listed in Table 2. Although there are downward trends in many of the prevalence indicators during the testing period, this trend started before mass testing and the presence of other non-pharmaceutical interventions, such as tier restrictions, means that we cannot be confident in attributing prevalence changes solely to mass testing. It should be noted that Pillar 2 data may not provide a good representation of underlying positivity trends, as it is not representatively sampled. Zoe[12] data is also not a representative sample, but it has been adjusted to account for known biases in the uptake of the Zoe app.

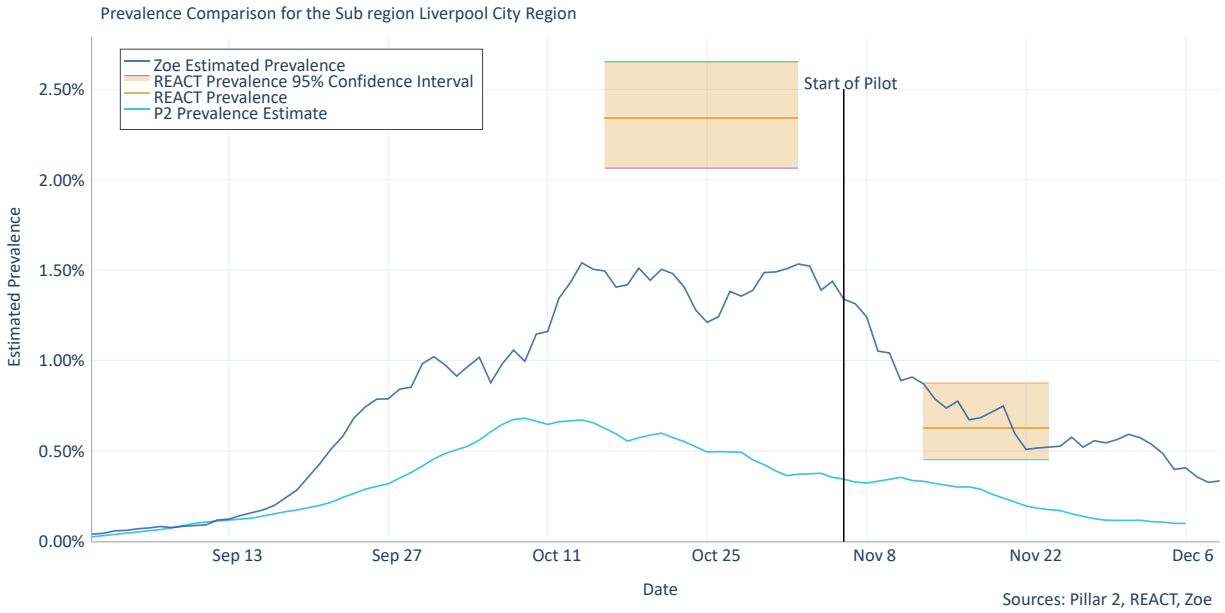
Table 7: The different measures of prevalence available for Liverpool City local authority area

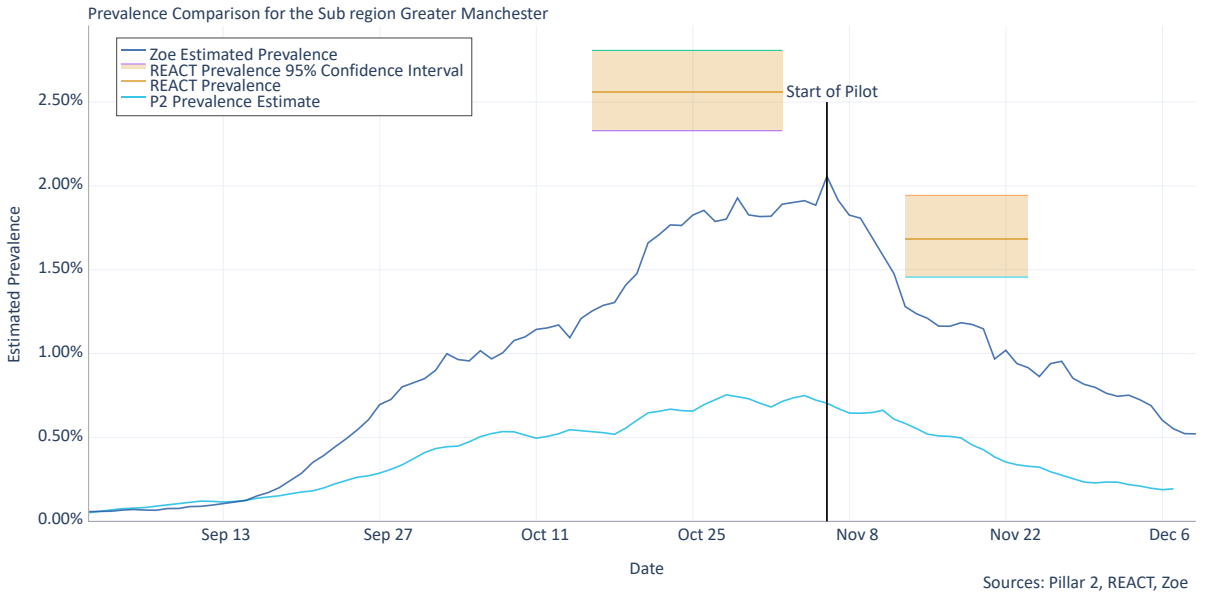
| **Study** | **Prevalence estimate** | **Region** | **Trend 6 Nov – 3 Dec** |
|---|---|---|---|
| Pillar 2 | 10-day rolling sum of positive cases / population | Liverpool City Region | Downward |
| REACT-1 | Positive tests / total tests (for a given period) | Liverpool City | Downward |
| ONS | Positive cases / total population | Liverpool, West Lancashire, Knowsley and Sefton | Upward |
| Zoe | Active cases / population | Liverpool City | Downward |
| Wastewater | SARS-Cov2 RNA concentration in gene copies per litre | Six sub-catchments in Liverpool | Initial spike but continuing downward |

[12] https://covid.joinzoe.com/data

Figure 21 shows estimates of prevalence in the Liverpool City Region and Halton area and in the Greater Manchester area for comparison. Based on Pillar 2 test data prevalence increased from the beginning of October, spiking in mid-October (when the Very High local alert level was introduced) and decreased from that point onwards. The prevalence estimates from the Zoe data are similar although there is a steeper decline after the introduction of mass testing. However, similar decreases in prevalence based on Zoe data can be seen across other Manchester, which suggests that this is not attributable to mass testing. REACT shows a marked reduction in prevalence, though only two estimates are available at this level. Whilst the ONS data (not plotted) shows decreases in prevalence before the introduction of mass testing, positivity increased quite substantially from 1.5% to 2.3% between 8 and 14 November. Unfortunately, a direct comparison is not possible as the ONS data also includes other areas in this estimate (West Lancashire, Knowsley & Sefton).

Figure 21: Prevalence estimates from Pillar 2, ZOE and REACT over time, comparing Liverpool City Region with Greater Manchester

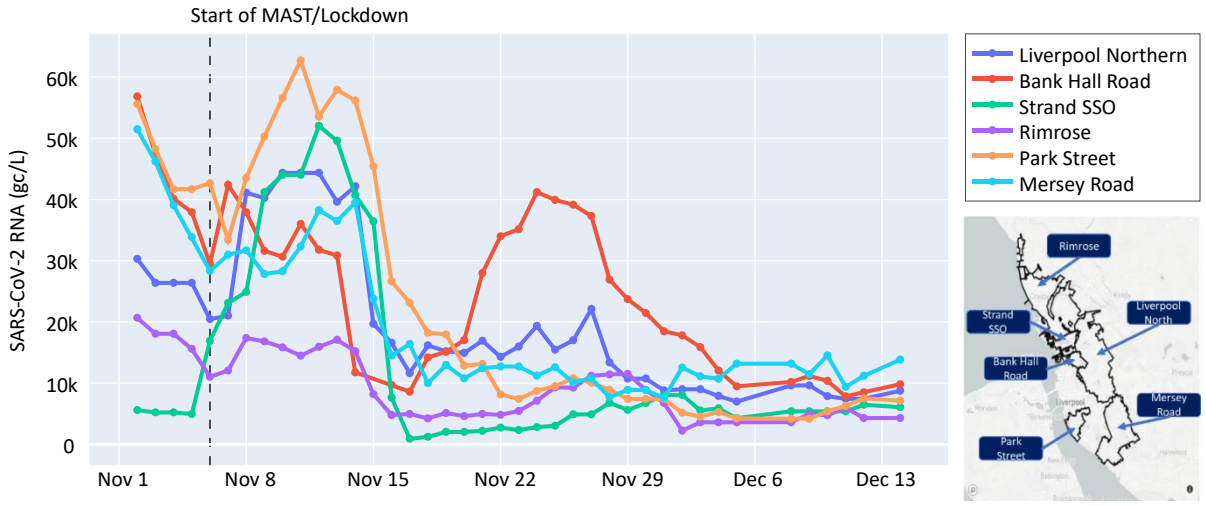


## Wastewater analysis

Although wastewater is aggregated and is not a direct measure of prevalence, it represents a valuable source of information given that it does not suffer from biases in testing rates. The wastewater trends in prevalence show an initial decrease followed by a spike in case numbers after MAST was introduced. This spike is likely due to increased movement of the population following the announcement of national lockdown (supported by trends in Google mobility data). However, since the initial spike, there has been a substantial reduction in prevalence continuing until the present. Wastewater analysis was used to guide the prioritisation of testing locations and was stepped up in the 3 days before the pilot started.

Figure 22: Seven day moving average SARS-CoV-2 indicators of prevalence as gene copies per litre of effluent in six sub-sewer catchment areas sampled.




After lockdown and pilot testing started 6th November there was a resurge between 9 and 12 November before levels declined across areas.

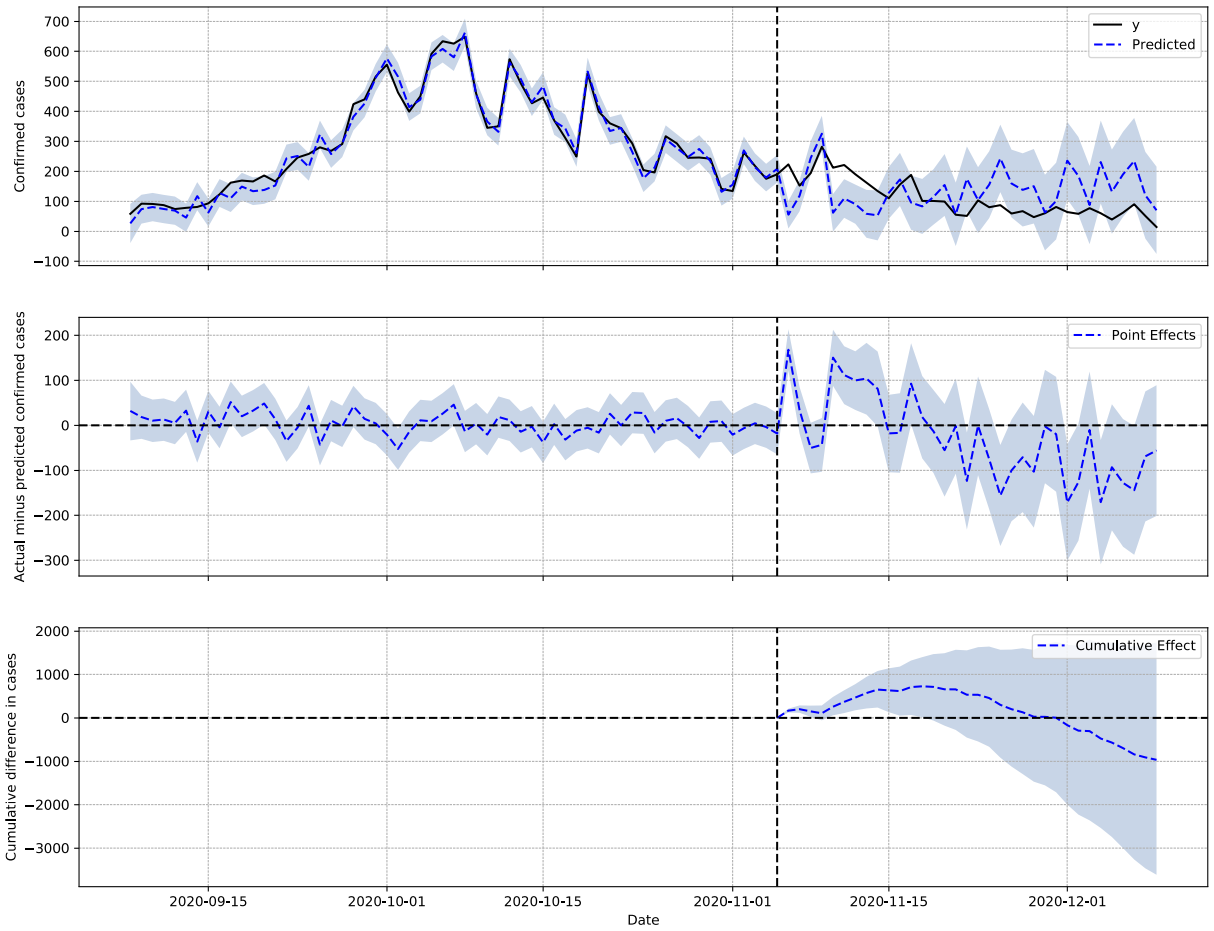
## Causal analysis of impacts on case and hospitalisation rates

The analysis of trends outlined above provides limited insight into whether any change in transmission is attributable to the introduction of MAST. To address this, a Bayesian structural time-series model[13] (sometimes called synthetic controls) was used. This approach uses information on similar areas that did not undergo mass testing to estimate what would have happened in Liverpool if MAST had not implemented on the 6 November. This method provides an estimate of the 95% credible intervals of the effect of the intervention, these are an indication of the range of values within which the true effect might lie – shown in the purple shaded region in the charts. Figure 22 shows analysis estimating the impact on Covid-19 cases in Liverpool. The first panel shows the trend in cases in Liverpool before and after the introduction of mass testing (black line) and the trend that is predicted in the absence of mass testing (blue dotted line). The second panel shows the estimated impact – i.e., the differences between the actual trend in cases and the predicted counterfactual. The third panel indicates the cumulative estimated impact. Although the estimates suggest a slight reduction in cases in Liverpool following the introduction of mass testing compared to the predicted levels – as the credible intervals

[13] https://storage.googleapis.com/pub-tools-public-publication-data/pdf/41854.pdf

cross zero, this could just be due to chance. So, the analysis does not provide any clear indication that MAST had an impact on the trend in cases in Liverpool during the study period.

Figure 23: Causal impact analysis on positive cases

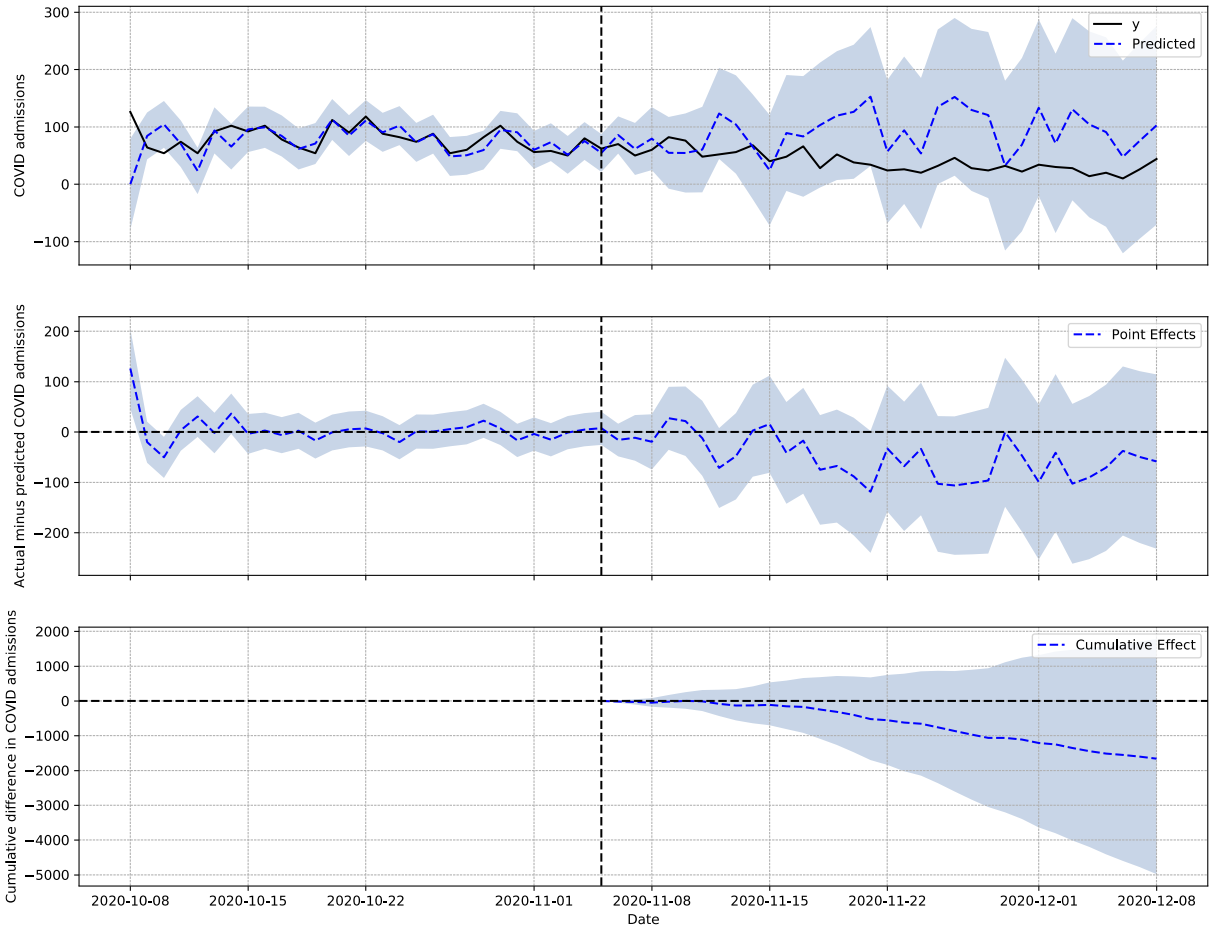



Note: The first 7 observations were removed due to approximate diffuse initialization.

The analysis of cases could, however, underestimate any effect of MAST, since MAST increases the number of cases identified regardless of any changes in infections. Applying the same technique to hospitalisations[14] mitigates some of these ascertainment biases. Figure 23 shows the same analysis utilising hospital admissions as an outcome. Similarly, the results indicate a slight reduction in hospital admissions in Liverpool following the introduction of MAST compared to the predicted levels, however the credible intervals cross zero, so the analysis does not provide any clear indication that MAST had an impact on the trend in hospital admissions in Liverpool during the study period.

[14] This includes all confirmed positive Covid-19 admissions for all NHS Trusts in Liverpool

Figure 24: Causal impact analysis on hospitalisations




Note: The first 7 observations were removed due to approximate diffuse initialization.

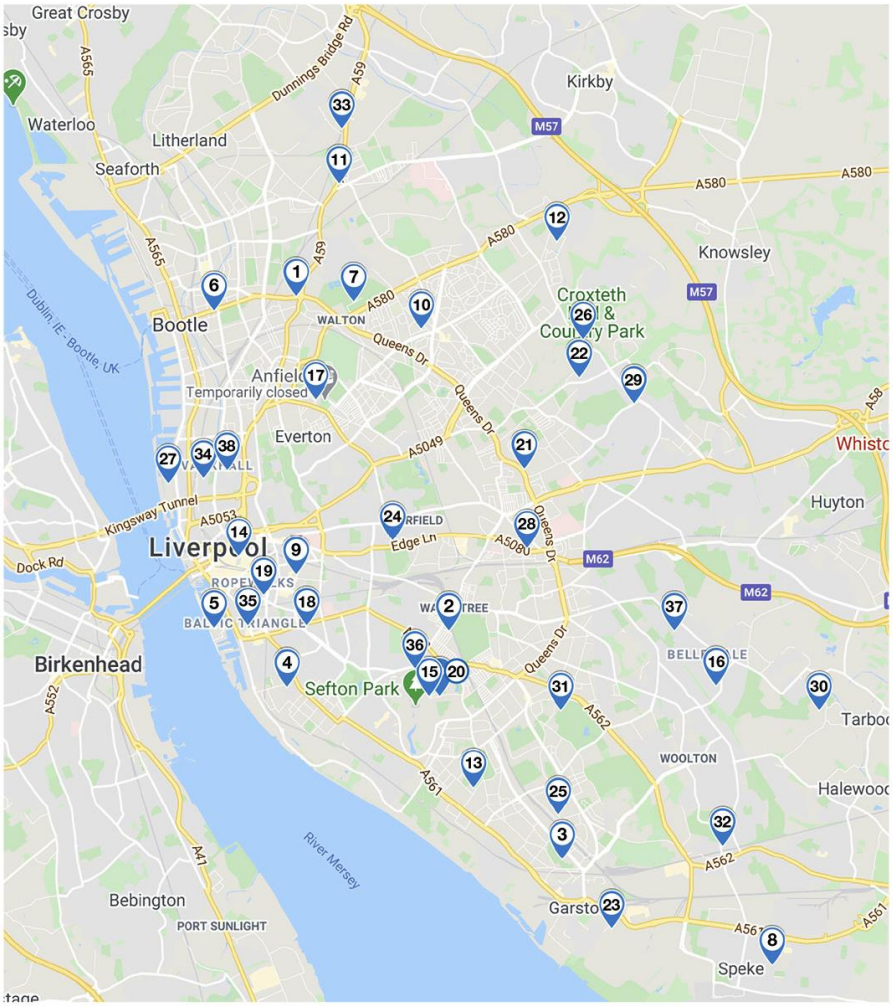
## Further information

A fuller report with confirmed findings is intended for publication in early 2021.

Evaluation work is ongoing, and the contents reported here may be updated.

Please contact buchan@liverpool.ac.uk for further information.

## Liverpool Testing Centres




1. Lifestyles Alsop Fitness Centre
2. Liverpool Tennis Centre
3. Lifestyles Garston
4. Lifestyles Park Road
5. Exhibition Centre Liverpool
6. Lifestyles Ellergreen
7. Lifestyles Walton
8. Lifestyles Austin Rawlinson
9. Liverpool University Gym
10. Bridge Community Centre
11. Aintree Baptist Church
12. Croxteth Sports Centre
13. IM Marsh Sports
14. St John's Market
15. Greenbank University Village - STUDENTS ONLY
16. St Stephen's Parish Centre
17. Liverpool Football Club
18. Caribbean Community Centre
19. Liverpool Hope University Sports Centre
20. Greenbank Sports Academy
21. Alder Sports & Social Club
22. Deysbrook Village Community Centre
23. David Lloyd Liverpool Speke
24. Devonshire Hotel
25. Heath Hall
26. Croxteth Hall
27. Invisible Wind Factory
28. 15th Fairfield Scout Group
29. St Luke's Church, West Derby
30. Woodlands Community Centre
31. East Wavertree & Childwall Community Association
32. St Hilda's Parish Hall
33. Aintree Race Course
34. Eldonian Village Hall
35. Liverpool City College
36. Conference Centre LACE
37. Salvation Army Belle Vale
38. Lee Jones