Targeted Lung Health Check Programme

Final evaluation report

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- Staff within TLHC services who have collected local data on the services for the evaluation dataset.
- The NHS England national programme team, the TLHC Clinical Leads, and wider stakeholders including members of the Evaluation Oversight Group and the Expert Advisory Group.

Please note, the results of an economic analysis of the programme are available separately from NHS England, and not published with this report.

Executive summary

Programme origins and design

The Targeted Lung Health Check (TLHC) programme is an ambitious endeavour, aiming to translate the promising outcomes from preceding clinical trials and pilots of lung cancer screening[1] into realised benefits within the NHS. The programme, which initially started as a five-year pilot programme, sought to confirm whether these promising outcomes in the earlier studies could be achieved on a population basis, working across a wider geography and in 'real world' (not trial) conditions. The overarching ambition is to diagnose lung cancers at an earlier, and therefore more treatable, stage.

Several design decisions were taken at an early stage, and shaped the programme:

- Project areas were selected based on need, defined by lung cancer mortality rates. As such, these areas are not representative of England more broadly. The implication is that these areas stand to see greater benefits of a TLHC intervention than other areas.[2] Areas were split into ten initial projects (phase 1 – starting in 2019), a further eleven projects (phase 2 – which started over a wide range of dates) and a larger final group (phase 3 – starting in April 2022). The evaluation focuses on phases 1 and 2.

- From a relatively early stage in the programme, there was an assumption that the pilot would be spread to other parts of the country, subject to confirmation from the UK National Screening Committee (UK NSC). In 2022, UK NSC recommended in that the four UK nations implement a national targeted lung screening service. This recommendation was supported by a government announcement in June 2023 of the roll out of such a service.

- The NHS England TLHC national programme team (referred to as the national programme team throughout), and its potential roles in supporting programme implementation, was designed to be lean. No central IT system has been procured (as has happened in other national screening efforts) and there has been no nationwide advertisement or promotion of the programme. Projects have therefore needed to deliver in a creative, agile, and relatively autonomous way locally, to organise aspects such as procurement, infrastructure, staffing, and IT.

- Whilst much was left to local decision-makers, the national programme team offered central support for several key facets of the programme. Clinicians set a Standard Protocol and Quality Assurance Standards to ensure a degree of consistency in delivery. Procurement and policy specialists offered support to projects to access CT scanner capacity.

[1] See for example, the findings from the Manchester pilot study: https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [Accessed: October 2024]

[2] Lung cancer incidence and mortality is higher in the most deprived areas. It is estimated that there are around 14,300 more cases of lung cancer each year in England than there would be if every deprivation quintile had the same age-specific crude incidence rates as the least deprived quintile. https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/incidence#heading-Five [Accessed: September 2024]

- Funding was made available by the NHSE Cancer programme, initially based on a fixed funding model (with additional variable funding provided to projects anticipating larger throughput)[3], then from April 2022 based on activity (i.e. number of Lung Health Checks (LHCs) and CT scans delivered). Both approaches took a relatively uniform approach to funding, rather than other considerations such as staffing make up, or population characteristics. Projects have therefore needed to carefully manage their throughput, to ensure efficient demand and supply management for the service.

- An evaluation partner was appointed with a brief to evaluate the processes, impacts and costs of the programme, gathering learning for future adopters. A Management Information (MI) dataset to collect aggregate level data on project delivery was designed, including the record level Minimum Dataset (MDS) return completed by a subset of Phase 1 and 2 projects, and work was undertaken with projects to enable them to report this data regularly. Projects have had to invest substantial time locally to ensure their systems are able to collect and report data in the required format, and some of the major outsourced providers have embedded data reporting capabilities across the projects they support.

Programme outputs

To support a comparison of programme outputs against original objectives, several documents, including modelling assumptions for Phase 1 projects, were supplied to the evaluation team. These assumptions were primarily drawn from the experience of one of the earlier trials in Manchester (and these are referenced here to offer benchmarks). An original business case for the programme was not made available to the evaluation partner, as the case for change for the programme was already established in the development of the NHS Long Term Plan.

Below is a summary of project activity from Phase 1 and 2 projects, the population of interest of this evaluation:

Invites: Between April 2019 and March 2024**,** 1.22 million TLHC invites were sent out (including follow-up invites[4]). Project delivery started in 2020 but was delayed by the COVID-19 pandemic. Activity accelerated significantly from April 2021.

LHC uptake: A total of 324,000 LHCs were delivered, with a final observed LHC uptake rate of 44% (increasing from 33% in March 2021 to 36% in March 2022 then 41% in March 2023). This is higher than the 26% uptake rate observed in the initial Manchester pilot study (which used a different approach to calculate uptake than the TLHC programme[5]) but slightly lower than the 50% LHC uptake rate initially anticipated for the programme. More than 4 in 5 LHCs were delivered by telephone. The majority of those LHCs delivered face-to-face were in Manchester, where an in-person model had been developed prior to the pandemic.

[3] The fixed funding settlement figure was determined based on an analysis of the staffing costs for the Manchester trial. This was £328,000 per project but rose to £488,000 for some larger projects.

[4] Follow-up invites are additional invites sent to eligible individuals after not responding to their initial invitation to an LHC.

[5] The Manchester study calculated uptake slightly differently to TLHC, as they identified a cohort of around 16,000 individuals and invited all of them. From that they estimated that only 10,000 were eligible. And they calculated the uptake based on the estimated 10,000 figure. It is not clear how many invites each person received for example. But with the 10,000 as the denominator, the uptake rate in this pilot was 26%.

CT scanning: A total of 242,000 CT scans were delivered, of which 163,000 were initial scans. Few projects have yet delivered 48-month follow-up scans. CT scan conversion (eligible) and (realised) rates[6] improved over the course of programme delivery (from 46% to 52% and from 43% to 50% respectively). This suggests that, over time, the TLHC programme has been conducting LHCs with higher risk individuals, and participants have been increasingly likely to attend their CT scan. However, CT scan conversion (eligible) remains slightly lower than the initial programme assumption of 54%, based on earlier trials.

Lung cancer diagnoses: A total of 2,748 TLHC participants received a lung cancer diagnosis. This represents 1.7% of all participants who received an initial CT scan. This is in the middle of the range of performance from the predecessor trials/ pilots and provides encouraging evidence that a similar diagnosis rate can be replicated at larger scale.

Stage at diagnosis: Of lung cancers diagnosed through the TLHC programme, 76% were diagnosed at an early stage.[7] This is similar to early diagnosis rates in the Manchester pilot study (80%) and other national screening programmes (79%).

Programme implementation

Setup and early delivery

Key setup steps included establishing appropriate local governance, ensuring data sharing agreements were in place, modelling anticipated local demand which built on national estimates, agreeing on a preferred implementation model, establishing protocols and pathways for the management of incidental findings, recruiting and training staff, and developing a local strategy for rolling out across different localities.

Very few projects had begun the pilot phase of delivery prior to March 2020, and activity slowed significantly across 2020 due to the COVID-19 pandemic. The original pilot programme's timeline was extended by one year to give projects more time to meet their delivery targets. The pandemic also impacted on planned implementation, including the updated requirement for LHCs to take place virtually (which ended up becoming an embedded feature of almost all projects). It appears unlikely that this will change as the programme rolls out nationally.

Projects welcomed the flexibility offered by the Standard Protocol in terms of selecting a model that would work best for their local context, the ad-hoc and more substantial support provided by the national programme team to projects during setup – for example around developing the nursing and radiology training offer – and the funding model used during setup which enabled local prioritisation. However, challenges included limited local capacity to deliver TLHC leading to substantial outsourcing of the programme, data sharing challenges particularly in accessing GP practice patient data, and challenges in securing buy-in from primary and secondary care providers.

[6] CT scan conversion (eligible) = Proportion of LHC attendees who are deemed high risk and eligible for a CT scan. CT scan conversion (realised) = Proportion of LHC attendees who attend an initial CT scan.
[7] Unstaged cancers have been removed from the calculation in line with national reporting.

Delivery

Projects have struggled to efficiently define and identify their eligible populations, largely driven by poor quality GP practice data on smoking status. Overall, projects felt that more centralised support from the national programme team to access patient records would be beneficial.

Projects typically rolled-out locally to patches of multiple GP practices, sometimes across the footprint of a Primary Care Network (PCN). This helped with administration, although it offered less control in terms of rolling out by other area characteristics, for example deprivation levels.

Ensuring local buy-in from GP practices was critical to the success of local implementation. Even at the time of the final qualitative data collection with projects – and despite the announcement by the National Screening Committee – some GP practices refused to participate in the programme citing concerns about the additional activity generated by the programme. Other crucial success factors were: efficient organisation and deployment of scanning infrastructure; local promotion of the service; and community engagement approaches. Common delivery challenges included: ensuring high and consistent participant uptake; and variable access to local smoking cessation service for onward referrals.

Implementation models and their effectiveness

Several implementation models emerged during delivery. These were selected both to meet the needs of local places (for example capacity and workforce) as well as perceptions and evidence about which models would be likely to produce the best results. Projects learned from each other, as intended in this pilot, and modifications were made to implementation models throughout programme delivery. This has presented challenges for the evaluation, in terms of understanding the relative effectiveness of different models, because these did not typically stay static. It should also be noted that the comparison of projects' different implementation models was not compared with a suitable counterfactual group.

There is no one definitive model that works best. Suitability will vary depending on local needs and context. However, the analysis broadly suggests the following:

- Opt-out models for LHC invitation help in driving LHC uptake but do not appear to result in more attendees who receive a high-risk score and are deemed eligible for a CT scan, or the highest rates of lung cancer detection;
- In the few projects that used it post-pandemic, the face-to-face model of LHC delivery appears to drive higher LHC uptake;
- Community-based CT scanning models were far more popular amongst Phase 1 and 2 projects; 85% of initial scans took place in community-based models. The proportion of individuals who are eligible and referred for a CT scan but do not attend it (referred to as CT scan drop off in this report) is higher for projects using acute-based scanners.

Engagement of different demographic groups

The TLHC programme was initially targeted at areas of the country with higher levels of lung cancer mortality; these areas are also characterised by higher-than-average deprivation and smoking rates, as well as predominantly White populations (96% of the eligible population). The evaluation examines uptake of LHCs, scans, and outcomes for patients (including rates of diagnosis) differentiated by a range of demographic characteristics.

Projects have made efforts to ensure that invites are reaching groups living in more deprived parts of their geographies, and to ethnic minorities. The data does suggest both groups are slightly over-represented in invite data compared to the eligible population estimates[8] although ethnicity data should be treated with caution due to the high proportion of unknown ethnicities for invitees.[9] However, LHC uptake appears to be lower in both groups, though still generally high overall, demonstrating the programme's contribution to targeting these groups. This is a particular issue in more deprived areas, where participants are more likely to be eligible for an initial scan. This suggests that, whilst targeting this cohort, individuals more likely to be assessed as high-risk for lung cancer are less likely to accept invitations. A further challenge experienced by projects is that participants in more deprived areas have a higher drop-off rate as they progress through the pathway; despite being higher risk, they are less likely to attend their scan. The proportion of participants attending an initial CT scan who go on to receive a lung cancer diagnosis (the lung cancer conversion rate) is higher in more deprived areas. This means that by focusing on improving the LHC uptake and CT scan attendance of people living in more deprived areas, even more lung cancers could be diagnosed, and at an earlier stage.

There is little difference between age and gender subgroups, except for patterns which could be expected given lung cancer incidence in the wider population such as higher CT scan eligibility amongst older age groups and males. Female participants have an unexpectedly higher lung cancer conversion (1.87% vs 1.27%) and early-stage diagnosis (67.2% of all cancers diagnosed at stages 1 and 2 vs 62.1%) than male participants, but this could be driven by confounding factors such as female participants being – on average – older.

There are further gains to be made in delivering effective engagement strategies targeted at specific groups. Projects have trialled a wide range of approaches to encourage eligible individuals to engage with the programme and book an LHC appointment, with mixed results, reported anecdotally. Examples include place-based targeting (such as high footfall places or workplaces where higher risk is more likely), a free appointment transport service and community and voluntary partnerships (such as Age UK and other local charities). However, there has not been sufficient resource or expectation that these strategies should be robustly tested. This means that the evidence base of "what works" is relatively weak.

The programme recognised many of these uptake challenges at an early stage. To improve participation and understanding of the barriers, the programme commissioned behavioural science research. A key finding suggested rebranding the programme to 'lung cancer screening', a name that tested well in online surveys, while retaining the 'lung health check' appointment name. The name change is expected soon. Further research will explore reminder types, communication wording, and engagement strategies to increase uptake among current smokers.

Participant experience

Participants cited very positive experiences of TLHC services. They were motivated to attend by the fact that the service was free to access and convenient, with some noting they had prior concerns about their health. Barriers to engagement included the risk of contracting COVID-19 (participant fieldwork took

[8] Eligibility population estimates are constructed using the GP Patient Survey (GPPS) 2022 data and Office for National Statistics (ONS) Population Estimates data. These estimates were created looking at the number and proportion of eligible individuals, by age range and ever-smoker status within all project areas. For more information, please see section 6.7.

[9] The ethnicity is 'not known' for 38% of invitees in the MDS, though reduces to 6% for LHC attendees.

place in 2021-22), and nervousness about potential findings. Some invitees did not see the benefit of a LHC given they had no symptoms they were concerned about. There was also an assumption among some invitees that, if the service were important, their GP would have told them about it. As such, it is possible that greater involvement of GPs in the LHC invitation process could improve both participant awareness and recognition of the value of health check programmes.

Participants were very positive about the booking process, the time it took to move between stages of the pathway, the information provided in advance of the scan and the staff and convenience. Overall, 94% described their experience as either “very good” or “good”.

Some areas of more constructive criticism included a preference amongst some for face-to-face appointments and a desire for more information about the process, including about the benefits and risks of CT scanning.

Programme outcomes

Lung cancer outcomes

- **The TLHC programme was effective in meeting its objectives relating to the number and share of lung cancers diagnosed at an earlier stage.** It is estimated that an additional 781 lung cancers were diagnosed at stage 1 or 2 in pilot areas between 2019 and 2022 that would have otherwise been diagnosed at a later stage or not diagnosed at all. The programme also enabled the detection of an additional 341 lung cancers at stage 3 or 4. Descriptive analysis identified that the share of total lung cancers diagnosed at stage 1 or 2 rose from 25% to 39% between 2019 and 2022 in pilot areas (with no clear improvement trajectory in non-pilot areas sharing similar characteristics). This is likely driven by the share of early-stage lung cancers diagnosed amongst those participants attending LHCs.

- The introduction of the programme is likely to place **additional short-term demands on NHS resources** by increasing the number of lung cancer diagnoses. This effect is likely to be temporary as the system reaches a new equilibrium in which a higher share of those with lung cancer are diagnosed at earlier stages, likely leading to a future reduction in demand for late-stage cancer treatment. Evidence from the evaluation indicates that the number of additional lung cancers diagnosed begins to fall three years following the introduction of the pilot. For the purposes of future capacity planning, it may be reasonable to expect that additional demand for diagnostic and treatment capacity will persist for at least four to five years. However, it should be noted that the programme was targeted at those areas with the highest lung cancer mortality rates, and the roll-out of a lung cancer screening service to other areas might reasonably be expected to produce smaller demands on NHS resources.

- **Earlier diagnostic staging has not yet led to improved lung cancer mortality outcomes over the timescale of the study.** This is in line with clinical expectations given the timescales required to observe improvements in mortality rates due to earlier diagnosis of lung cancer.

- **The increased volumes of lung cancer diagnoses were predominantly concentrated among those individuals identifying as White British.** Within TLHC intervention areas, the number of lung cancers per 10,000 increased more within White British groups than in other

ethnic groups[10] compared to comparison areas. Descriptive analysis indicates that the likely widening of this gap is due to increases in the number of lung cancers in White British groups, whilst the number of lung cancers in other ethnic groups showed no deviation from prior trends. This raises some questions as to how all groups within the target population can be effectively engaged.

- **The programme did not lead to any other positive or adverse impacts across subgroups.**
    - While there was a larger increase in the number of stage 1 or 2 cancers diagnosed amongst those aged 66 to 76 than amongst those aged 55 to 65, this is likely largely attributable to higher prevalence amongst the older cohort.
    - The introduction of the TLHC programme was equally effective in the 20% most deprived areas and the 80% least deprived areas. Nevertheless, the pilots were likely to help narrow the gap between the most and least deprived areas as they tended to be targeted at more deprived areas. Additionally, the TLHC programme identified cancer at an earlier stage, regardless of level of deprivation. In the analysis of the full patient-level dataset (Appendix 6) which examined distribution of lung cancer staging for those who took up the TLHC offer and those who did not, a greater proportion of lung cancers were diagnosed at an early stage by the TLHC programme. This was compared to people whose lung cancers were detected using routine services, and was evident, regardless of whether people lived in areas of deprivation.

Incidental finding outcomes

Incidental findings are the other (non-lung cancer) conditions detected via TLHC in participants, typically during CT scans but also during the LHC. Three-quarters of participants who received an initial CT scan had one or more incidental finding(s) reported. The three most commonly reported incidental findings are:

- Coronary calcification (identified in 56.35% of participants)
- Aortic valve calcification (29.80%) and,
- Moderate or severe emphysema (15.64%).[11]

Diagnosis rates for incidental findings vary significantly across Cancer Alliances, ranging from 10% to 87.1% of participants per LHC. This variation might be influenced by different local clinical and reporting practices (i.e. reporting all conditions or just those which are clinically treatable, which is set out in the programme's protocol so is variably adhered to).

In addition to the 2,748 lung cancers diagnosed through the programme in all Phase 1 and 2 projects, within the subset of record-level Phase 1 and 2 projects (from whom this data was collected), 1,697 other (non-lung) cancers were diagnosed between February 2020 and August 2023 in 1,673 participants

[10] Those who do not identify as from a white ethnic group (for example, white British) are referred to as 'other ethnic groups'

[11] These conditions are recognised as common findings during lung CT scans. Source: https://academic.oup.com/ejcts/article/64/4/ezad302/7295842?loginhttps://academic.oup.com/ejcts/article/64/4/ezad302/7295842?login=false=false [Accessed: September 2024]

who received an LHC and were assessed as high risk.[12] 481 of these cancers (28% of all diagnoses) were diagnosed within three months of the participant's last TLHC event.[13] This may indicate that these cancers may have been detected and referred via TLHC or as a result of the programme encouraging improved health behaviour in participants. The most common tumour group sites were Urological (680 diagnoses, 40% of all other cancers), Upper Gastrointestinal (254, 15%), and Colorectal (178, 11%).

Stakeholders felt that the number of incidental findings being found was higher than initially anticipated compared to local modelling. The additional strain placed on primary and secondary care services to manage this demand has been a recurring theme throughout the evaluation and the evaluation has been informed that the national programme team is developing more advice and guidance on the management of incidental findings.

Smoking cessation outcomes

Most current smokers were offered advice and support for smoking during their LHC, but the offer was not universal. Fewer still reported receiving a referral or being signposted to a local service. This is likely, at least in part, due to local authorities being responsible for smoking cessation services and pressures on local authority budgets. Additional funding was announced for local authorities for smoking cessation services in October 2023. Of those who were referred or signposted, nearly all attended their first appointment, with the majority attending all appointments. Stakeholders suggested that uptake from TLHC participants was lower than anticipated, and that those that did engage were typically older with longer smoking histories. It is noted that the programme is exploring this as an area of improvement.

Half of survey respondents who reported smoking at the time of their LHC reduced or stopped smoking around three months after their LHC, though smoking cessation staff reported varying quit rates and that quit rates were suggested to be lower than from self-referrals.

Examining changes in current smoker prevalence within the eligible age range in intervention areas shows an overall decrease since areas started delivering TLHC. However, this evidence is circumstantial and descriptive, rather than being attributable to the TLHC programme.

Wider system outcomes

Demand for lung cancer services: Evidence collected from project teams strongly suggests that there has been a perceived increase in demand for lung cancer treatment services, and the MDS shows additional referrals generated through the programme. To further test this, the evaluation analysed Cancer Waiting Times (CWT)[14] data on the number of patients starting lung cancer treatment via the urgent suspected cancer (USC) route and performance against the 62-day standard for lung. This highlights that lung cancer service performance in TLHC intervention areas declined at a faster rate than non-intervention areas between Q3 2021 and Q2 2023 (averaging a -2.9 percentage point (pp) decline per quarter vs -2.0pp respectively). This may be due to greater numbers of patients starting lung cancer treatment in these areas due to the activity generated through the programme. It is also notable that the

[12] Note this data is only available for the 14 sites reporting record-level data (representing 71% of the total eligible population).
[13] This data does not allow referral route to be detected, so not all cancers can necessarily be attributed to the TLHC programme.
[14] CWT is a national dataset that tracks patient care activity from referral, diagnosis and treatment, and is used to monitor cancer waiting times performance targets at the national, provider and commissioner level. See: https://www.england.nhs.uk/statistics/statistical-work-areas/cancer-waiting-times/

number of patients starting treatment via the USC route did not decline, as may have been hypothesised.

Skills gaps and shortages: The most common training courses attended by LHC nurses, radiologists and administrative staff, identified by self-reported project training data, related to communicating with LHC participants, rather than advancing their clinical skills. This suggests some staff may have been recruited who already had these accreditations. Qualitative evidence from stakeholders summarised that skills gaps and workforce shortages were reoccurring themes throughout the evaluation. Workforce shortages were particularly a challenge in radiology, though this did not prevent or pause delivery in any area, whilst local skills gaps during setup were seen to make recruitment timelier and more challenging.

Managing additional activity: Qualitative evidence from project stakeholders suggests that local providers have been able to manage additional activity. Some 'pinch points' have been created by TLHC, but this has generally been manageable. According to stakeholders, new activity generated by TLHC has been predominantly early-stage treatments (such as surgeries), meaning the types of treatment providers have been delivering has changed.

Transitioning Phase 1 and 2 projects to a steady state of delivery

The introduction of TLHC necessitated that a largely unscreened population is screened over several years. Once this cohort of eligible people is screened, and with the potential for improved targeting of the LHC offer, it is likely that there will be a reduction in the volumes of people being screened. The resources required to deliver this 'steady state' service over the longer-term should be lower.

The following are key considerations as Phase 1 and 2 projects begin to transition into "business as usual" (BAU):

- **Service commissioning:** NHSE needs to consider whether and how to support local and regional procurement, to ensure the delivery of LHCs in a locality, after the initial wave of newly identified individuals (referred to as steady state in this report) are not deprioritised by third party providers.
- **CT scanner purchase:** cross-programme knowledge sharing about managing in-house scanners could help to improve efficiencies and enable the NHS to invest in its own infrastructure.
- **Staffing TLHC services:** demands for nursing capacity will be lower, whilst demand for radiographers and radiologists will remain high. Services will need to consider how to manage this and how best to use trained TLHC nurses across newly expanding areas.
- **Ageing-in and re-invitation:** modelling will be required to estimate anticipated demand; data from early adopters should be shared widely across all TLHC areas.
- **Long-term management of scans:** ongoing knowledge sharing will be critical in creating efficiencies in the management of CT scanning, particularly within community settings.

Considerations for programme expansion

Drawing on analysis from across the evaluation, the following suggestions are made for those responsible for planning and delivering future rollout of lung health checks to new areas.

Pace of rollout

- The pace of programme expansion should be closely considered alongside system capacity, particularly the capacity of secondary and tertiary care centres.
- The process for setting-up new services should be closely monitored to ensure the pace of roll-out does not impinge upon delivery of thorough local stakeholder and community engagement activities.
- The regional/ national capacity of third-party providers to deliver end-to-end services at significant scale (and their effects on supply of staff and infrastructure to the NHS) should be reviewed, to help prevent over-commitment with the associated risks of under-delivery.
- The programme should consider the relative benefits and drawbacks of increased programme outsourcing, particularly considering the potential risk to longer-term investment in NHS-owned capital, infrastructure, and staffing.

Design and stringency of protocol

- Leaders at the local level would welcome clear and punctual communications from the national programme team about the likely parameters and features of a national screening service Standard Protocol, to enable a smoother transition and give greater certainty for those looking to commission or expand new services.
- Perspectives vary widely in terms of the optimal way of delivering the service; the national screening service will need to decide where variation can be allowed, versus where consistency must be prioritised.

Procurement and pooling of resources

- Whilst contracting with third party providers will continue to be led by provider organisations, there needs to be national involvement in conversations with key suppliers, to help avoid a ‘cliff-edge’ in supply. One approach could be establishing collaborative procurement approaches for outsourcing key elements of the pathway such as scanning and reporting, to help deliver economies of scale.
- National analysis which provides anticipated throughputs in each year to 2027/28 and the level of outsourcing required to meet those numbers would be welcomed by Cancer Alliances and local projects.
- As the programme transitions into a national screening service, local stakeholders would value more information about the plans for centralising functions such as project management and data analysis, and the evaluation understands this is in development.
- Projects suggested that eligible participant lists should be extracted at a national level, rather than on a practice-by-practice basis. This would ensure better alignment with other screening programmes, reduce the burden on GPs, and ensure greater consistency and efficiency.

Modelling for optimal delivery

- More bespoke estimates should be used in planning for replicating the service in other parts of the country, rather than the standard assumptions of 50% LHC uptake and 54% CT scan conversion, used for Phases 1 and 2. These estimates can build on data collected and reported

through this evaluation, which suggest a lower LHC uptake rate (44%, on average across the programme) and a lower proportion of LHC attendees being eligible for an initial CT scan (most recent data indicates 50%).

- Areas in Phases 1 and 2 were predominately selected based on lung cancer incidence, meaning their eligible populations are generally more deprived than the rest of the country. This should also influence future uptake and scan conversion estimates. Based on evidence, including from this evaluation, it is logical to assume that:
    - The eligible population, as a proportion of the total population of new areas, is likely to decline over time (as the programme expands to less deprived areas);
    - Uptake of the offer, amongst eligible individuals, may increase over time, as the programme rolls out to less deprived areas (associated with higher uptake in this programme);
    - CT scan eligibility is likely to decrease over time, due to lower proportions of current smokers within those who live in less deprived areas;
    - Detailed modelling, building on the more nuanced data now available, will help determine how many participants will receive onward referrals, diagnoses and treatment in the future.
- Cancer Alliances will need to decide how the TLHC intervention model should be tailored within their locality. For example, it may be appropriate to implement more "intensive" implementation models (such as "one-stop-shop"[15]) in areas of higher deprivation. Consideration will also need to include the proportion of resources that should be reserved for community engagement activities.

CT scanning capacity

- Greater standardisation of incidental findings management is desired, particularly given the complexity of lung cancer screening, variation in practice across projects, and the wide range of possible conditions that can be detected. New guidance is currently being developed by the national programme team.
- Community Diagnostics Centres (CDCs) could provide useful additional capacity for local areas in meeting the scanning demands of the TLHC programme. However, there are some concerns that CDCs may not be able to accommodate delivering the programme in the way that has been envisioned. This is because CDCs will be providing diagnostics support for many different services and therefore any TLHC activity will need to be scheduled alongside other commitments. They may be better suited for addressing overspill from the main TLHC scanner or for delivering interval scans.

[15] This is an implementation model where the LHC and CT scan are delivered at the same site, with LHC attendees completing their CT scan, if eligible, shortly after their LHC.

Administrative data system

- A consistent Patient Administration System (PAS) is required across the programme and a business case was submitted in July 2024 to procure one or more “off-the-shelf” national TLHC ICT systems for management at a national level.
- NHSE should consider the centralisation of risk score generation to help minimise human error.

Staffing TLHC services

- NHSE will need to play a key role in modelling future workforce requirements over the next 15 years. NHSE has begun this work already, by feeding into to the NHS Long Term Workforce Plan[16] and is continuing to model future staffing requirements, for example for radiologists and radiographers for diagnostics and therapeutics. A particular focus has been on determining the number of thoracic surgery training places required.
- Teams in NHSE responsible for national policy on workforce planning will be major stakeholders for wider rollout and development of a national screening service.

General public engagement

- A centralised communications campaign would raise awareness amongst the public. Organising this centrally would create efficiencies, which could either replace or supplement local communications initiatives. It should be carefully planned alongside demand modelling work.
- Careful consideration would need to be given in terms of how best to communicate about eligibility as the programme gradually rolls out (both geographically and in terms of age and smoking status) to avoid unnecessary worry.

Primary care engagement

- The programme should provide further guidance about incidental findings management, particularly for those findings that cannot be treated or acted upon. New guidance is currently being developed by the national programme team.

Further research and evaluation

Areas for future research and evaluation could include:

- Conducting robust impact evaluations of LHC engagement strategies (including their ability to address health inequalities);
- Conducting a robust impact evaluation of other (non-lung) cancers detected by the programme;
- Exploring the feasibility of longer-term impact and economic evaluation, particularly with the aim of exploring the impact of the programme on lung cancer mortality over a longer period;
- Working to improve data access which can then enable research into the benefits associated with embedding smoking cessation alongside a targeted lung screening programme;

[16] https://www.england.nhs.uk/publication/nhs-long-term-workforce-plan/ [Accessed: July 2024]

- Revisiting some Phase 1 and 2 projects to learn how they have moved into a steady state of delivery, with the aim of further knowledge sharing across areas.

1 Introduction

1.1 Purpose of this report

In 2019, NHS England (NHSE) commissioned Ipsos UK (hereafter "Ipsos") and the Strategy Unit to deliver a process, impact, and economic evaluation of the Targeted Lung Health Check (TLHC) programme (2019-2024). This is the final report, which summarises evaluation evidence and insight produced across the five years of the evaluation and draws conclusions about the extent to which the programme met its objectives.

1.2 Programme overview

In a 2024 update on the NHSE Cancer programme, it was noted that cancer survival is the highest it has ever been and thousands more people now survive cancer every year.[17] Yet evidence suggests that the UK's performance on cancer survival lags behind that of other comparable countries.[18] Key to improving survival is the earlier diagnosis of cancers. The NHS Long Term Plan (NHS LTP, published 2019) set a new ambition that the proportion of cancers diagnosed at stages 1 and 2 would rise from around half of cancer patients in 2019 to three-quarters in 2028.

Lung cancer is the third most common cancer in the UK, although lung cancer survival rates have not improved in the last 50 years in the UK (up to 2017). There is an established link between lung cancer and inequality, with the complex intersection of different factors such as health literacy, ethnicity, socioeconomic status, age, gender, geography, and lifestyle choices contributing to higher incidence, later diagnosis, and poorer survival in some groups.[19] Between 2013-2017, it was estimated that there were 14,300 more cases of lung cancer each year in England than there would otherwise be if all areas had the same incidence rate as the least deprived areas.[20]

The TLHC programme was introduced to contribute to tackling these challenges. The primary aim of the programme was to diagnose lung cancers at an earlier and therefore more treatable stage, to enable reduced mortality from lung cancer in the long term. Other aims included to:

- Reduce variation in the diagnostic and mortality outcomes;
- Increase identification of a range of incidental findings through the LHCs and scans (and ensure access to appropriate treatment pathways);
- Increase the number of individuals accessing smoking cessation services, and increase the number of who have i) reduced; and ii) stopped smoking following participation in TLHC; and
- Ensure participants in the LHCs and scans have a positive experience;

[17] One year survival for patients diagnosed in 2020 was 74.6%, up 9 percentage points from 2005 and five year survival of patients diagnosed in 2016 was 55.7%, up 7.8 percentage points since 2005. https://www.england.nhs.uk/long-read/nhs-england-cancer-programme-progress-update-spring-2024/#:~:text=One%20year%20survival%20for%20patients,up%207.8%25points%20since%202005. [Accessed: September 2024]

[18] https://researchbriefings.files.parliament.uk/documents/SN06887/SN06887.pdf [Accessed: September 2024]

[19] https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(24)00443-7/fulltext [Accessed: November 2024]

[20] https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/incidence#heading-Five [Accessed: September 2024]

The TLHC programme, in the current form being evaluated, was not designed to be a systematic population screening programme. It was intended to be a mechanism by which the NHS can ensure that the identification, testing and surveillance of participants at high risk of lung cancer be carried out to consistent standards. This commitment to delivery at scale, and in 'real world' settings, was put to the test in a highly significant manner with the COVID-19 pandemic. The pandemic had two main impacts on the programme: 1) The original CCG pilot sites were given an additional year to deliver the four-year programme due to delays incurred by the necessary pausing and/or postponement of TLHC services. LHC and scanning numbers were very low throughout 2020 and into early 2021; 2) To comply with social distancing and infection control measures, the protocol for the LHCs was changed.

Despite these delivery challenges, in part due to the delivery of the TLHC programme, this evaluation, and wider national and international literature on similar screening pilots and programmes, the UK National Screening Committee (UK NSC) recommended in 2022 that the four UK nations implement a national targeted lung screening service. This recommendation was supported by a government announcement in June 2023 of the roll out of such a service.

1.3 Evaluation aims and objectives

1.3.1 Evaluation scope

The evaluation focuses on the first two phases of programme delivery. The initial pilot projects (Phase 1) were launched in 2019 and were selected on the basis of having the highest rates of lung cancer incidence nationally. An onboarded set of projects (Phase 2) was made up of sites where locally led targeted lung screening initiatives were already underway prior to TLHC programme commencement. Phase 2 projects were onboarded to the programme in 2020. The evaluation concludes at a time when the initial eligible cohort for each Phase 1 and Phase 2 project has been invited to participate and – where applicable – attended an LHC, and all relevant scans up until the 24-month follow-up scan.

At programme inception, £70m was earmarked for expenditure between April 2019 and March 2023. The total spending on phase 1 and 2 (the main focus of this evaluation) between April 2019 and March 2023, as provided by NHSE, was £63.3m.[21]

1.3.2 Evaluation objectives

Evaluation objectives (Table 1.1) sit within three evaluation workstreams: process, impact, and economic evaluation. Throughout this report, these three workstreams are triangulated to ensure evaluation questions are answered as comprehensively as possible. Further information about the methodologies used for each workstream is set out in Chapter 2.

This evaluation was designed to build on previous targeted screening studies and research trials[22], by focusing on testing the targeted lung screening intervention in real world settings. The evaluation questions therefore prioritise themes relating to implementation in non-trial environments and build on the existing evidence base by exploring strengths and weaknesses of delivery model variations. The wider economic evidence base - established prior to the TLHC programme - suggests that targeted

[21] Total spending on phase 1-3 projects between April 2019 and March 2024 was £184.4m.
[22] See, for example, https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [accessed: November 2024].

screening with low dose CT scanning is very likely to be cost effective for the NHS.[23] As such, this evaluation focuses on understanding the real-world costs and consequences associated with delivering the programme and the investment that would be required to fund a national roll-out. The results of the economic evaluation are available separately from NHS England.

Table 1.1: Evaluation questions[24]

1. Implementation model and feasibility	Workstream
1.1 How has the programme been implemented?	Process evaluation
1.2 How were the TLHC projects set-up?	Process evaluation
1.3 What have been the barriers and enablers to implementation? How has this varied across different parts of the system (e.g. Cancer Alliances, Primary Care, Secondary Care)?	Process evaluation
1.4 How were participant cohorts determined?	Process evaluation
1.5 How does the programme operate and interact within wider local systems?	Process evaluation
1.6 How have implementation models varied within and across projects?	Process evaluation
1.7 What can be learnt about which implementation models seem to be most effective? Does this vary by patient characteristics?	Process evaluation
2. Replicability and scalability	
2.1 What contextual factors contribute to success in implementation?	Process evaluation
2.2 How has the introduction of a lung health checks programme impacted demand and activity for lung cancer services locally?	Impact evaluation
2.3. Are local providers able to respond to, and manage, this additional activity?	Process evaluation
2.4 What are the key considerations for the sustainability of the programme across projects?	Process evaluation
2.5. What further aspects must be considered if the programme is scaled up to a national level?	Process evaluation
3. Impact on participant outcomes	
3.1 Was the programme successful in enabling earlier stage lung cancer diagnosis?	Impact evaluation
3.2 What was the lung cancer conversion rate through the programme (i.e. lung cancer diagnoses as a proportion of participants invited)?	Process evaluation
3.3 What other health conditions were detected during the TLHC intervention and how often did these occur?	Impact evaluation
3.4 What was the entry and completion rate of smoking cessation courses and what were the outcomes?	Impact evaluation
4. Health inequalities	
4.1 Did the programme attract those most at risk of developing lung cancer, including the most deprived, vulnerable populations, and minority groups?	Process evaluation
4.2 How were these groups targeted, how effective were different engagement strategies, and how did take up rates vary by different engagement approaches?	Process evaluation
4.3 What impact has the programme had on reducing the variation in lung cancer outcomes across each of the projects?	Impact evaluation
5. Participant experience and satisfaction	
5.1 What motivated participants to engage with the TLHC programme?	Process evaluation

[23] Exeter Test Group and Health Economics Group (2022), Final report on the cost-effectiveness of low dose computed tomography (LDCT) screening for lung cancer in high risk individuals.

[24] Small amendments were made to question wording during the study and in consultation with the national programme team and other key stakeholders including the TLHC Clinical Leads and representatives from the Cancer Alliance Data, Evaluation, and Analysis Service (CADEAS), to ensure the evaluation would meet the needs of relevant stakeholders.

5.2 What were the barriers to engagement / attendance?	Process evaluation
5.3 Overall, were participants satisfied with the programme?	Process evaluation
5.4 What was the experience of those participating in the programme?	Process evaluation
6. Economic evaluation	
6.1. What are the costs and consequences from earlier diagnosis of lung cancers during the post-intervention period, on a year-by-year basis?	Economic evaluation
6.2 What investment would be required for a successful, comprehensive national roll-out of this programme?	Economic evaluation

1.4 Structure of this report

This report is written for an informed policy audience; technical terminology is avoided where possible and clearly defined where necessary. The remainder of the report takes the following structure:

- Chapter 2 sets out the methodology for the evaluation;
- Chapter 3 covers the design and development of the TLHC programme, including the rationale, the programme's evolution, and the programme's theory and a diagrammatic logic model;
- Chapter 4 describes what was delivered through the TLHC programme, focusing on quantifying the intended programme outputs, with comparison against what was expected at the outset of the programme;
- Chapter 5 describes how the TLHC programme was set-up and associated key learning;
- Chapter 6 discusses how the TLHC programme has been delivered and what has been learnt;
- Chapter 7 explores participant experiences of TLHC services;
- Chapter 8 explains the outcomes of the TLHC programme, covering lung cancer outcomes, incidental findings, smoking cessation outcomes, and wider system outcomes;
- Chapter 9 provides conclusions across the whole evaluation, offers considerations for further scaling of programme activities, and suggests areas for further research and evaluation.

A detailed set of appendices are included separately to this report.

2 Overview of evaluation approach

The evaluation takes a theory-based approach, whereby the theory of how the programme is expected to achieve the desired outcomes forms the overarching structure for the evaluation. The Theory of Change (TOC) for the programme is included in full in Appendix 4.

The approach has been designed to share emerging findings at regular intervals throughout the implementation of the programme, to support the national programme team and other stakeholders to adjust programme design and delivery in close to real-time. This final report brings all of these findings together, providing evidence on the overall effectiveness of the programme in achieving its intended outcomes, and summarising insights about how the programme delivered those outcomes.

Both qualitative and quantitative methods and analysis have been used to collect evidence to answer the evaluation questions and test the programme TOC. These are briefly summarised below. Comprehensive methodological statements are included in the Appendices.

2.1 Evaluation oversight

An Evaluation Oversight Group (EOG) was convened by NHSE to oversee the TLHC Programme Evaluation and the evaluation of the Faster Diagnosis Programme. The group comprised members of the NHSE Cancer Programme, NHSE analysts, and clinical representatives. The group met quarterly between February 2021 and March 2024 to advise on various aspects of the evaluation methodology.

2.2 Brief methodological overview

The study commenced with a scoping stage (September 2019 - January 2020) comprising of a literature review, scoping interviews, calls with each Phase 1 project, and a review of programme documents. A core minimum dataset (MDS), which had been developed prior to the evaluation, was reviewed and iterated working closely with the national programme team and clinical leads. This culminated with a scoping report setting out the overall framework for the evaluation.

The main stage method is comprised of the following tasks across the three strands of the evaluation.

The process evaluation included:

- **Seven waves of qualitative fieldwork with staff** involved in delivering the projects (including Project Leads and Clinical Directors) between February 2020 and May 2024 - 148 total interviews;

- **A survey of LHC and CT scan attendees, and a follow-up survey**. Surveys were mixed mode (online and postal). Follow-up surveys took place three to four months after original LHC or CT scan appointments. There were 11,979 responses to the attendees' survey (June 2021 to May 2022) from 21 CCG areas covering 14 projects. It is not possible to provide a response rate for the attendees' survey, because projects did not record the number of times a survey had been offered, not all participants received a survey and not all projects distributed all of their allocated surveys. There were 2,296 responses to the follow up survey (November 2021 to September 2022). For the follow-up survey (distributed by Ipsos) the response rate for Q1-4 was 23%. Unless otherwise stated, any comparisons that are drawn using either the attendees' survey or using the follow-up survey are statistically significant;

- **Four waves of interviews with LHC attendees** (October 2021 to June 2022). Interviewees were recruited via the participant survey, and were sampled to capture a range of demographic and attitudinal characteristics - 100 total interviews;

- Data collection to understand **reasons for invitee non-engagement and/or non-attendance** at an LHC, from a subsample of 11 Phase 1 and 2 projects (May 2022 to April 2023);

- **Monitoring information (MI) data** collected from all Phase 1 and 2 projects. A detailed record-level MDS was collected from all Phase 1 projects and some Phase 2 projects, whilst the other Phase 2 projects submitted an aggregate level return. The record-level MDS was linked to cancer diagnosis and staging data from the National Cancer Registration and Analysis Service (NCRAS). This linked dataset was used for patient-level analysis to track participant pathways from invite to cancer diagnosis, where available. Where included in the report, this analysis is based on TLHC activity data submitted up to March 2024 and NCRAS lung cancer activity to August 2023. Cancer diagnoses are sourced from linking the record-level TLHC dataset to cancer outcomes from the Rapid Cancer Registration Dataset (RCRD) where available, and aggregate level data, where record level data is not available.

- **Eligible population estimates** constructed using GP Patient Survey (GPPS) 2022[25] data and ONS Population Estimates 2022[26] data.

The impact evaluation included:

- **A quasi-experimental design** to estimate the impact of the TLHC programme. The National Cancer Registration Dataset (NCRD) and the ONS Civil Registration Deaths dataset are used to provide area-level[27] estimates of the number of lung cancers, and deaths due to lung cancer, per 10,000 people in the target population (informed from the 2021 Census). Using a propensity score matching - difference-in-differences (PSM-DiD) methodology - the estimated impacts can be attributed to the TLHC programme. The impact evaluation explores the impact of the TLHC programme on the key outcomes in turn: i) the number of lung cancers diagnosed in the target population; ii) the number of lung cancers diagnosed at stage 1 or 2, stage 3 or 4 and not staged at diagnosis within the target population; iii) the number of deaths due to lung cancer within the target population.

- **Descriptive analysis of Cancer Waiting Times[28]** to assess the programme's secondary outcomes (relating to incidental findings, smoking and wider-system impacts) and their associated indicators (used to analyse impacts of TLHC). This analysis presents key points and insights from the data presented to aid interpretation by describing, demonstrating and summarising the data, such as changes over time. No statistical approaches are used.

An economic evaluation, following a Cost-Consequences Analysis approach, was undertaken. The results are available from NHS England and are not included in this report.

[25] See: https://www.gp-patient.co.uk/About [Accessed: May 2024]
[26] See: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates [Accessed: May 2024]
[27] The geographic footprints used are Middle Super Output Areas (MSOA), containing approximately 2,000 to 6,000 households, or 5,000 to 15,000 individuals.
[28] https://www.england.nhs.uk/statistics/statistical-work-areas/cancer-waiting-times/

2.3 Methodological limitations

Readers should bear the following methodological limitations in mind when reading this report.

- **Stakeholder interviews:** The qualitative data illustrates many of the dominant themes within the programme, rather than forming a representative sample. Contributions from clinical roles came primarily from TLHC Clinical Directors, with some input from frontline staff (e.g. LHC nurses, radiographers and third-party smoking cessation staff).

- **Attendees' survey**: fieldwork took place between June 2021 and May 2022 (over four fieldwork quarters timed for when projects were in their main phase of delivery as well as to provide formative findings at an earlier stage), meaning that the findings may not reflect any changes in participant experience since then. Not all projects distributed surveys across the whole fieldwork period, meaning that there were differences in sample sizes throughout the period. Projects' distribution methods varied, to ensure feasibility; this limits the comparability of the survey results across projects. The amount of time between a participant's LHC and when they received the survey varies by project. For practical reasons, projects were asked to survey a proportion of their participants rather than all participants. Some projects may have distributed all their surveys more quickly than others, depending on their throughput of attendees.

- **Attendees' follow-up survey**: fieldwork took place between November 2021 and September 2022 (over four fieldwork quarters timed for when projects were in their main phase of delivery as well as to provide formative findings at an earlier stage), meaning that the findings may not reflect changes in participant experience since then. Due to the number of overall responses some sub-group analysis is limited. Where base sizes are low, caution is noted.

- **Participant qualitative fieldwork**: fieldwork took place between October 2021 and June 2022 (over four fieldwork quarters timed for when projects were in their main phase of delivery as well as to provide formative findings at an earlier stage), meaning that the findings may not reflect any changes in participant experience since then. Quotas were used to ensure an adequate distribution of participant characteristics, though the sample is not representative of all TLHC participants.

- **MI:** The MI data contains a mix of record level[29] and aggregate level data. Submission of record level dataset was only mandatory for Phase 1 projects[30] although a limited set of Phase 2 projects also chose to submit record level data. The aggregate dataset included a limited set of key metrics with no breakdowns by other factors, such as demographics. This means it is not possible to run some analyses for all the projects. Demographic data and the cancer diagnoses from the NCRAS dataset is only available from projects that submitted record level data. There are some data quality issues, particularly with the smoking cessation data, that some projects were not able to resolve. These are flagged in the report. A breakdown of projects, which dataset they reported, and strands of the evaluation they participated in is in Appendix 7.

[29] 76% of first invites were from the record level dataset. LHCs and CT scans had similar levels.
[30] Phase 2 sites were commissioned separately. It was decided to collect aggregate data due to the cost of commissioning additional record level data and the complexity for projects to collect the data.

- **MDS linked with NCRAS datasets:** As noted, a subset of projects submitted record level data. Therefore, it was not possible to include all projects in the patient-level analysis. Due to a lag in the NCRAS data available, it is only possible to include cancer diagnoses up to the end of August 2023.[31] Aggregate level cancer diagnosis data is used for Phase 2 projects that did not submit record level data.

- **GPPS eligible population estimates:** these are estimates only and are separate to the modelling used by the national programme team to design and fund TLHC projects. The estimates account for the gradual rollout of the TLHC programme which means some Phase 1 and 2 projects have been funded to deliver to only part of their geographic footprint or that some project areas have had previous lung screening activity delivered within their footprint outside of the TLHC programme.

- **Non-attendees' tool**: there are some known inconsistencies in how projects recorded and reported this data. However, given projects reported aggregate data it was not possible to assess the source of inconsistencies. As the data collection was optional and dependent on projects' local models, the figures and trends in the data should be considered as indicative of what projects experienced.

- **Descriptive analysis of Cancer Waiting Times data:** no statistical approaches are used and therefore causality cannot be claimed by any trends within data. Data quality issues may be present with secondary datasets and may limit the analysis presented. Where data quality issues are known, caution is noted.

[31] This influences the calculation of the cancer conversion rate for this cohort. It also means that analysis of follow-up activity is limited. For example, cancers diagnosed for up to three months after a scan can be included for the majority of the cohort, but this decreases for 12 and 24 month follow-up as the data is not yet available.

3 Design and development of the TLHC programme

This section describes the case for the programme in strategic, clinical, and economic terms. The programme's case for change is captured as it was set out in 2019. Contextual developments made throughout programme delivery, which have a bearing on the case for change, are also presented.

3.1 Strategic rationale

The NHS LTP sets out the following two key ambitions to improve cancer outcomes and services in England over ten years from its publication in 2019:

- By 2028, the proportion of cancers diagnosed at stages 1 and 2 will rise from around half in 2019 to three-quarters of cancer patients; and
- From 2028, 55,000 more people each year will survive their cancer for at least five years after diagnosis.[32]

Stakeholders interviewed as part of the evaluation scoping phase considered these targets to be ambitious, partly due to the relatively modest improvements in performance on these measures in the years leading up to the TLHC programme[33], and partly because of the size of the gap to fill. However, lung cancer is typically associated with high prevalence rates, relatively late-stage diagnosis, and low survival rates. This means that there was a general view among stakeholders that diagnosing lung cancer earlier through the TLHC programme had the potential to be an important contributor to meeting those LTP targets. As a result, there has been political interest and support for the TLHC programme throughout the evaluation period, as demonstrated by frequent Ministerial visits to LHC sites.

At the programme's outset, lung cancer was the fifth most common cause of death in England and Wales.[34] It was the most common cause of cancer death in the UK, equating to 21% of all cancer deaths and resulting in approximately 35,300 deaths per year (2015-2017 average).[35] This has partly been due to its high prevalence – as of 2019, lung cancer was the third most common cancer in the UK, accounting for 13% of all new cancer cases[36] - but also because most lung cancers are diagnosed at a late stage, when treatment with curative intent is less likely. Across cancer types, at programme outset, lung cancer was one of the most commonly diagnosed at a late stage. This meant that, of the 39,000 people who are diagnosed with lung cancer every year in England, about 71% were diagnosed at stage

[32] https://www.england.nhs.uk/cancer/strategy/
[33] 51.8% of cancers in England were diagnosed at stage 1 or 2 in Q1 2018 compared to 43.9% in Q4 2011. The 1-year index of cancer survival in England was 73.3% in 2017 compared to 62.6% in 2002 (The National Cancer Registration and Analysis Service).
[34] Office for National Statistics – Mortality statistics (2018 data, released August 2019), https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/latest, [Accessed: December 2019].
[35] Cancer Research UK,.https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer#heading-One, [Accessed: December 2019].
[36] Public Health England – National Cancer Registration and Analysis Service, Office for National Statistics (2017 data, released April 2019), https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/cancerregistrationstatisticsengland/2017, [Accessed: December 2019].

3 or 4 (among those where stage is recorded at diagnosis).[37] The predicted 10-year net survival was the lowest for lung cancer across cancer types for both men and women, at 7.6% and 11.3% respectively.[38]

Smoking is the most common cause of lung cancer; at the time of programme inception, around 72% of lung cancer cases, and an estimated 86% of lung cancer deaths in the UK, were attributed to smoking.[39] Improvements in outcomes are particularly needed for people living in more deprived areas; a quarter (25.3%) of people in England diagnosed with lung cancer in the least deprived group survive their disease for five years or more, compared with less than a fifth (18.2%) of people in the most deprived group (2016-2020).[40]

3.2 Clinical rationale

At the time of programme inception, the UK NSC did not recommend a national targeted population screening programme for lung cancer, citing insufficient quality evidence in support of it. At the time, the full results of a key trial - the NELSON randomised lung cancer screening trial - were still outstanding and the policy position was to be reviewed after their publication. Results from this study were published in 2020.[41]

Critical to building the clinical case for change were the results of several landmark clinical trials and pilots in the years preceding the TLHC programme.[42] See Appendix 2 for further information. Throughout the evaluation, it has been reported by stakeholders that the generally positive results contributed to the clinical case for piloting of low dose CT (LDCT) scans more widely. The UK-based studies were reported to be particularly influential in the design of the TLHC programme. They showed similar findings suggesting that targeted screening, in at risk populations, resulted in higher rates of early-stage diagnosis and reduced cancer mortality. Taken together, but especially the results from the UK Lung Health Check Pilots associated with the ACE Programme, the evidence on the impact of the targeted lung screening on diagnostic staging and mortality, was instrumental in NHSE deciding to further pilot LDCT more widely.[43]

The small scale and geographical spread of trials and pilot studies completed prior to the programme's inception limited the generalisability of findings. Herein lay one of the central aims of the programme and its evaluation: to determine whether the results secured through earlier studies could be achieved on a population basis, working across a wider geography and in 'real world' (not trial) conditions.

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[37] National Cancer Registration and Analysis Service (NCRAS), Stage breakdown by CCG 2017, http://www.ncin.org.uk/publications/survival_by_stage, [Accessed: December 2019]. Based on 2017 data across all CCGs, 38,888 patients were diagnosed with lung cancer. Data were extracted from the English National Cancer Registration Service database CAS (Cancer Analysis System) which has a staging flag pre-calculated. Cancer stage was recorded at diagnosis in 94 percent of cases. The stage breakdown was as follows: Stage I – 7,656; Stage II – 2,955; Stage III – 7,564; Stage IV – 18,213.

[38] Public Health England – National Cancer Registration and Analysis Service, Office for National Statistics (2018 data, released August 2019), https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/cancersurvivalinengland/stageatdiagnosisandchildhoodpatientsfollowedupto2018 [Accessed: December 2019].

[39] Cancer Research UK https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/risk-factors#heading-Two [Accessed: May 2024].

[40] Cancer Research UK https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer#heading-Two [Accessed: May 2024].

[41] https://www.nejm.org/doi/full/10.1056/NEJMoa1911793 [Accessed: May 2024].

[42] Including the American National Lung Screening Trial (NLST), the European NELSON trial, the UK Lung Cancer Screening Trial, the UK Lung Health Check Pilots, the Yorkshire Lung Screening Trial and the SUMMIT trial.

[43] See: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8589705/ [Accessed October 2024]; https://pubmed.ncbi.nlm.nih.gov/29440588/ [Accessed: October 2024]; and https://thorax.bmj.com/content/74/7/700 [Accessed: October 2024].

The UK NSC's position has changed during programme delivery and targeted lung screening with integrated smoking cessation service provision is now recommended in all four UK nations, for people aged 55 to 74 identified as being at high risk of lung cancer.[44] This recommendation was made in 2022 and was followed by a government announcement in June 2023 of the roll out of a national targeted lung screening service. There has been widespread interest in supporting the development of a road map to a UK national lung cancer screening programme, including an article published in The Lancet in 2023.[45] In this, the authors emphasised that – following the UK NSC's recommendation – further work was needed to prove that it would be possible to deliver a national roll-out of the first major targeted screening programme.

3.3 Economic rationale

Prior to the establishment of the TLHC programme, early systematic reviews of economic evidence on CT screening programmes for the early diagnosis of lung cancer had indicated significant heterogeneity in results and challenges with drawing conclusions about cost-effectiveness. Despite a subsequent growing body of national and international economic evidence, some uncertainties about cost-effectiveness have remained. A systematic review by Snowshill et al. in 2018[46] reviewed five systematic review studies and 19 trial- and model-based economic evaluations. These were mostly from Europe, but some in the USA (including by far the largest, the National Lung Screening Trial (NLST), with over 50,000 participants[47]). The review found that, despite the number of economic evaluations, cost-effectiveness results were inconsistent, with incremental cost-effectiveness ratios[48] varying from low thousands of US dollars per quality-adjusted life year (QALY) to over US$100,000 per QALY. Also, few studies indicated the generalisability of their findings.

However, two economic evaluations in the UK both concluded that LDCT screening could be cost-effective in the UK. For example, the UK Lung Cancer Screening (UKLS) trial[49] suggested that increased estimated lifetime treatment costs for an individual diagnosed with lung cancer are more than offset by the corresponding QALY gain, resulting in a cost per QALY estimate of £8,466. The authors highlighted that designing programmes that maximise efficiency was key for achieving cost-effectiveness. Meanwhile, Snowshill et al. identified in their review that a few key factors were important in determining cost-effectiveness: (1) the cost of a LDCT scan, (2) the risk of lung cancer in the screened cohort and (3) the general effectiveness of LDCT screening in the various ways this can be defined.

Snowshill et al's own independent cost-effectiveness analysis was based on a natural disease model and informed by the literature and estimated that LDCT screening would not be cost-effective at a cost-effectiveness threshold of £20,000 per QALY.[50] However, a single screen for individuals aged 60–75

[44] https://view-health-screening-recommendations.service.gov.uk/lung-cancer/ [Accessed: May 2024].
[45] https://www.sciencedirect.com/science/article/abs/pii/S1470204523001043?dgcid=coauthor [Accessed: May 2024].
[46] Snowsill T, Yang H, Griffin E, Long L, Varley-Campbell J, Coelho H, et al. Low-dose computed tomography for lung cancer screening in high-risk populations: a systematic review and economic evaluation. Health Technology Assessment 2018;22(69).
[47] Black WC, Gareen IF, Soneji SS, Sicks JD, Keeler EB, Aberle DR, Naeim A, Church TR, Silvestri GA, Gorelick J, Gatsonis C; National Lung Screening Trial Research Team. Cost-effectiveness of CT screening in the National Lung Screening Trial. N Engl J Med. 2014 Nov 6;371(19):1793-802.
[48] The incremental cost-effectiveness ratio captures the economic value of an intervention, compared with an alternative (comparator). It is usually the main output of an economic evaluation.
[49] Field JK, Duffy SW, Baldwin DR, Brain KE, Devaraj A, Eisen T, et al. The UK Lung Cancer Screening Trial: a pilot randomised controlled trial of low-dose computed tomography screening for the early detection of lung cancer. Health Technology Assessment 2016;20(40).
[50] The lower end of the £20,000 to £30,000 threshold range considered acceptable in the decisions of the National Institute for Health & Care Excellence.

years with at least a 3% risk would cost approximately £28,000 per QALY. Incremental cost-effectiveness ratios for other forms of screening programmes were over £30,000 per QALY (or not cost-effective at any cost-effectiveness threshold).

The evidence therefore suggests that service delivery models are likely to be key to the cost-effectiveness of such programmes, particularly at the scale of national screening. Understanding how costs might vary across different implementation models was therefore of high importance for the delivery and evaluation of the TLHC programme.

3.4 Programme evolution

The three main phases of programme development are as follows:

- **Original design** – the original design was captured in the first version of the Standard Protocol and was based on several previously developed trial protocols.[51] The national programme team and lead clinicians designed the original pathway, protocol, quality standards, and overall programme aims. This was underpinned by modelling of anticipated demand, throughput, and cancer diagnoses. The programme was initially planned as a discrete, four-year pilot programme to test the intervention at larger scale and in real world settings. The programme was designed and funded by NHSE, which selected tightly defined project areas, developed in relation to (former) CCG areas, to take part. It was designed to reach individuals living in areas with the highest lung cancer mortality; this was the key selection criterion for the pilot areas. The plan was for projects to launch in March 2019 and have invited their full initial eligible population for an LHC by March 2021. All 24-month scans would have been completed by March 2023.

- **COVID-19 pandemic** – in March 2020, England went into lockdown in response to the COVID-19 pandemic. This included a range of social distancing and infection control measures, which had direct effects on how healthcare services could be delivered, including mask wearing, and the shift towards remote delivery of services/ appointments/ patient monitoring. Health and care systems also refocused resource on acute care for people with COVID-19, with a range of knock-on impacts on other services. This had two impacts on the programme: 1) Aspects of the pathway and Standard Protocol were amended to enable the programme to continue to deliver within the health protection and social distancing regulations that were established. This included the move to remote appointments and removal of spirometry from the protocol. 2) The original CCG pilot sites were given an additional year to deliver the four-year programme due to delays incurred by the necessary pausing and/or postponement of TLHC services. LHC and scanning numbers were very low throughout 2020 and into early 2021. Some of the programme aims also started to evolve. One of the key reasons for this was that NHSE aimed to make up lost ground by mobilising more quickly. This meant greater emphasis was given to early diagnosis aims, with a reduced emphasis on other health aims that were originally planned (e.g. broader health/ dietary advice, spirometry, and blood pressure checks).

- **National screening service and the Health and Care Act 2022** – as mentioned in section 1.1, in 2022, the UK NSC recommended that the four UK nations should introduce a national lung screening service to support the earlier diagnosis of lung cancers. This was followed by a

[51] See Appendix 2 for further detail.

government announcement in June 2023 of the roll out of a national targeted lung screening service. The implication for the TLHC pilot programme was that its aim moved beyond testing the intervention in real-world settings (the focus of delivery Phases 1 and 2) and became centred on how it could achieve full national coverage by 2028/29. The key programme aim remains improving the early diagnosis of lung cancer. However, following the UK NSC decision to support wider roll-out, policy and programme emphasis has shifted from *whether* this can be achieved through TLHC to *how quickly* this can be achieved.

In parallel, NHS commissioning was restructured via the Health and Care Act 2022, with CCGs being dissolved and their powers (including commissioning and funding) being transferred to Integrated Care Boards (ICBs). As such, NHSE no longer selects CCGs to begin delivering the TLHC programme and has instead handed responsibility to Cancer Alliances to plan roll out across their locality against nationally set targets. Programme funding is now distributed to ICBs. The Standard Protocol has also been developed so that high-risk participants are recalled for a CT scan every two years until they are over 75, and to ensure that participants previously deemed "low risk" are reinvited for an LHC.

3.5 Wider policy and service delivery context

In addition to the impact of the pandemic on the programme and the wider health and care service, several other developments in the wider policy and service delivery are relevant:

- **Cancer policy**: In addition to NHS LTP commitments on improved cancer diagnosis performance, further policy changes during the life of the programme include the Major Conditions Strategy (MCS), which reiterated the early diagnosis target and the TLHC programme's role in reaching this.

- **Structural system changes:** Changes to NHS commissioning and public health structures occurred during the programme but were not of direct relevance to delivery. As the wider programme transitioned towards spreading beyond the original pilot areas, Cancer Alliances took on greater responsibility for expansion within their own areas.

- **For lung cancer services, the pandemic had a significant impact:** The number of urgent referrals for suspected lung cancer declined by 35% in 2020/21 compared to the year prior (from 65,614 to 42,395). It increased 42% the following year, though this was still below the 2019/20 figure (60,314). Referral rates have now recovered and are above pre-pandemic levels (68,643 in 2022/23).[52] Performance against metrics related to treatment following referral or diagnosis also deteriorated during the pandemic.

- **Technological advancements and adoption**: The use of artificial intelligence (AI) in radiology reporting is a key example of this, primarily through Aidence reporting software. AI reporting has been integrated into many projects' pathways. Acting as a concurrent or secondary reader provides reassurances to the radiologists that their readings are correct, whilst also speeding up the reporting process. Project stakeholders were generally positive about the value of AI

[52] https://nhsd-ndrs.shinyapps.io/cwt_referral_conversion_detection/ Accessed June 2024

reporting throughout the evaluation, including in detecting nodules and in observing volume doubling times between the baseline and follow-up scans.[53] [54]

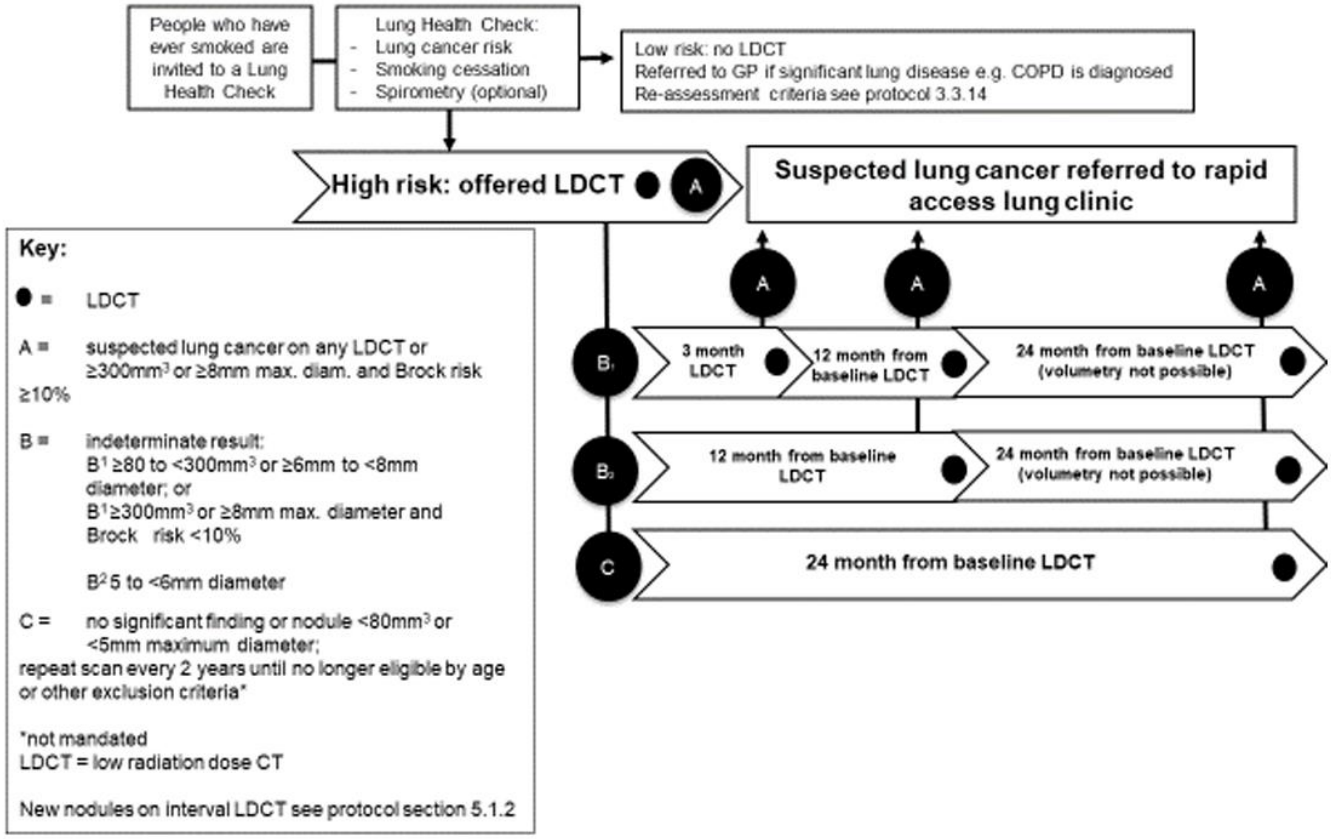
3.6 Programme design

3.6.1 TLHC Standard Protocol

The TLHC Standard Protocol was first published in February 2019. Designed by the NHSE TLHC Programme Lung Cancer Expert Advisory Group (EAG), and building on learning from prior trials and studies (see section 4.1), the protocol was designed to ensure standardisation across key components of programme design. It was designed with scope to make refinements as the programme progressed.

At the time of writing, the latest version of the Standard Protocol is the version published in November 2022.[55] An overview diagram of the participant pathway is included in Figure 3.1. Below, the main steps in the participant pathway are described. A summary of the alterations made to the protocol over time is captured in section 3.6.2.

Figure 3.1: Overview of TLHC participant pathway



Source: TLHC Standard Protocol

[53] The volume doubling time (VDT) of a nodule is defined as the number of days in which the nodule doubles in volume. See: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3439160/ [Accessed: July 2024].
[54] VDT is a key parameter in the differentiation of aggressive tumours from slow-growing tumours. See: https://pubs.rsna.org/doi/full/10.1148/radiol.2020191835 [Accessed: July 2024].
[55] https://www.england.nhs.uk/wp-content/uploads/2019/02/B1646-standard-protocol-targeted-lung-health-checks-programme-v2.pdf [Accessed: May 2024;].

Key staffing: Each project must have four clinical roles in place to ensure the effective delivery of care and clinical governance of the programme. The clinical director of programme will work with the responsible assessor, responsible radiologist and responsible clinician.

Participant selection and exclusions: The TLHC programme targets individuals at high risk of developing lung cancer. Eligibility criteria for being invited to participate in the programme include:

- **Age**: Between 55 and 74 years and 365 days old at the time of the first LDCT scan. This age group was determined by the EAG, using previous trials as a basis and the requirement to balance clinical need with manageable levels of service demand. As long as participants are within this age bracket at the time of their baseline CT scan (where relevant), they will continue to be eligible for the programme even if they turn 75.

- **Smoking history**: Must have ever smoked.

Invitation: Eligible individuals are identified through GP records and invited to participate in an LHC via letter and/or telephone call. Text message reminders are also sometimes deployed. Reasonable adjustments are made to ensure accessibility for all, including those with disabilities or limited English proficiency. Invitations can either state a pre-determined date and time for the appointment, and request individuals opt-out if they do not wish to participate ("opt-out"), or they can invite the participant to contact the service and book an LHC if they would like to take part ("opt-in").

Initial assessment or triage[56]: Whilst not compulsory, some sites choose to conduct an initial assessment or triage of participants. This can be completed by a Band 3 member of staff, though Band 4 is recommended. The purpose of this assessment is to pre-populate the risk calculator data, but this is distinct from the LHC assessment itself, which must be completed by a Band 6 (or higher) nurse.

Lung Health Check: The LHC can take place over the telephone or in-person, and it involves a discussion to assess individual lung cancer risk, including smoking habits. To be deemed "high-risk" and therefore eligible for an initial LDCT scan, the participant must meet a minimum risk threshold based on validated risk prediction models (PLCOm2012 or LLPv2). Current smokers should be offered smoking cessation advice, formal smoking cessation service referral on an opt-out basis, and treatment, e.g. nicotine replacement therapy.[57] High-risk individuals may also undergo additional investigations like spirometry and blood pressure measurement.

There are some additional eligibility criteria for being referred for a LDCT scan. The participant must not have:

- Physical limitations preventing LDCT scan (e.g., weight exceeding scanner limit, inability to lie flat);

[56] When such triage leads to participants being excluded from LHC assessment by a non-clinical assessor, cases should be audited by the Responsible Assessor or a delegated clinician not junior to a Band 6 LHC nurse, for example by review of recorded telephone consultations.
[57] As part of an LHC, all current smokers should be advised on smoking cessation by a trained professional. Some of these participants may then go on to a LDCT scan. Smoking cessation advice and information about locally available support should be incorporated into written correspondence and should be face-to-face where possible. Enhanced smoking cessation interventions are also encouraged including the use of pharmacotherapy. Current smokers should be offered on-site smoking cessation advice and support and an opt-out referral to further smoking cessation support.

- Poor health that would preclude curative treatment for lung cancer.

Individuals who have had a full thoracic CT scan within the past 12 months are not excluded but will have their LDCT appointment deferred.

Initial LDCT scan: High-risk individuals are offered a LDCT scan[58], which may show:

- No significant findings: Participants return for routine screening after 24 months.
- Indeterminate results: Further scans are scheduled at specified intervals before returning to routine screening.
- Findings requiring further investigation: Referral to a specialist lung clinic is made.
- Lung cancer risk: Must meet a minimum risk threshold based on validated risk prediction models (PLCOm2012 or LLPv2).

Follow-up scans: The frequency of follow-up LDCT scans depends on the size and characteristics of any nodules detected. Protocols based on established guidelines ensure appropriate monitoring and timely intervention. Participants exit the programme at age 75 or 76, or if they become ineligible due to changes in health status.

Incidental findings: TLHC services should have protocols in place for the reporting and management of incidental findings. Clinically insignificant findings should either not be reported or be clearly identified as such. An emphasis should be placed on reporting of findings where there are proven interventions for participant benefit, as set out in the Quality Standards. This is because minor incidental findings are common on LDCT and have the potential to cause increased unnecessary investigations and anxiety to participants. The NHSE TLHC Incidental Findings Management Protocol provides guidance on the management of the most common findings.[59]

3.6.2 Alterations to the Standard Protocol

At several points during programme delivery, amendments have been made to the protocol. These amendments have enabled the programme to respond to changing delivery contexts and also absorb and reflect learning from early-stage delivery.

In June 2020 an addendum to the TLHC Standard Protocol was published, setting out modifications to delivery of the intervention during the COVID-19 pandemic. Several changes were introduced, including that:

- Projects were instructed to undertake LHCs by telephone or video-calling during the pandemic, making reasonable adjustments for specific groups when necessary;

[58] The standard protocol uses two thresholds to be deemed high risk and therefore eligible for CT scan: a risk threshold of ≥1.51% risk of lung cancer over six years as the minimum threshold for PLCO; and ≥2.5% risk of lung cancer over five years for LLPv2.
[59] https://www.england.nhs.uk/wp-content/uploads/2019/02/B1647-quality-assurance-standards-targeted-lung-health-checks-programme-v2.pdf [Accessed: May 2024].

- The requirement for spirometry and blood pressure assessment to be undertaken as part of the LHC was deferred; and,
- Staff and participants were required to adhere to social distancing and clinical delivery had to follow local infection control guidelines.

In March 2022, an updated protocol was shared with all projects, aligning with the end of the Standard Protocol Addendum implemented in response to the pandemic. The main changes to the protocol were:

- LHCs could be delivered either face-to-face, over the telephone or via video-call. As a result, spirometry was no longer a requirement during LHCs (as stated in the original, pre-pandemic, protocol);
- The option for triaging of participants was added to the protocol. To conduct these assessments, staff are required to complete all relevant training, such as Communicating with High-risk Individuals;
- Projects were no longer required to reinvite participants who were originally assessed to be below the risk threshold for a CT scan but may now exceed the threshold (including because of their age, additional pack years every two years, or if they have aged-into the eligibility criteria) though this remained recommended. The rationale behind this change was the difficulty for projects to implement this, particularly those using a mobile scanning unit that travels across a large geographic area;
- The Quality Assurance Standards were adapted to remove the requirement that all radiologists must be FRCR[60] qualified to report CT scans. Instead, the standards were updated to recognise radiologists with equivalent non-UK qualifications (recognised by the General Medical Council) so they can report on CT scans.

In July 2024, the national programme team ran a further consultation with projects and programme stakeholders to seek input on any further necessary changes to the protocol. An updated version of the protocol is expected to be published in December 2024.

3.6.3 TLHC Quality Assurance Standards

The Quality Assurance Standards were prepared with guidance from the EAG.[61] There are 15 quality standards for the programme that together form the quality assurance framework for skills and training, information and communication, and clinical delivery. This document set the standards for staffing, nurse and radiologist qualifications, experience and training, hardware, software, data management, communications, radiology acquisition and reporting, and follow-on clinical management in secondary care.

3.7 Overview of funded projects

Table 3.1 outlines the 23 Phase 1 and 2 areas that are within the scope of the evaluation.

[60] Fellowship of the Royal College of Radiologists.
[61] https://www.england.nhs.uk/wp-content/uploads/2019/02/B1647-quality-assurance-standards-targeted-lung-health-checks-programme-v2.pdf Accessed May 2024.

Table 3.1: TLHC Phase 1 and 2 project areas included within scope of the evaluation.

Project name	Phase	Launch date
Blackburn Darwen and Blackpool	1	Jul-21
Corby	1	Apr-21
Doncaster	1	Mar-21
Hull	1	Apr-21
Luton	1	Feb-21
Mansfield and Ashfield	1	Mar-21
Newcastle Gateshead	1	Mar-21
North Kirklees	1	Sep-21
Southampton	1	Aug-19
Tameside and Glossop	1	Jul-21
Thurrock	1	Nov-20
Bradford	2	Dec-19
Cheshire and Merseyside (Halton)	2	Dec-21
Cheshire and Merseyside (Knowlsey)	2	Nov-21
Cheshire and Merseyside (Liverpool)	2	Jun-21
Coventry and Warwickshire	2	Jun-21
Hammersmith & Fulham	2	Oct-18
Hillingdon	2	Oct-18
Manchester	2	Apr-19
Salford	2	Sep-19
Stoke on Trent	2	Apr-19
Sutton	2	May-21

3.8 Project delivery models

The Standard Protocol and Quality Assurance Standards aim to ensure a high degree of consistency in, and clinical assurance of, the participant pathway. However, there is also scope for heterogeneity in project delivery models. Some of the key areas of variation are summarised below, and the delivery models operating across the programme are outlined in Figure 6.1[62] (in Chapter 6). Further discussion and interpretation of the impact of different delivery models on programme outputs and outcomes is considered in subsequent chapters.

The main areas of variation in project delivery models are as follows:

- Invite model: either opt-in, opt-out, or combined.
- LHC delivery model: virtual, face-to-face, or hybrid.
- CT scanning location: community-based, acute-based, or hybrid.

[62] Note that delivery models have changed in some projects during the course of delivery. The content in Figure 6.1 shows the models in place in projects in January 2024.

Project implementation models are discussed in further detail in Chapter 6.

Alongside these main areas of variation, projects have outsourced aspects of their TLHC pathway delivery to varying degrees. For example, some projects have outsourced the pathway from end-to-end meaning that a private provider delivers the service from invitation through to onwards referrals. Other projects have partially outsourced their service, commonly the delivery of CT scanning. Some projects have delivered the whole pathway in-house, typically managed within an acute trust.

3.9 Programme Theory of Change

Both narrative and diagrammatic depictions of the TLHC TOC are included in Appendix 4. These provide further details about how the programme is expected to achieve its objectives.

4 Descriptive analysis of key programme outputs

This section provides an overview of what has been delivered through the programme, focusing on the following[63]:

- Key pathway engagement metrics, including an exploration of change over time;
- Lung cancer diagnoses;
- Incidental findings;
- Smoking cessation.

These correspond to the programme outputs outlined in the programme TOC (Appendix 4).

This chapter focuses on the overall activity delivered by Phase 1 and 2 projects. Chapters 4 and 5 provide additional insights relating to different implementation models and demographic groups.

4.1 A note on benchmarking TLHC programme performance

The initial submissions and set up of the programme were made alongside the NHS Long-Term Plan process in 2019, rather than a standard business case document being produced.

Assessing programme performance against its main output objectives has drawn on a range of sources. Several documents, including some modelling assumptions for Phase 1 projects, were supplied. Original modelling was based on previous trials, which differed by design and population, so were an imperfect assumption of outcomes. Based on discussions with the national programme team, it was concluded that it would be most relevant to compare key TLHC programme outputs and outcomes with those from the Manchester pilot study, and – in cases – from across a range of the UK-based predecessor trials and pilots. The Manchester pilot was used in original modelling assumptions, with the assumption of a 3% initial scan cancer detection rate.

Table 4.1 provides an overview of results from the main predecessor trials and pilots. On key metrics, such as the initial scan cancer conversion, it provides a useful range of interpreting TLHC performance. It should be noted that there are important differences in the design of each of these trials, the health of the underlying population, and the design of each study.

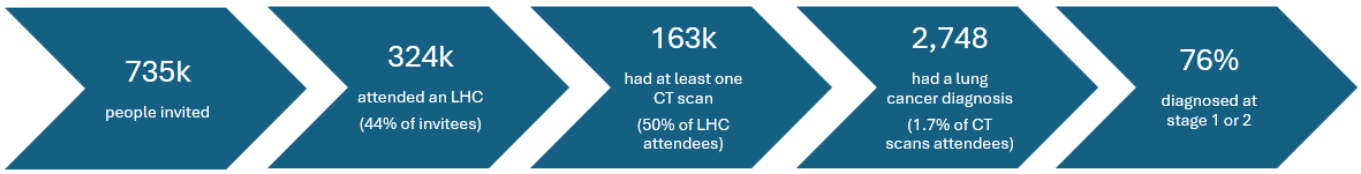
[63] Note that demographic and implementation-model breakdowns of these figures are covered in subsequent chapters. The focus of this chapter is on the programme-wide summary overview.

Table 4.1: Overview of results from preceding trials and pilots (provided by NHSE) – see Appendix 2 for more details

Study	Number screened with LDCT	Initial scan cancer conversion	2-year scan cancer conversion	Lung health check uptake (attended/ invited)	Recall rate	Current smoker rate	Median pack years
National Lung Screening Trial (NLST)[64], [65]	26,722	1.0%	0.9%	n/a	n/a	48.1%	48
Manchester Lung Health Checks[66], [67]	1,384	3.0%	1.6%	26.3%	12.7%	35.1%	36.7
NELSON [68], [69]	7,557	0.9%	0.5%	25%	n/a	55.5%	42
UK Lung Cancer Screening Trial (UKLS) [70], [71]	2,028	2.1%	n/a	30.1%	47.7%	38.3%	20
Liverpool Healthy Lung Programme [72] [73], [74]	1,318	1.9%	n/a	40.0%	n/a	~29.0% [75]	40
Lung Screen Uptake Trial (LSUT) [76]	768	4.7%	n/a	52.6%	n/a	70.9%	36
West London lung screening pilot [77]	1,145	2.5%	n/a	20.9%	14.2%	24.1%	n/a

The flow chart below provides a summary of the programme by the main stages.

Figure 4.1: Summary of programme activity



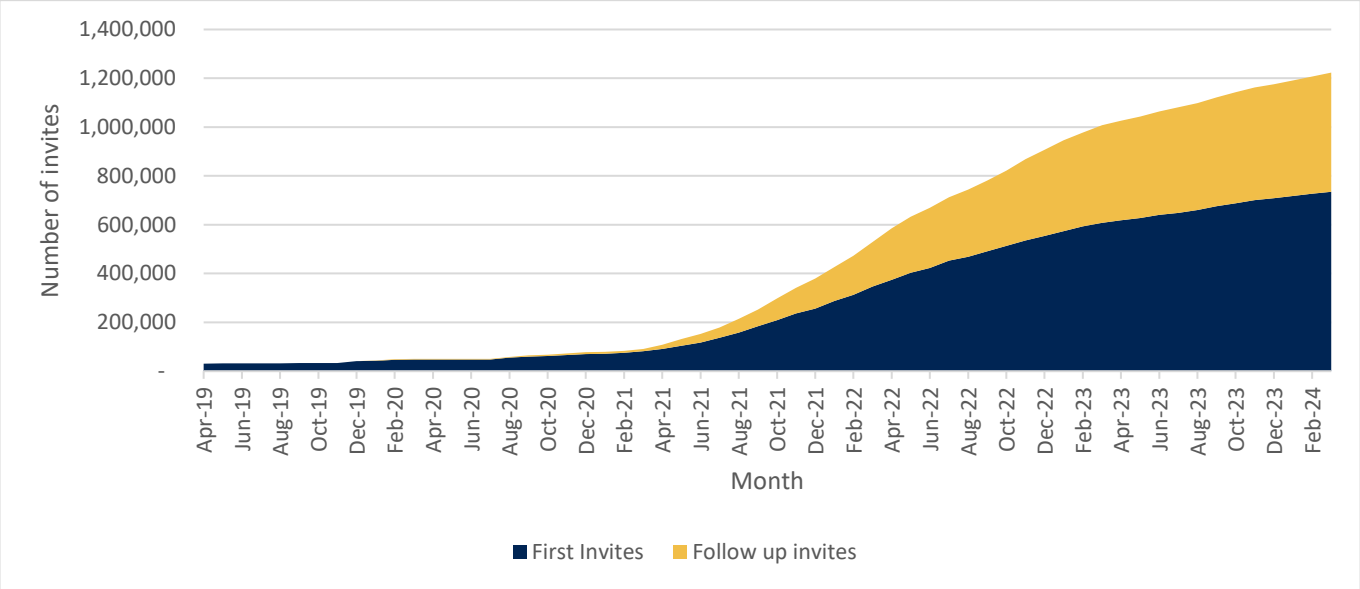
[64] https://pmc.ncbi.nlm.nih.gov/articles/PMC2994863/ NLST
[65] https://www.nejm.org/doi/full/10.1056/NEJMoa1102873 NLST
[66] https://pmc.ncbi.nlm.nih.gov/articles/PMC6585285/
[67] https://pubmed.ncbi.nlm.nih.gov/29440588/
[68] https://www.nejm.org/doi/full/10.1056/NEJMoa0906085
[69] NELSON did not limit invitations to ever-smokers. Assuming ~50% ever-smoker rate, we can consider this to be 50% uptake.
[70] https://www.thelancet.com/journals/lanepe/article/PIIS2666-7762(21)00156-3/fulltext
[71] UKLS and LHLP used *years of smoking duration*.
[72] https://pubmed.ncbi.nlm.nih.gov/31319997/
[73] UKLS and LHLP used *years of smoking duration*.
[74] Number of scans reported in the published evaluation, final number in aggregate data known to be high (Balata, 2021).
[75] Estimated since LHLP did not have data on whether ever smokers were current or ex-smokers.
[76] https://pmc.ncbi.nlm.nih.gov/articles/PMC7509385/
[77] https://pubmed.ncbi.nlm.nih.gov/32771715/

4.2 Invites

Phase 1 and 2 projects sent out 1.22 million invites; 735,000 were first invites and 488,000 were subsequent invites. Invites were sent to more than 100% of the initial cohort identified in 2019. This is because some participants who 'aged in' to the criteria were also invited. The first invites sent represent 11.9% of the total estimated eligible population in England (6.2 million). Project delivery was delayed by the COVID-19 pandemic; Phase 1 projects started to send invites in August 2020 rather than the planned start date in March 2020. Activity increased significantly from April 2021, as shown in Figure 4.2.

A total of 323,921 people accepted their invite (representing 44.1% of the first invites sent). Based on the patient-level analysis, around a third of participants who accepted their invite to a LHC responded to their first invite, another third responded to their second invite and the final third to their last invite. This data should be treated with caution as some projects, such as those with opt-out models, may not accurately capture the point of acceptance.

Figure 4.2: Cumulative number of TLHC invites sent by month



4.3 LHCs

A total of 323,921 LHCs were delivered by Phase 1 and 2 projects between April 2019 and March 2024. This accounts for 44% of the participants invited[78] (the 'LHC uptake rate'). This compares to a 26% LHC uptake rate in the initial Manchester pilot study, though this used a different methodology for calculating update.[79] [80] The uptake rate increased over the course of the programme. The cumulative rate increased by ten percentage points between April 2020 and March 2024 (34% to 44%). The potential reasons for this, including the numerous strategies deployed by projects to boost uptake, are assessed in Chapter 6. Initial programme modelling anticipated an LHC uptake rate of 50%.

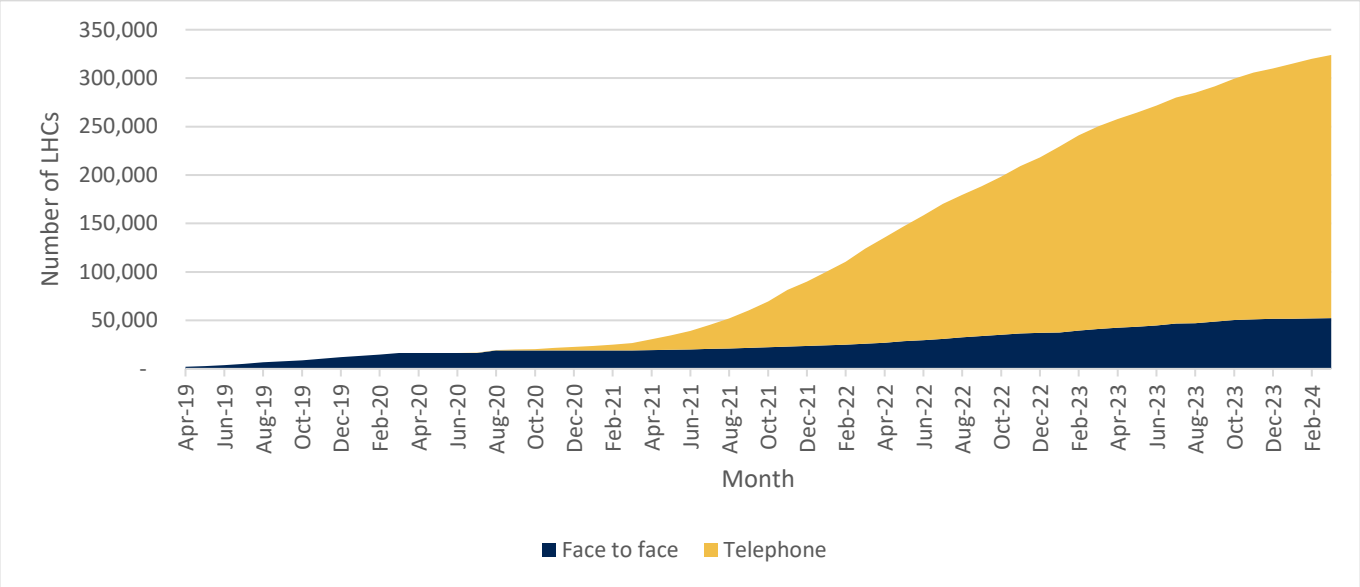
[78] This is different to the patient level analysis (see Appendix 6) as it includes Phase 2 sites which submitted record level data.

[79] The Manchester study calculated uptake slightly differently to TLHC, as they identified a cohort of around 16,000 individuals and invited all of them. From that they estimated that only 10,000 were eligible. And they calculated the uptake based on the estimated 10,000 figure. It is not clear how many invites each person received for example. But with the 10,000 as the denominator, the uptake rate in this pilot was 26%.

[80] https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [Accessed: July 2024]

More than 4 in 5 (84%) of the LHCs were delivered by telephone, reflecting the mandated shift to virtual appointments as part of the Standard Protocol Addendum produced in response to the COVID-19 pandemic. This model remained popular with projects even after the Addendum was archived. Greater Manchester was the only Cancer Alliance that delivered more face-to-face LHCs than virtual. The three projects in this Cancer Alliance delivered 77% of all the face-to-face attendances. This is largely due to the Manchester project starting earlier than the other projects and being fully operational before the COVID-19 pandemic. As the programme was introduced to other project areas within Greater Manchester, the decision was made to implement a similar face-to-face model. Further detail about implementation models and factors influencing decision-making are covered in Chapter 6.

Figure 4.3: Cumulative number of LHCs attended per month

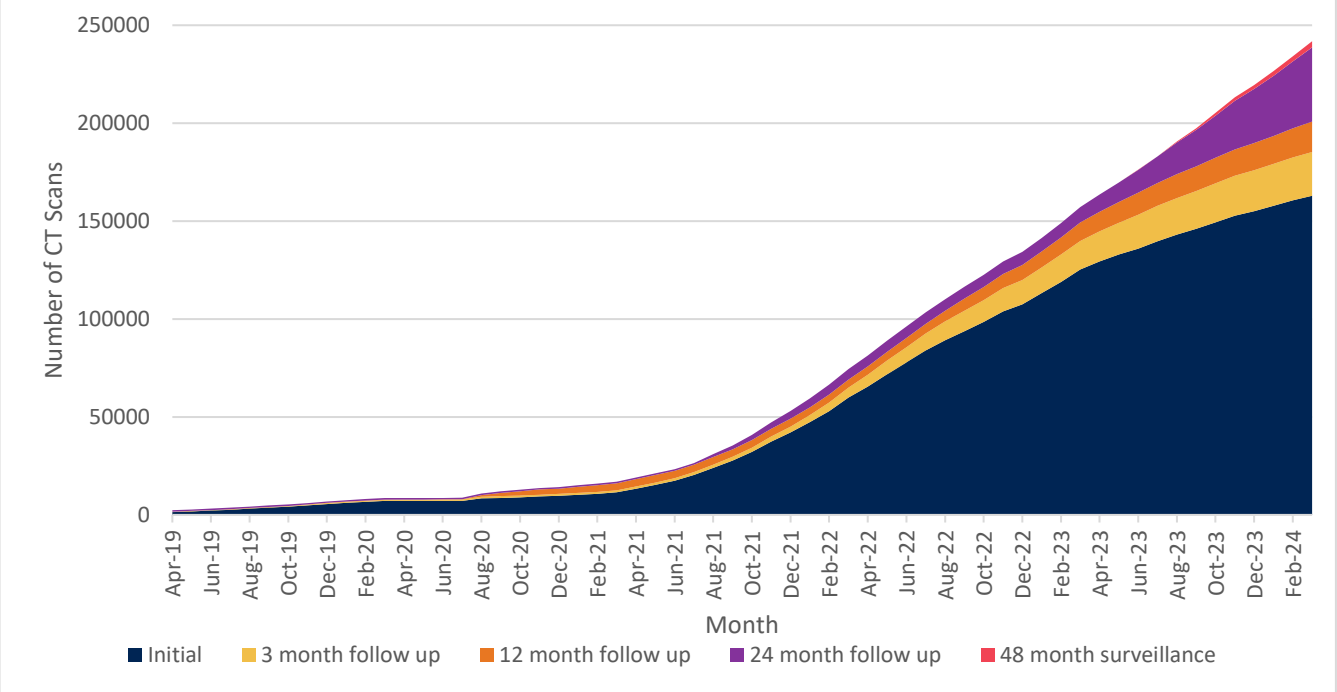


4.4 CT scans

A total of 242,000 CT scans were delivered by Phase 1 and 2 projects between April 2019 and March 2024. Of these, 163,000 were initial scans, 22,000 were 3-month scans, 16,000 were 12-month scans, 38,000 were 24-month scans and 3,000 were 48-month scans. The higher proportion of 24 months scans is due to the clinical protocol which does not require everyone to have a 3- or 12-month scan, but everyone who attends a baseline scan is eligible for a 2-year scan.

Most 48-month follow up scans were undertaken in Greater Manchester (84%). This is due to the Manchester project starting first and therefore having more participants eligible for a 48-month scan.

Figure 4.4: Cumulative number of CT scans per month



Two metrics are used within the evaluation to better understand eligibility for, and engagement with, initial CT scans. These are CT scan conversion (eligible) and CT scan conversion (realised). Only participants deemed eligible for a CT scan, based on LLP/PLCO risk scores established during the LHC appointment, are referred for a scan. The following formulae can be used to understand CT scan uptake[81]: CT scan "drop-off" can be defined as the difference between conversion (eligible) and conversion (realised). This is explored further in Chapter 5.

Conversion (eligible):

$$\frac{\text{\# eligible \& referred for a CT scan}}{\text{\# attended an LHC}} \times 100$$

Conversion (realised):

$$\frac{\text{\# attended a CT scan}}{\text{\# attended an LHC}} \times 100$$

Both measures of CT scan conversion have increased since April 2020:

- The CT scan conversion (eligible) rates increased from 46% to 52% between April 2020 and March 2024. This compares to the initial Manchester pilot study in which 55% of LHC attendees received a positive PLCO risk score and were therefore deemed high risk.[82]

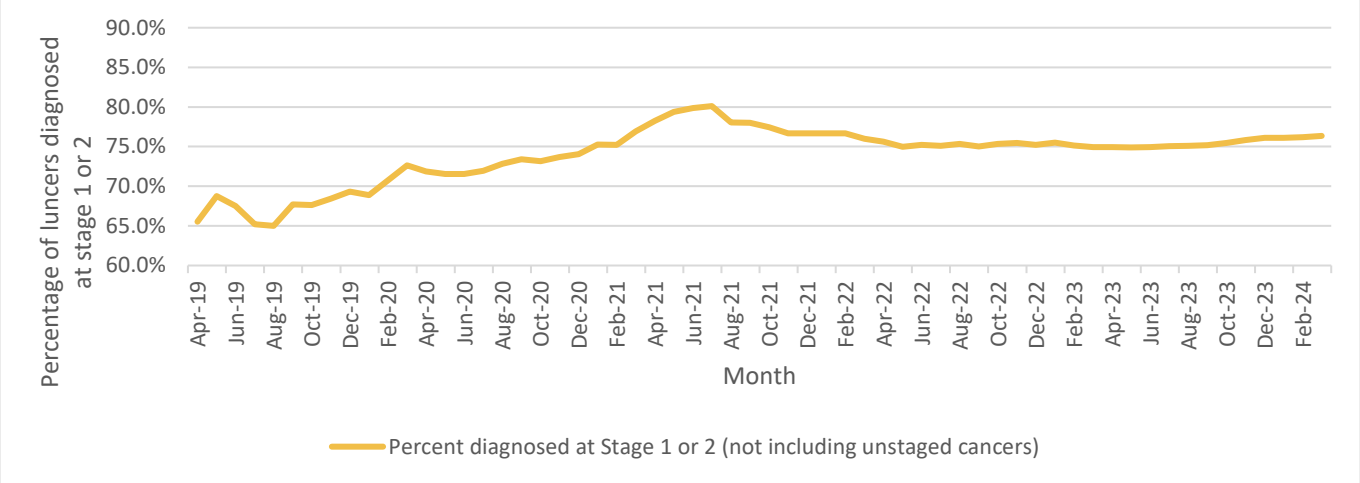
[81] Risk score data is used to derive the number of individuals eligible for a CT scan (i.e. the number of LHC participants deemed eligible for a CT scan). Where risk score data is not reported, the 'referred for a CT scan' MDS metric is instead used. Some individuals with a risk-score that deems them eligible for a CT scan are not able to have one due to factors such as having had a recent CT scan or not meeting weight thresholds. These individuals are removed from the denominator, so that they do not impact the analysis.

[82] https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [Accessed: July 2024].

- The CT scan conversion (realised) rate increased from 43% to 50%. This compares to the initial Manchester pilot study in which 53% of LHC attendees went on to receive an initial CT scan.

This suggests that, over time, the TLHC programme has been conducting LHCs with higher risk individuals, and participants have been increasingly likely to attend their CT scan. This is because there are two factors that drive CT scan conversion. The percentage referred on for a scan (i.e. high-risk participants) and the 'did not attend (DNA) rate. If the conversion has increased over time either more participants have been referred, DNA rates have decreased or a combination of the two. There are data quality issues with the rates between April 2019 and March 2020, including small numbers, that make the rates difficult to interpret.

Figure 4.5: Cumulative CT scans conversion rates per month



4.5 Cancer diagnoses

Cancer diagnoses are sourced from linking the record-level TLHC dataset to cancer outcomes from the RCRD where available, and aggregate level data, where record level data is not available. See section 2.2 for further information.

A total of 2,748 TLHC participants received a lung cancer diagnosis. This represents 1.7% of all participants who received an initial CT scan. This is lower than the 3% diagnosed in the Manchester pilot study.[83] The Manchester pilot study covered the baseline scan and a three month follow up scan, with a separate paper covering the annual follow up scan. The first annual follow up scan for patients with an indeterminate baseline scan in Manchester shows a diagnosis rate of 1.9%.[84]

The patient level analysis shows diagnosis rates are similar after each CT scan with rates of between 1.1% and 1.4% for initial, 3-month, 12-month and 48-month scans. The 24-month CT scans have a lower rate (0.4%). This was reviewed by clinicians and is as expected. An explanation for this variation will be that 24-month scans are prevalence scans, offered to all participants who had a baseline scan, and not nodule surveillance scans, offered to participants with a suspect finding in a previous scan. 'Other scans'

[83] https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [Accessed: July 2024].
[84] https://thorax.bmj.com/content/74/7/700 [Accessed: July 2024].

in the table include all scans completed outside the standard protocol. For example, some projects undertook another scan 12 months after the 3-month scans, 15 months, after their baseline scan.

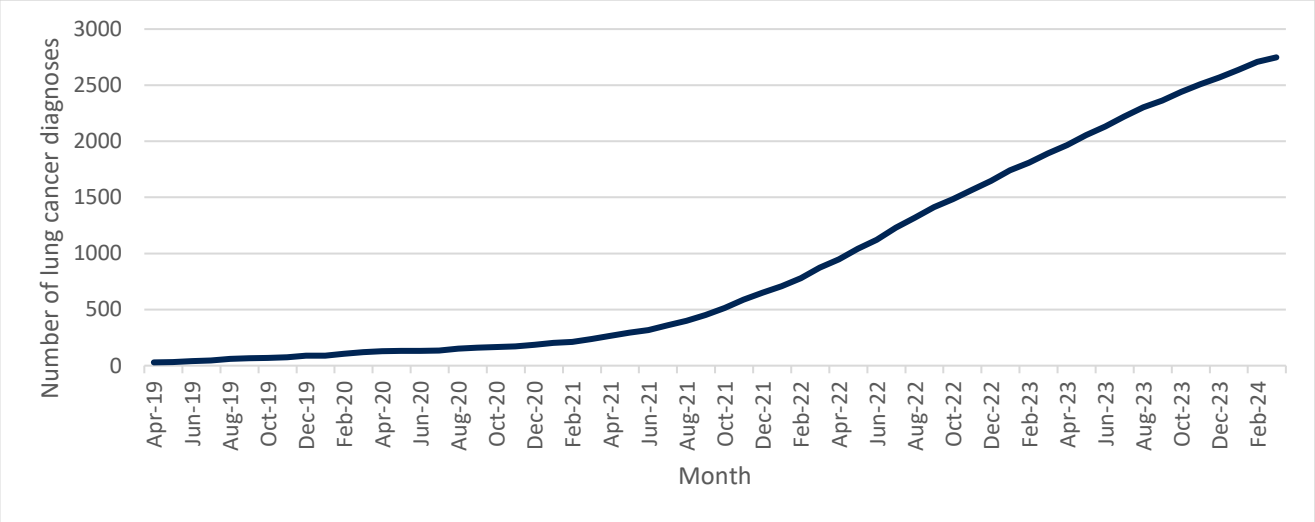
The diagnosis rates for each scanning round are shown in Table 4.2 below.

Table 4.2: Cancer diagnosis rate by scanning round

Scanning round	Cancer diagnosis rate[85]
Baseline	1.1%
3 month	1.4%
12 month	1.4%
24 month	0.4%
48 month	1.1%
Other scan	2.9%

Other cancer screening programmes have lower diagnosis rates. Breast screening saw a diagnosis rate of 0.87%[86] in 2022/23 and bowel screening was 0.16%[87] in 2021/22 (6,500 diagnosed from 4,083,100 patients who adequately participated (i.e., 'were screened')), although these are not targeted programmes and the cost of screening each participant may be lower.

Figure 4.6: Cumulative number of Lung Cancer diagnoses per month[88]

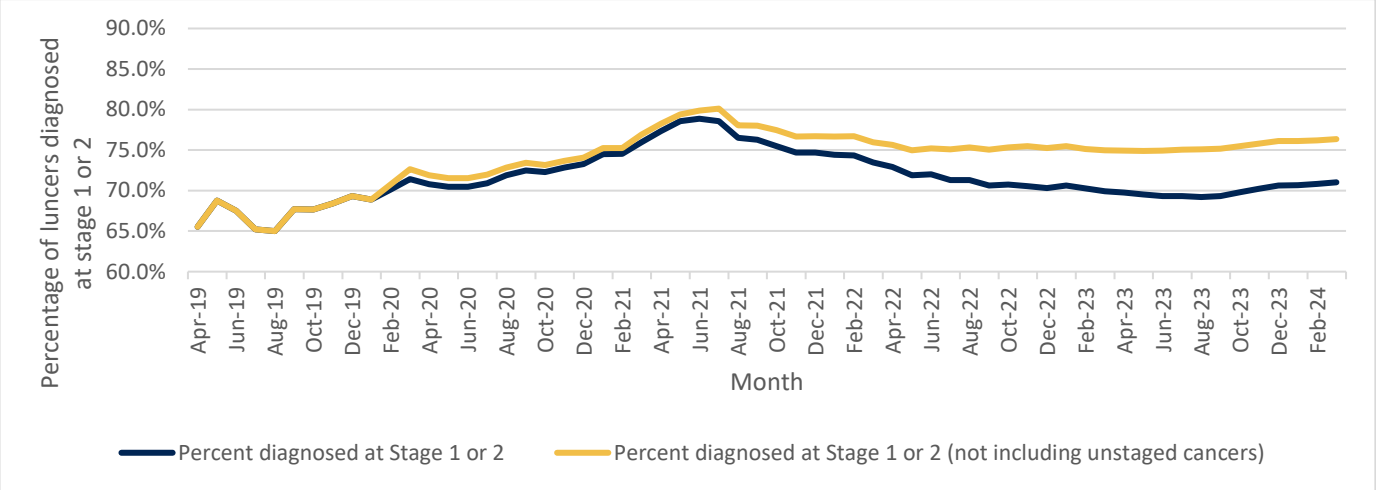


[85] Calculated using the record level dataset which is only available to September 2023. These figures are defined as the number of people who received a TLHC-associated lung cancer following the scan as a proportion of people who underwent the scan.
[86] https://digital.nhs.uk/data-and-information/publications/statistical/breast-screening-programme/england---2022-23 [Accessed: July 2024].
[87] https://www.gov.uk/government/publications/bowel-cancer-screening-annual-report-2021-to-2022/bowel-cancer-screening-annual-report-2021-to-2022 [Accessed: July 2024].
[88] This uses record level data, where available, and aggregate data for projects and time periods where record level data is not available. The record level data goes up to August 2023.

The programme was developed to improve outcomes for participants with lung cancers, particularly in areas with the highest prevalence. 76%[89] of the lung cancers detected in the TLHC programme were stage 1 or 2. This is similar to the Manchester pilot study and other national screening programmes in which 80%[90] and 79%[91] of lung cancers were diagnosed at stage 1 or 2.

The rate of lung cancers detected at stage 1 or 2 drops between April 21 and March 2024 to a more stable trend, as shown in Figure 4.7.

Figure 4.7: Cumulative percentage of lung cancers diagnosed at stage 1 or 2 per month



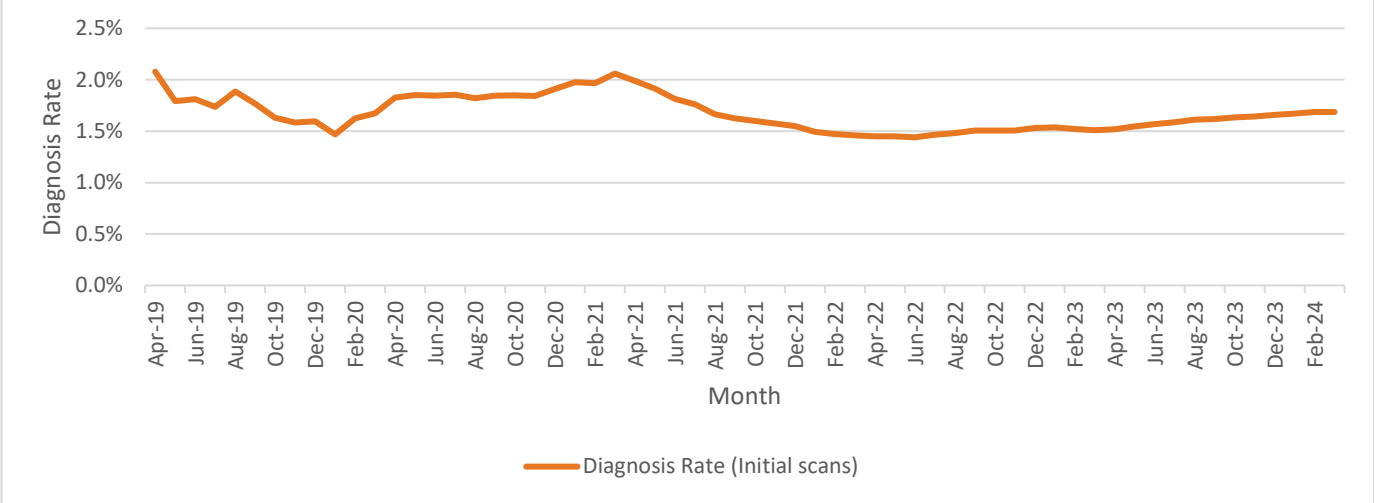
The cumulative number of lung cancer diagnoses per initial CT scan drops from a high of 2.1% in March 2021 to around 1.5% until April 2023 and then increases to 1.8% by March 2024. A breakdown of projects, which dataset they reported, and strands of the evaluation they participated in is in Appendix 7.

[89] Unstaged cancers have been removed from the calculation in line with national reporting

[90] https://thorax.bmj.com/content/74/4/405?ijkey=e73903b9576ac45332be585c490b4bd327bcdc31&keytype2=tf_ipsecsha [Accessed July 2024]

[91] Routes to Diagnosis Dashboard (https://nhsd-ndrs.shinyapps.io/routes_to_diagnosis/) [Accessed July 2024] based on cancers flagged by the cancer registry as detected via the breast, bowel or cervical screening programmes

Figure 4.8: Cumulative lung cancer diagnosis rate per month



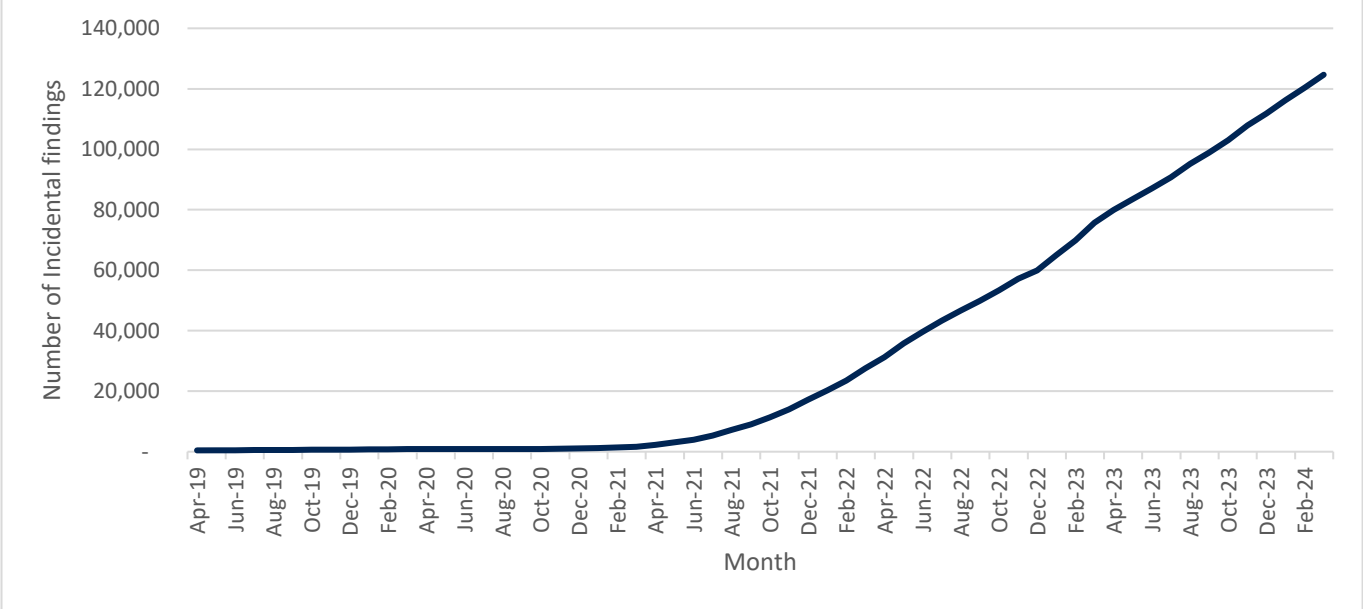
To finalise this section reporting on cancer diagnoses, it is necessary to assess lung cancer diagnoses among those that did not engage with the TLHC programme (having been found to be eligible) or who were identified as low risk at their LHC. This includes:

- A total of 39 people identified as low risk at their LHC were diagnosed with lung cancer (although nine of these did have a subsequent LDCT).
- A further 59 participants who were identified as high risk at their LHC but who did not attend their baseline LDCT went on to be diagnosed with lung cancer. Seven of these people did however have a subsequent LDCT.
- A further 477 people who were invited but did not attend a LHC were diagnosed with lung cancer.

4.6 Incidental Findings

125,000 participants were diagnosed with at least one incidental finding through the TLHC programme. This represents more than three-quarters (76.5%) of all the participants who had an initial CT scan. Nearly three-quarters (74%) of participants with an incidental finding had coronary calcification, two-fifths (39%) had aortic valve calcification and one-fifth (20%) had emphysema.

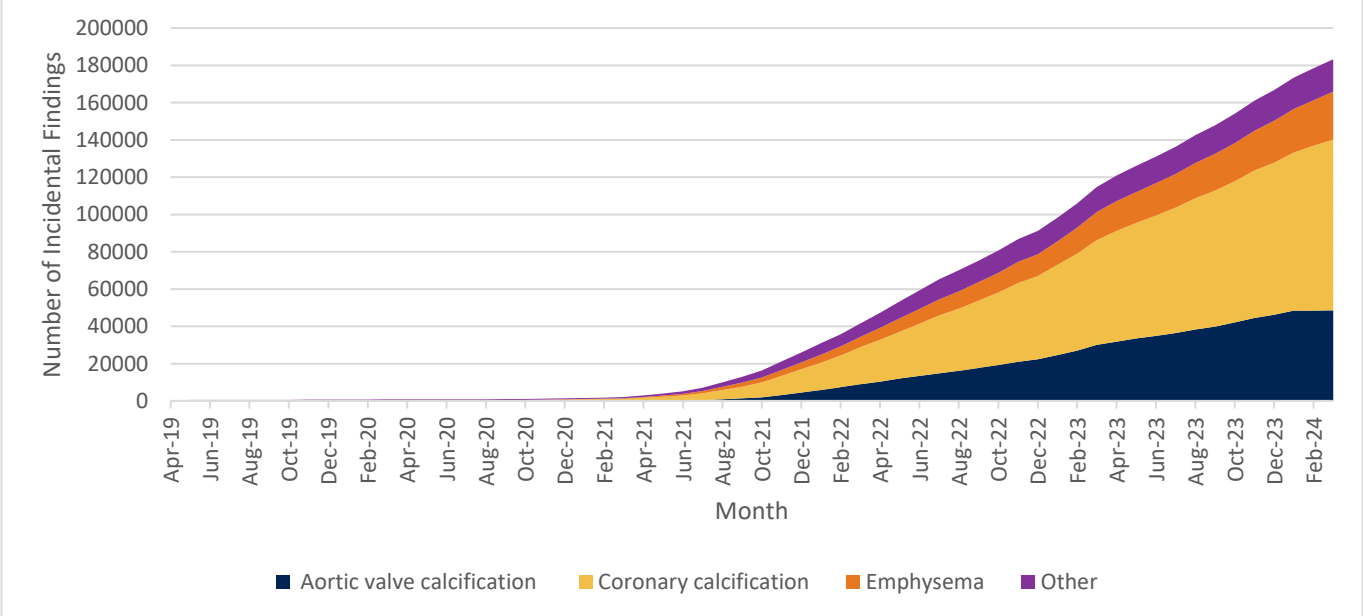
Figure 4.9: Cumulative number of incidental findings diagnosed per month



There is a wide variation in the diagnosis rates of incidental findings across Cancer Alliances. The overall proportion of incidental findings per LHC ranges from 10% of participants within a Cancer Alliance receiving a diagnosis of an incidental finding to 87.1%. Low data quality cannot be ruled out as a partial explanation for this wide variation, however all the data was validated by Cancer Alliances, so this reduces the likelihood that data quality is the main cause.

There is also wide variation in the specific incidental findings diagnosed. This may reflect the varied clinical approaches being taken across the projects. 39% of participants with at least one incidental finding were in a single Cancer Alliance. This Cancer Alliance also saw significantly more aortic valve calcification findings than any other Cancer Alliance (94.2% of all diagnoses).

Figure 4.10: Cumulative number of incidental findings diagnosed per month by finding



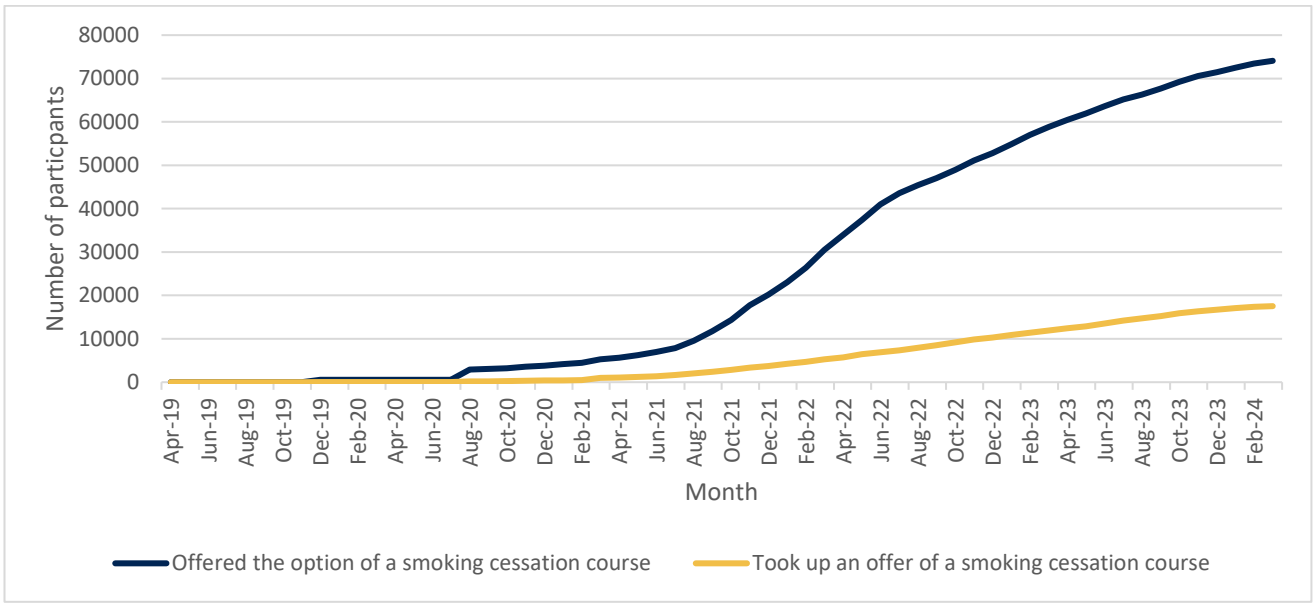
1,697 other (non-lung) cancers were diagnosed between February 2020 and August 2023[92] amongst 1,673 TLHC participants[93] who received a LHC and were assessed as high risk.[94] [95] Of these cancers, 481 (28% of all diagnoses) were diagnosed within three months of the participant's last TLHC event. This may indicate that these cancers may have been detected and referred via TLHC, or as a result of the programme encouraging improved health behaviour in participants. Incidental findings are discussed in further detail in Chapter 8.

4.7 Smoking cessation

Data was collected on the number of participants that completed a smoking cessation course by some projects. However, projects reported difficulties in accessing reliable data from third party smoking cessation providers, and so this data is not included due to data quality issues. Data on smoking cessation services is also variable across the projects.

In total, 74,000 participants were offered a smoking cessation intervention, and 17,500 (23.7%) took up the offer. There are large differences in the percentage that took up the offer across the Cancer Alliances. One had a rate of 98%, although this is based on small numbers, whilst another did not offer any such interventions. This suggests a general issue with data quality for this part of the pathway. Five of the 12 Cancer Alliances had rates between 40 and 50%. If four outlier Cancer Alliances[96] are removed, the rate of those taking up the offer increases to 31.2%. Smoking cessation is discussed in further detail in Chapter 8.

Figure 4.11: Cumulative number of smoking cessation services offered and taken up per month



[92] Non-lung other cancer data starts from February 2020 due to (record-level) TLHC-countable activity starting in January 2020 and cancer diagnoses usually being made following a time lag from TLHC activity.
[93] 24 participants had multiple diagnoses for other cancers, explaining the differences in these figures.
[94] This figure does not include other cancers detected via other screening programmes: Breast = 113; Colorectal = 61; Gynaecological = <10
[95] It is not possible within the NCRAS linked data to know whether cancers were detected or referred directly through the TLHC pathway, therefore a denominator has not been used with this data. This also means that the other cancers reported cannot necessarily be attributed to the TLHC programme.
[96] Three projects with rates less than 3% and one with 98%.

5 How were TLHC projects set up?

This chapter sets out findings on the steps taken by project teams to establish themselves and prepare for delivering LHCs.

5.1 Initial steps taken by projects to set up

Across the course of the evaluation, project teams provided insights into the steps necessary to establish a LHC project locally. Below, the key steps are outlined, following a general chronology followed by most projects:

- **Establishing governance and reporting structures** – An essential first step to set up was investing time and resourcing into developing a clear governance and reporting structure for the project locally that aligns with the Standard Protocol. This was perceived by project stakeholders as critical, as it established the foundations of the project, filling key governance roles and developing partnerships, decision-making processes and responsibilities that would be pivotal to the set-up and delivery of their service.

  "[My recommendation is] map out your governance process, that can take time, that can hold up things, because often these contracts are over £1 million so they have to go right up to board level, not just in the ICB but also in the acute providers as well, the governance has to go through there as well, so that can take time." [Project Lead]

- **IT and information governance** – Significant resource was spent in ensuring data sharing agreements and data protection impact assessments were in place to enable delivery. Projects' approaches to this varied; some established workstream specific task and finish groups, whilst a responsible individual led this in others. Stakeholders highlighted the challenges this step caused due to its complexity, leading to delays. Due to the legal requirements of having data sharing agreements in place to proceed with delivery, this was regarded as a critical risk and significant project resource was spent ensuring this step was delivered correctly.

  A key aspect was identifying and agreeing an IT platform to use within the project. Significant resource was spent selecting a tailored solution that worked best locally and within their proposed delivery model. For example, one project held a data mapping workshop with all local stakeholders which identified that it made most practical sense if the acute Trust hosted the booking service. The workshop helped overcome initial Trust hesitancy by identifying that alternative approaches would have significant drawbacks due to data sharing requirements.

- **Modelling demand across the pathway** – Projects reported using both national modelling and local modelling carried out by themselves to understand expected onward demand across their local system, including for incidental findings. National modelling data played a particularly key role at the outset of the project to inform decision-making, whilst local modelling could be conducted. This process helped projects identify where onward services are likely to experience increased demand so that local solutions could be put in place to manage this. For example, implementation plans, such as whether a project would rollout in a phased approach and/or scale up capacity over time, were agreed to ensure secondary care was able to manage the anticipated increased demand. Similarly, several projects noted that additional targeted investment was made in onward services, such as respiratory care, following local modelling where there was substantial risk that they would not have sufficient capacity to managed

increased demand. Modelling local demand also helped overcome apprehension towards the service from stakeholders within the local system and helped them prepare ahead of delivery, supporting local buy-in.

"We can [not] underestimate the time that [the Trust Lead Clinician] and [Responsible Radiologist] spent on talking to colleagues and making sure the pathways from [screening review meetings] would be as smooth as possible. And I think sometimes when projects are rushed, that conversation doesn't happen and then it's to the detriment of the programme longer term." [Project Lead]

- **Agreeing a service delivery model** – A crucial step during setup was agreeing a TLHC delivery model locally (specific models are described in the next section). This required significant stakeholder engagement with constituent organisations and wider stakeholders to agree responsibilities across the pathway. A key factor in determining local models was the local context and the provision of services. For example, assessing whether the acute Trust had sufficient CT scanner capacity to manage the increased number of CT scans generated through the programme.

  As part of this, projects had to agree a CT scanning and reporting model. This choice was generally about whether to use a static CT scanner based within the Trust and/or use a mobile CT scanner based within the community. The time and resource needed to agree this was influenced by projects' existing local CT and radiology capacity. Where there was existing capacity within the Trust and a willingness to do so, agreeing this approach was quicker once buy-in was secured. When projects opted for a mobile CT scanner model, tendering processes to procure scanners, radiographers, and healthcare assistants were required. Selecting suppliers required significant time and resource.

- **Establishing local protocols and referral pathways for incidental findings** – Managing the anticipated increase in demand on services due to the identification of incidental findings via TLHC has been a key challenge for projects. Given 1) the variation across local health systems (i.e. strong community services in place in some areas whilst others had more constrained services) and 2) the complexity of the programme compared to other screening services, projects had to engage with an extensive number of stakeholders across primary and secondary care and community services to agree how incidental findings will be managed locally. Projects conducted local modelling analysis to better understand downstream demand generated by the service and worked extensively with stakeholders within primary and secondary care to establish buy-in, build referral pathways and ensure there was capacity to respond to incidental findings generated by the programme. As noted, this process continued into the delivery phase, as services entered new areas where local concern from both primary and secondary care about their ability to manage the volume of incidental findings generated via TLHC was an ongoing challenge that needed to be overcome through engagement. This is discussed further in Chapter 8.

- **Staff recruitment**– recruitment of both clinical and non-clinical staff, including clerical, IT and programme management needed to deliver TLHC services, was a key step in project setup. It required substantial resource and time to complete. Along with securing CT scanner capacity, staffing was considered by programme leadership from the outset to be one of the key challenges for the programme to move at the desired pace. Specific staff and recruitment requirements varied across projects, depending on existing local capacity and chosen delivery models. Most projects primarily recruited externally. This step had notable challenges. Along with general recruitment timescales lasting several months and workforce challenges in some specific

geographic areas, recruitment for clinical roles, notably in radiology, was identified as a challenge. Projects provided examples of recruitment taking significantly longer than initially anticipated and procurement being initially unsuccessful and requiring re-procuring a second time to fill vacancies.

- **Staff training** – In addition to the national nursing and radiology training offer, as specified in the Standard Protocol, several projects invested time and resource into developing a wider suite of training courses. While the specific courses offered varied across projects, these supplementary courses principally focused on (i) awareness raising of the local programme across the pathway, (ii) clinical training to understand LHC protocols, (iii) training to support use of IT platforms, (iv) training on how to use mobile scanners and (v) full spirometry training. Projects' chosen delivery models were noted as a factor in developing their training offer. Only once project teams understood their chosen model, and the implications for this for their workforce (such as whether their model was to be outsourced or not), could they then consider how to address their knowledge gaps and who would be responsible for the staff delivering the health checks and thus their training.

- **Developing a rollout strategy**– with the above steps complete or underway, projects started to develop their local rollout strategy and which areas to deliver in first. This is discussed in greater detail in Section 5.2 below.

- **Project 'soft' or gradual launches** – Several projects undertook either 'soft' or gradual launches to their services ahead of a full launch. Soft launches typically lasted a couple weeks ahead of the full launch, whilst gradual launches often took a lot longer before projects reached full capacity. The reason project teams gave for doing this was to test processes on a smaller cohort so 'teething' issues could be addressed. Areas which followed these approaches explained that issues with IT and administrative processes were addressed before they were in position to launch fully.

5.2 How were participant cohorts determined?

The identification of the local eligible population and the order in which cohorts are invited shaped the delivery of the TLHC programme. This section explores each of these components in turn.

5.2.1 Cohort identification

Cohort identification was a critical first step of the programme pathway, ensuring that the true eligible population is invited to the programme. It is also an example of how projects have adapted their approaches based on key learning from delivering the service.

The eligible cohort within a local area was typically identified through GP practice data, which is usually shared directly with the project team or centrally via the local Primary Care Network (PCN), dependent on local setup. Projects reported that this process, whilst workable for the programme in its early stages, was resource intensive for administrators. It was suggested that an automated and centralised process, similar to other screening programmes, should be implemented in the future.

> **"We're early days, but we need to get to a point, the same with breast cancer screening, bowel cancer screening, where the project would be given a list of participants rather than us having to go to the GP to ask for a list which, for the administrator, is the most time-consuming bit."** [Project Lead]

Identification challenges

The accuracy of GP smoking status data has been a key challenge in most areas. Inaccurate smoking status data had significant implications for projects, with both non-eligible individuals being invited, and eligible individuals not being invited. This issue was reported to have wasted time and resource. The quality of GP smoking status data appears to vary across projects, with a few projects suggesting their data was generally of a much higher quality than the rest of the projects and nationally, and thus could be confidently used to identify the cohort.

Learning from the challenges caused by poor smoking status data drove adaptations to projects' implementation models. Adaptations include the 'combined' invitation model whereby current smokers received an opt-out LHC appointment and the rest of the eligible age range are sent opt-in LHC invitations, and the triage before LHC risk assessment model, whereby a project staff member calls the participant before their LHC to confirm their eligibility. Both models are discussed further in **Chapter 6.**

Cohort identification – learning and best practice

Some project stakeholders identified changes made to their cohort identification process and learning they had gathered. One project flagged the importance of setting specific eligibility and exclusion criteria and providing very specific instructions, otherwise each GP practice would return inconsistent datasets, thereby introducing delays and variations into the invitation process. Another project referenced the value of gradual roll-out and engagement across GP practices; this project started by engaging four GP practices, before inviting more practices in later waves. This process allowed them to tease out and solve cohort identification issues gradually and worked effectively.

> **"It was a difficult process as, like most programme managers… wanted it to be right from the first day… but through that partnership working we worked together [to solve all the issues], and it was a good supportive network." [Project Lead]**

5.2.2 Approaches to local rollout

Projects took different approaches to inviting people registered at a GP practice as part of individual local rollouts. Most projects invited individuals from multiple GP practices at one time, whilst a smaller number of projects rolled out on a practice-by-practice basis. Projects generally chose to rollout to more than one practice at a time because it helped reduce the burden (both administratively and clinically from TLHC-related incidental findings and referrals) on the practice during rollout. This helped to maintain practices' support for the initiative.

Of those that rolled out in multiple practices at a time, some projects rolled out to all practices within a PCN at the same time. Others grouped individual GP practices together based on shared characteristics (which one project referred to as 'blocks').

The advantage of the 'PCN approach' was that it often made sense geographically, with practices usually close to one another, and demographically, with practices sharing similar profiles. Similarly, project teams suggested this approach was more administratively efficient, with PCNs collating patient data centrally before sending to the project. This reduced the burden to request and process this ahead of sending invitations.

A disadvantage of the 'PCN approach', and one of the key reasons other projects grouped practices together themselves, was that risk factors such as deprivation can vary considerably within a PCN area, with less deprived areas neighbouring more deprived areas. Grouping practices together meant projects had more control over targeting the most deprived areas first. One project felt this approach likely resulted in individuals in more deprived areas being invited to the programme later:

> **"We have one particular PCN in [location] where they have an area that's really deprived, but the poshest part of [location], it's not that posh but relatively… So, actually the people who were in the most deprived area probably got their LHCs and scans later than they might have done if they'd have been separate."** [Clinical Director]

Key factors determining the ordering of local rollouts

Risk factors, such as deprivation, current smoker prevalence, and lung cancer incidence and mortality, were identified by projects as key factors in how they prioritised different localities in rollouts. Using these factors helped to ensure that their service would invite those who are most at risk sooner. At the start of the programme, projects' approaches to organising this was more simplistic, either choosing one or more risk factor and using this to create an ordering of practices or PCNs. As the programme advanced, this approach has become more sophisticated, with several projects noting they have adopted a risk stratification model to inform future rollouts:

> **"As we've moved to other areas, we've had a much more sensitive method of scoring on smoking rates, deprivation, COPD rates, and then a score we use to compare most recent lung cancer rates compared with previous lung cancer rates before COVID. And we used all four of those to give us a matrix… it feels a bit more scientific than just going on deprivation."** [Clinical Director]

Determining which areas to rollout within was not solely influenced by risk factors, however. Projects stated the importance of logistics, infrastructure and using resources efficiently as key considerations. One project summarised why this was the case:

> **"The idea was that we would go to the practices that were in the most deprived areas first and obviously see the practices in the least deprived areas towards the end... I'm not sure that that's always worked quite to plan because of… the logistics of actually getting a van in that locality. Or, you know, if you're in that location or in that vicinity… why would you not do the practice that's next door?"** [Project Lead]

Projects found that transporting mobile CT scanners and identifying suitable locations requires planning, working with partners such as supermarkets, and the time of staff with logistics expertise due to the complexity of the equipment. This meant projects generally tried to ensure that a whole locality's eligible population was invited whilst the scanner was based there before moving on. This reduced the need to return or ask participants to travel further. Similarly, in at least one project where LHC nurses were based in local community buildings, reducing the need to move across the area minimised disruptions to the team.

Local buy-in from GP practices to the TLHC programme was another determining factor on where local rollouts took place. Several projects noted they initially rolled out within the practice where their lead GP for the programme was based. This was due to strong local buy-in, and it offered an opportunity to demonstrate to other neighbouring practices that the additional activity generated by the service is manageable. Some projects noted that poor GP practice buy-in has been a barrier to local rollouts. One project suggested that in the areas with strong buy-in, uptake rates were much higher than those with less local buy-in.

“As we started with the pilot size and the practices that had those lead GPs in, the uptake in those practices seemed to be much better than some of the other practices. So, I think engagement with the GP practices is pretty critical.” [Project Lead]

5.3 What have been the barriers and enablers to implementation?

This section outlines the key enablers and barriers to implementation identified throughout the evaluation. Enablers and barriers specific to different implementation models are discussed within Chapter 6.

Table 5.1: Enablers and barriers to implementation

	Enablers	Barriers
Project setup	**Flexibility to design a locally suitable model**: the Standard Protocol and national programme team gave projects the freedom to determine what service model best suits a given locality. This allowed local stakeholders to consider their local context and whether they could deliver the service using existing capacity and workforce. **The involvement of key stakeholders within the Trust(s), ICB and primary care** was seen as critical to their success. Their influence and specialisms helped in overcoming setup challenges, including with information governance, IT, and clinical pathways. "When we first started, it was about having those keen, dedicated and trained clinicians who were… wanting to put it together and knew what they were doing. And then it was all about logistics. So, it was IT, it was HR… you have to make sure that you're involving all those teams early doors.'" [Project Lead] **A key component of achieving this was stakeholder engagement:** working with partners to generate buy-in to the project's primary aims and objectives and drive the project forward. Projects highlighted examples throughout the	**Workforce challenges**: including limited national radiology capacity to cover the programme; particular workforce challenges in areas without any teaching hospitals; and projects only being able to offer temporary contracts, limiting the number of applicants. **COVID-19 pandemic:** the subsequent national lockdowns resulted in considerable delays to project setup. The Standard Protocol Addendum additionally meant projects had to adapt their LHC model to virtual, when they had previously planned face-to-face models. **Securing partner buy-in**: the volume of stakeholders within each local system that were impacted by TLHC and its downstream activity meant projects had to extensively engage with partners across primary and secondary care. A key focus of this was reassuring them that TLHC will not harm their services through the additional activity generated by the programme.

Enablers	Barriers
evaluation of delivering workshops and presentations to stakeholders across the system to support their project. "My top tips for a new project site would be engagement-, basically, you can't do enough of it. There's so many different stakeholders involved in this programme, and get out there and talk to people about it as early as possible." [Project Lead] **The funding model used during setup**: projects highlighted how this provided freedom to spend on their local priorities, including engagement work and training. This was particularly beneficial as they were establishing a new service. **The national programme team**: their input into the setup phase, including coordinating the nursing and radiology training offer and modelling work, was seen as a vital enabler locally. It allowed projects to focus on local operational and logistical challenges. "The national lung health check team I think have actually been pretty good in terms of standard setting and programme design... It was always fairly clear wording-, I don't think everything they set out was perfect but then you wouldn't expect it to be." [Clinical Director] **Greater emphasis was placed on setting up correctly, rather than just at pace**: projects felt the national programme team allowed them to start their service slowly, making use of soft launches and gradually increasing throughput. This allowed projects to ensure systems were in place, teething issues addressed and the workforce ready for delivery.	"They were worried that if there were increased lung cancer diagnoses, particularly the early stage diagnoses, they would not be able to manage the cardiothoracic capacity plus the finding that is associated with specialised commissioning." [Project Lead] **Data sharing challenges**: in accessing GP practice patient data. Challenges include agreeing data sharing agreements between constituent organisations – compounded by different interpretations of advice from Data Protection Office (DPO); organising the Data Processing Agreement , identifying who owns the information and how it can be shared. Resolving these challenges could be time and resource intensive.

	Enablers	Barriers
Project delivery	**Innovations:** technological innovations have been developed and implemented to improve service efficiencies. In addition to the AI reporting primarily through Aidence, other innovations, such as TLHC administration systems that automate process across the pathway were introduced locally to improve efficiency. "We have built our own patient administration system, [that] automates… all the invites being sent out… the referrals being sent, all through the central system. So, that's very useful for cutting down the amount of staff you need, both admin and nurses… the process is automated as far as we can." [Project Lead] **Local promotion**: word of mouth, social media and case studies that highlight the impact of the programme on individuals were seen as effective for driving uptake. "I think word of mouth definitely, you know, practices themselves, or nurses, or patient groups encouraging patients to go. I think case studies. You know, sharing those sorts of success stories about finding cancer early, that kind of thing, I think has helped." [Project Lead] **Community engagement**: projects undertook engagement activities within community locations and with partners to improve their uptake from specific groups throughout the evaluation. Examples included working with homeless charities to improve uptake from the homeless population, and religious and community organisations to improve uptake from some ethnic minority communities. See Chapter 6 for further detail.	**Local capacity to deliver TLHC:** projects with limited existing administrative, nursing or CT scanner capacity had to select outsourced models, regardless of preference. **Dependency on senior stakeholder buy-in:** Challenges with securing buy-in from key senior local stakeholders within primary and secondary care have threatened or halted the service reaching some areas. Projects were able to overcome this with some stakeholders but not with others, leading to the service not reaching some GP practices. "Every time we start somewhere new, there's been something unexpected… For example, for [location], the director for public health, at the beginning, was not a fan of targeted lung health checks. [They] said [they] opposed it. But [they have] warmed up to it now because [they have] had a few years to see it's actually working okay. [They] could have completely scuppered it happening in [location]." [Clinical Director] **Concerns and resistance from primary and secondary care about downstream activity**: throughout the evaluation, projects have had to manage concerns about downstream activity from the service via incidental findings and their impact on workload. This is discussed further in Chapter 8. **IT systems**: the lack of a national integrated IT system for the programme was seen as a significant barrier. It meant that additional time and resource was spent doing administrative tasks and moving data between systems. One project suggested they had 24 different spreadsheets in use for the programme. An

	Enablers	Barriers
	Dedicated Communications or Engagement Lead role: having a staff member solely working on communications and engagement helped drive uptake. Several projects noted this was available when they first started delivery, though later in delivery the team had to manage this themselves. **Smoking cessation service buy-in/support**: where projects had a local service, there was generally strong buy-in to establish referral pathways and collaboration. Local services saw the opportunities to support participants who are in most need, though may never have sought support.	integrated national IT system was suggested as a key component of a national screening service. This is discussed further in Chapter 10. **COVID-19 pandemic:** the pandemic continued to be an ongoing barrier during project delivery. Lockdowns meant projects had to pause or slow down delivery, and fear of contracting COVID-19 was a barrier to uptake. **Participant uptake:** the key reasons for non-engagement with the service identified by the non-attendee tool data collection were participant ineligibility and participants not seeing the benefits of an LHC. The key reasons for non-attendance / DNA of an LHC were more varied, though forgetting about the appointment, or it no longer being convenient, were common reasons. **Absence of national campaigns**: stakeholders throughout the evaluation discussed the need for a national campaign to promote the programme. This was seen as a critical step to transitioning to an established screening service that is nationally recognised, like the other cancer screening programmes. This is discussed further in Chapter 10. **Variable public health resource and capacity to support smoking cessation:** where projects do not have a local service able to support TLHC services, they have had to offer

	Enablers	Barriers
		alternatives, such as signposting to national services or virtual services, which are seen as less effective.

6 How has the TLHC programme been delivered?

As the programme has progressed, projects have adopted variations in their delivery models, based on local context, learning from other projects, and responses to events. The following section explores the different implementation models being used by TLHC projects, including the key factors informing projects' reasons for following their chosen model.

6.1 TLHC participant pathway and different implementation models

Figure 6.1 below defines and visualises the distribution of the different implementation model used by TLHC projects. Definitions of each model variation can be found in Appendix 9. The key messages from these are:

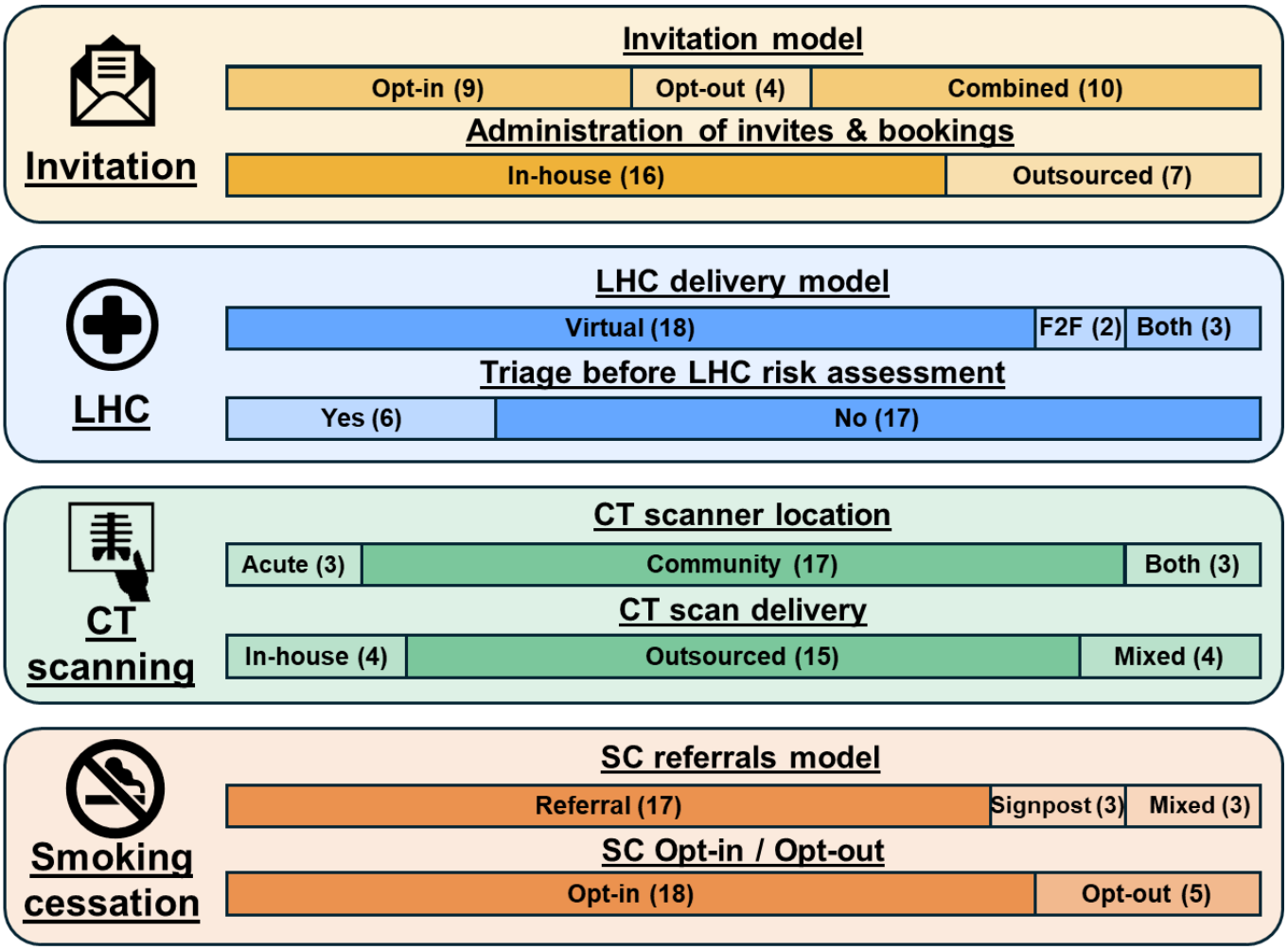
- **Invitation**: The combined invite model was the most followed invitation model (10 projects have used this model) closely followed by opt-in (nine). Few projects used just the opt-out model (four). For the administration of invites & bookings, the majority of projects delivered this in-house (16) using their own administrative staff, with the rest outsourced this to a third-party provider (seven).

- **Lung Health Check:** Most projects delivered virtual LHCs (18), with just two delivering face-to-face LHCs. A minority of projects offered both virtual and face-to-face LHCs (three), usually offering individuals a virtual LHC first. For the triage before LHC risk assessment, most projects did not triage (17); six projects delivered these.

- **CT scanning:** Community-based scanners were used by most projects (17), with only three projects using an acute-based scanner. Three projects had access to both community- and acute-based scanners. Looking at the staffing of CT scans, most projects outsourced this to a third-party provider (15), with just four projects staffing these in-house. Four projects used both in-house and outsourced staff to deliver scans.

- **Smoking cessation:** Most projects provided formal referrals to current smokers during LHCs (17), with just three projects signposting participants to services. A small number of projects both referred and signposted to services (three), usually when a project spanned areas with different types of provision. An opt-in approach to referrals was used by most projects (18), with a rest following an opt-out approach (five).

Figure 6.1: Breakdown of implementation models used by projects[97]



6.1.1 Why have projects adopted their chosen model

Projects chose either to adapt their models at the set-up stage, or during the delivery phase, usually based on their own or other projects' learning of what does and does not work. The decisions taken during project set up (as opposed to later in the process) were typically the larger scale decisions about how the service would be delivered and not easily adjustable once they had been put in place. Some of the key considerations were:

- **Trusts' capacity to deliver all stages of the pathway in-house** (including workforce and equipment). Where projects did not have capacity, they usually outsourced this part of the pathway to a third party or leased equipment to increase capacity, such as additional CT scanners. This applies to: administration of invites & bookings; CT scanner location and CT scan delivery.

[97] Project models as of January 2024, collated by NHSE. Projects included are: Blackburn With Darwen; Blackpool; Bradford District and Craven; Corby; Coventry and Warwickshire; Doncaster; Halton; Hammersmith and Fulham; Hillingdon; Hull; Knowsley; Liverpool; Luton; Manchester; Mansfield and Ashfield; Newcastle Gateshead; North Kirklees; Salford; Southampton; Stoke on Trent; Sutton; Tameside and Glossop; Thurrock.

- **The Standard Protocol and the COVID-19 pandemic.** The pandemic meant projects delivered virtual LHCs, as per the Standard Protocol Addendum. Once the Addendum was revoked in March 2022, most projects continued to operate a virtual model as processes were well established. Only two projects followed a face-to-face model, as part of operating a "one-stop-shop" delivery model, whilst a few projects started offering participants the option of a face-to-face LHC if requested.

- **Local smoking cessation service provision.** A referral smoking cessation model was regarded as best practice but not all projects were able to build a referral pathway for TLHC participants, either due to strict local eligibility criteria for support or no service operating locally. Where this was the case, projects followed a signpost model.

Other implementation models were chosen based on learning from project delivery to mitigate or address specific delivery challenges. These challenges include:

- **LHC uptake**. Most projects initially followed an Opt-in invitation model, though projects often reported this led to poor LHC uptake. Many projects started trialling the Opt-out model based on learning from the few projects that followed this model and reported stronger uptake. Over time, some projects transitioned to this and the Combined model.

- **Smoking status data**. As discussed in Section 5.2.1, GP practice data on smoking status is known to be poor in some areas. By relying on this, projects risked inviting ineligible individuals (potentially leading to poor use of resources) and eligible individuals missing out. In response to this, projects started adopting the Combined invitation model, whereby the whole eligible age range would receive an Opt-in invitation to ensure no eligible individual is excluded.

- **Participant ineligibility**. Similar to above, to mitigate ineligible participants only being identified at the LHC stage, often due to smoking status, projects started following the triage before LHC risk assessment model. With this model, a project administrative staff member would ring the individual before their LHC to confirm eligibility, meaning LHC nurses' time is better used.

6.2 What can be learnt about which implementation models seem to be most effective? Does this vary by patient characteristics?

This section focuses on how the approach to a) inviting participants, b) delivering the LHCs and c) selecting the location of CT scanners affects uptake and outcomes. This analysis uses patient-level MDS data (to examine variation in outcomes associated with the different invitation models and how the LHCs are delivered) and aggregate TLHC MI (for CT scanner location[98]). It provides an assessment of the advantages and disadvantages of model variations, using data collected throughout the evaluation. The main findings from this section are summarised in Table 6.1 below.

[98] This is due to all projects submitting MDS data using the community-based CT scanner model, meaning MDS analysis is not possible.

Table 6.1: Summary overview of key programme metrics, by different implementation models[99]

Model	Invites[100]	Uptake of LHC[101]	Uptake of scan[102]	Lung cancer conversion rate[103]
Invitation model (opt-in/ opt-out/ combined)[104]	For those invited to take part in the programme, most were invited by a project using the combined model.	LHC uptake is highest in projects following the opt-out model, and lowest for the combined model.	This analysis does not produce a clear finding[105] though does suggest LHC attendees from a combined invite are most likely to be eligible for a CT scan.	The lung cancer conversion rate is highest in opt-in model areas and lowest in opt-out model areas.
LHC approach (f2f/ virtual)[106]	Nine-in-ten participants were invited to a virtual LHC.	LHC uptake is notably higher for face-to-face models, though based on one project limiting generalisability of this finding.	Those who receive a virtual LHC may be more likely to be eligible for a CT scan and attend it, though this is hard to assess given projects overwhelmingly use a virtual approach.	Face-to-face models had a considerably higher lung cancer conversion rate, though this is based on one project limiting generalisability of this finding.
CT scan location (community, acute)[107]	Not presented.	Not presented.	More LHC attendees from acute models are eligible for a CT scan, though fewer receive a scan, due to a higher drop-off.	The lung cancer conversion rate is slightly higher for community-based scanners vs acute-based scanners.

6.2.1 A note on implementation model analysis

The analysis of implementation model variations throughout this section using the MDS and MI is not controlled nor compared to a standardised comparison group. External factors beyond the TLHC programme (e.g., local needs and context) therefore may be driving differences in the data presented.

[99] The approach to the analysis presented in the main body of the report is different to the approach shown in Appendix 6. Here, the denominator used reflects the previous stage in the pathway (e.g. calculating the proportion of participants eligible for a CT scan by dividing CT scan eligibility by LHC attendance). Within Appendix 6, the denominator is invitees throughout.
[100] Analysis of which implementation model variations participants were invited to.
[101] Analysis of LHC uptake (LHC attendees / invited to LHC) by implementation models.
[102] Analysis of CT scan uptake (initial CT scan eligibility / LHC attendees & initial CT scans performed / LHC attendees) by implementation models.
[103] Analysis of lung cancer conversion rates (lung cancers diagnosed / initial CT scans) by implementation models.
[104] This analysis uses the MDS dataset, covering activity from all Phase 1 projects and a subset of phase 2 projects.
[105] The analysis presented in the main body of the report looking at Opt-in vs Opt-out vs Combined, whereas the analysis in Appendix 6 looks at Opt-in vs Opt-out and Opt-in + Opt-out vs Combined (in addition to the difference noted in footnote 98). For uptake of CT scan, this led to an overall unclear finding.
[106] This analysis uses the MDS dataset, covering activity from all Phase 1 projects and a subset of phase 2 projects.
[107] This analysis uses the MI dataset, covering activity from all Phase 1 and 2 projects.

6.2.2 A note on lung cancer diagnoses analysis

The lung cancer diagnoses data presented in this section covers up to March 2024[108] and encompasses all Phase 1 & 2 projects (including both projects that reported record-level and aggregate-level data). The analysis combines NCRAS lung cancer diagnoses figures to the end of August 2023 (for record-level projects) and aggregate lung cancer diagnoses data reported by projects to the end of March 2024 (both record-level and aggregate-level projects). For this analysis, this means:

- *Record-level projects:* lung cancer data includes NCRAS figures to August 2023 and then is supplemented by project-supplied aggregate lung cancers to March 2024.
- *Aggregate-level projects:* lung cancer data is just project-supplied aggregate lung cancers to March 2024.

6.3 Invitation model

6.3.1 Pathway analysis – invitation model

The data[109] in Figure 6.2 and Tables 6.2 and 6.3, and the key findings from the patient-level analysis (Appendix 6), show that:

- Most participants were invited to their LHC by a project following the combined invite approach (61% compared to 23% for opt-out and 16% for opt-in).
- Opt-out invites have the highest LHC uptake. Participants are three percentage points more likely to attend an LHC when invited by an opt-out model (46%) vs an opt-in model (43%). Comparatively, combined models saw much lower LHC uptake (33%). More ineligible people are likely to have been invited under the combined model, hence a higher declination and non-response rate.
- LHC attendees from a combined invite are most likely to be eligible for a CT scan, followed by opt-in and then opt-out. 57% of LHC attendees are eligible for a CT scan in combined areas, followed by 54% for opt-in and 49% for opt-out. For Combined and Opt-in models, it suggests that their LHC attendees are at greater risk.
- CT scan drop-off is the same between Opt-in and Opt-out invites (-4pp for both models).[110]

[108] Activity for the Hammersmith & Fulham, Hillingdon and Sutton TLHC projects only goes to July 2023, impacting initial CT scans and lung cancer diagnoses. This is due to a system change at the Cancer Alliance level meaning these projects were unable to provide data at the project-level. This means that the totals may be lower than anticipated.

[109] Projects' invitation model classification uses their latest implementation model, as per January 2024, and applies this to all data reported by this project. It does not account for changes to their model throughout delivery.

[110] Data quality issues related to missing risk scores mean this is not presented for combined models.

Figure 6.2: Pathway breakdown, by invitation model

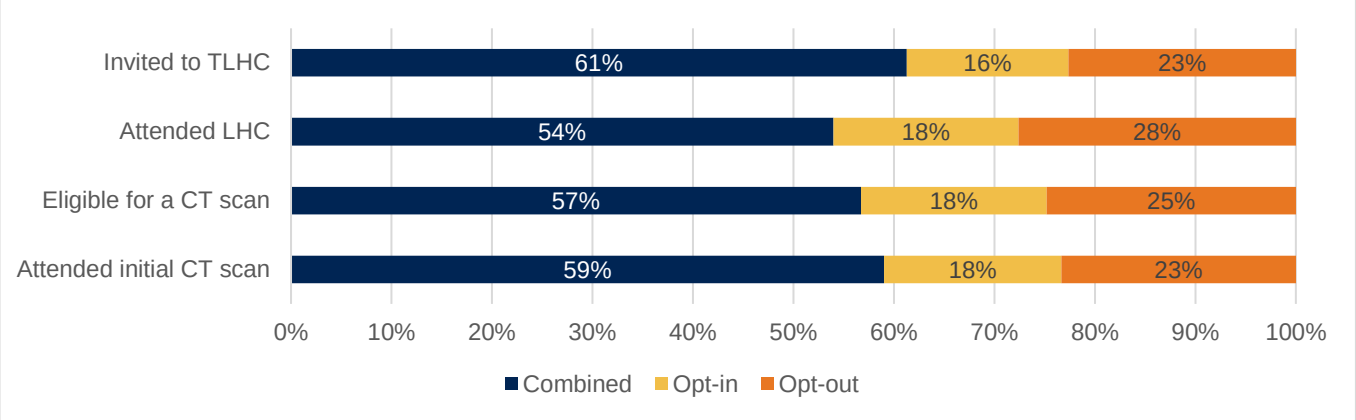


Table 6.2: Breakdown of invites sent, LHCs attended and LHC uptake, by invitation model

Invite models	Invited to TLHC (%)	Attended LHC (%)	LHC uptake (%)
Opt-in	91,976 (16%)	39,931 (18%)	***43%***
Opt-out	129,346 (23%)	59,917 (28%)	***46%***
Combined	350,362 (61%)	117,136 (54%)	***33%***
Total	**571,684 (100%)**	**216,984 (100%)**	***38%***

Table 6.3: Breakdown of CT scan eligibility, attendance and conversion, by invitation model

Invite models	Attended LHC appointment	Referred for a CT scan	Attended initial CT scan	Conversion (eligible)	Conversion (realised)	Drop off
Opt-in	*39,931 (18%)*	*21,658 (18%)*	*20,181 (18%)*	***54%***	***51%***	***-4%***
Opt-out	*59,917 (28%)*	*29,082 (25%)*	*26,709 (23%)*	***49%***	***45%***	***-4%***
Combined	*117,136 (54%)*	*66,497 (57%)*	*67,538 (59%)*	***57%***	***58%***	***1%***[111]
Total	***216,984 (100%)***	***117,237 (100%)***	***114,428 (100%)***	***54%***	***53%***	***-1%***

Lung cancer diagnoses

Looking at the data in Table 6.4, the following key messages emerge:

- **2,732 lung cancers were diagnosed in Phase 1 & 2 projects in total.** 55% of diagnoses were from projects that used the combined invitation model, whilst 24% were from Opt-out models and 21% from Opt-in models. These proportions may be different to expected, with more projects following the Opt-in model vs Opt-out (nine vs four) and only slightly fewer using the combined model (10).

[111] Missing risk score data used to calculate the 'referred for a CT scan' metric from projects following the combined model means this data point is unreliable.

- **Opt-in models have the highest lung cancer conversion rates (2.06%).** This is 0.4pp higher than the conversion rate for combined models (1.66%) and 0.5pp higher than Opt-out models (1.56%). The average across all models is 1.70%.
- **Opt-in models similarly have the higher proportion of lung cancers diagnosed at Stages 1 & 2 (73.0%).** This is followed by Opt-out models (71.1%) then combined model (70.3%).
- **Proportions of unstaged lung cancers are highest in combined models (9.2%) and lowest in Opt-in models (4.1%).** The proportion of unstaged lung cancers in Opt-out models is similar to opt-in models (4.5%).

Table 6.4: Breakdown of lung cancer diagnoses and staging (all phase 1 & 2 projects, April 2019 – March 2024), by invitation model

Invite models	Attended initial CT scan	Lung cancer diagnoses	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Combined	*90,899*	***1,505***	***1.66%***	***70.3%***	*20.5%*	*9.2%*
Opt-in	*27,082*	***559***	***2.06%***	***73.0%***	*22.9%*	*4.1%*
Opt-out	*42,803*	***668***	***1.56%***	***71.1%***	*24.4%*	*4.5%*
Total	***160,784***	***2,732***	***1.70%***	***71.0%***	***22.0%***	***7.0%***

Combined analysis examining the overlap of invitation model and participant demographic characteristics on the TLHC pathway can be found within Appendix 6.

6.3.2 Advantages and disadvantages – invitation model

	Opt-in	Opt-out	Combined
Advantages	**Lower DNA rates**: because participants actively book their appointment, projects observed a lower LHC DNA rate compared to the Opt-out model. **Easier to plan and manage capacity**: when participants actively book an appointment, staff can plan with more certainty for LHC and CT scan demand. *"From an operational point of view [it is beneficial]. We knew exactly what was booked into clinics and we knew exactly who was going to attend by booking in that way. So… we could manage our expectations."* [Project Lead] **Greater participant choice**: participants are able to select a time and date that suits their other commitments, this is particularly advantageous for the 55-64 cohort who are more likely to still be in employment. *"I think you're giving the patient a choice of what date and time suits them best for their appointment [as] a lot of people are working. So, I think that's a plus side to hopefully reduce the DNA rates."* [Project Lead] **Effective when supported by good administrative staff**: having staff contact	**Higher LHC uptake**: projects felt Opt-out led to improvements in uptake rates. This is because it reduced the burden on participants to actively book an appointment. *"I would say the benefits [of an Opt-out model] would be we saw a significant improvement in uptake by 20% if not more [when we switched from Opt-in]."* [Project Lead] **Higher uptake with target cohorts**: such as people from more deprived areas, as outlined in Appendix 3. **Reduced administrative burden booking appointments:** fewer administrative staff are required to process appointment bookings.	**Mitigates issues with smoking status data held by GP practices, enabling greater inclusivity**: the whole eligible age range are given the opportunity to take part, ensuring all those who are eligible can participate.

	Opt-in	Opt-out	Combined
	participants after their second invitation can mitigate the disadvantages of the model. *"[Opt-in invites] work. I think our uptake is good because we've got a really really good admin team who are very very persuasive on the telephone."* [Clinical Director]		
Disadvantages	**Lower LHC uptake**: participants having to make the active decision to book an appointment can be a barrier, leading to some projects changing their model mid-delivery to improve their uptake. Lower LHC uptake in the younger age range: as outlined in Appendix 3. **Burden on administrative staff**: staff must be available to manage bookings. **More reliant on GP practice buy-in**: reliant on practices encouraging participants to book an appointment. *"Sometimes we get a really good practice that's really engaged with the process and the programme and they really try and push patients through. Whereas, there are other areas [where] we've noticed a really significant drop off in the uptake."* [Project Lead]	**Higher DNA rates:** participants are more likely not to have known their appointment was scheduled for that time and date or forgotten to contact the project to reschedule or cancel when it was booked for them. *"So, we obviously are booking all these patients in for an appointment, and if they don't engage with us, we don't necessarily know until the day whether they will or won't attend."* [Project Lead] **More difficult to manage capacity**: due to higher DNA rates, it is more challenging to predict the volume of appointments that will go ahead, particularly at large scales, and this has implications for staff and CT scan utilisation and capacity. **Increased administrative burden confirming appointment attendance**: to counteract higher DNA rates, administrative staff would contact the participant to confirm their appointment.	**Greater levels of participant ineligibility:** inviting the whole eligible age range means more staff time is spent checking participant eligibility, including during booking the appointment and pre-LHC triage.

6.4 LHC delivery model

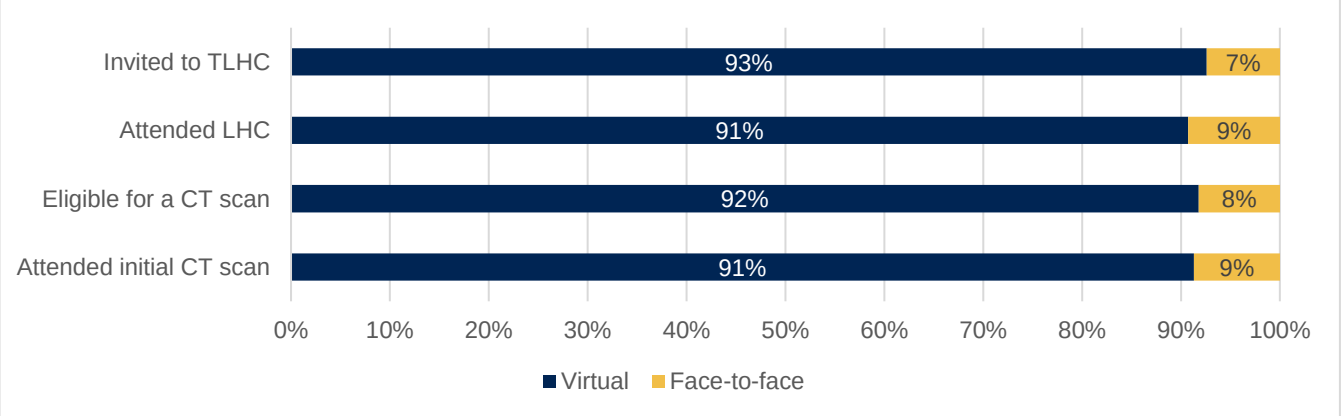
Comparisons between LHC delivery models should be treated with caution as the face-to-face projects consists of just one project.[112] It should be noted that – whilst many projects offer some form of face-to-face offer (e.g. for participants with a disability or preference) – only one project has a fully face-to-face service model.

6.4.1 Pathway analysis – LHC model

Looking at the data in Figure 6.3 and Tables 6.5 & 6.6, and patient-level analysis (Appendix 6), the following key points emerge:

- **Most participants were invited to a virtual LHC**: Nine-in-ten (93%) participants were invited to a virtual LHC, whilst only 7% were invited to a face-to-face LHC.
- **LHC uptake is notably higher for face-to-face models**: Face-to-face models have an 11pp higher uptake rate compared to virtual LHCs (48% vs 37%). The likelihood of an invitee attending LHC are increased by 56% using a face-to-face model, as shown in Appendix 6.
- **Those who receive a virtual LHC may be more likely to be eligible for a CT scan and attend it**, though this is hard to assess given projects overwhelmingly use a virtual approach: 55% of virtual LHC attendees were referred to a CT scan, with a drop-off of -2pp. This compares with 48% of face-to-face LHC attendees being referred to a CT scan. The drop-off data for face-to-face attendees is unreliable, thus has not been presented.

Figure 6.3: Pathway breakdown, by invitation model



[112] Amongst those projects reporting record-level data.

Table 6.5: Breakdown of invites sent, LHCs attended and LHC uptake, by LHC model

LHC model	Invited to TLHC (%)	Attended LHC (%)	LHC uptake (%)
Virtual[113]	529,346 (93%)	196,872 (91%)	***37%***
Face-to-face	42,338 (7%)	20,112 (9%)	***48%***
Total	**571,684 (100%)**	**216,984 (100%)**	***38%***

Table 6.6: Breakdown of CT scan eligibility, attendance and conversion, by LHC model

LHC model	Attended LHC appointment	Referred for a CT scan	Attended initial CT scan	Conversion (eligible)	Conversion (realised)
Virtual	196,872 (91%)	107,604 (92%)	104,483 (91%)	***55%***	***53%***
Face-to-face	20,112 (9%)	9,633 (8%)	9,945 (9%)	***48%***	***49%***
Total	***216,984 (100%)***	***117,237 (100%)***	***114,428 (100%)***	***54%***	***53%***

Lung cancer diagnosis

Looking at the data in Table 6.7, the following key messages emerge:

- **The majority of lung cancer diagnoses were for participants who received a virtual LHC (84%).** This largely reflects that nine in 10 (91%) participants who received an initial CT scan did so after receiving a virtual LHC.
- Face-to-face models had the highest lung cancer conversion rate (2.73%), though this is based on one project. Virtual models had a conversion rate more than 1pp lower at 1.59%.
- **Virtual models had a higher proportion of lung cancers diagnosed at Stages 1 & 2 (72.8%).** This is notably higher than the face-to-face stage at diagnosis rate, though this may be partially explained by one in five (21.5%) diagnoses being unstaged in the face-to-face model.

Table 6.7: Breakdown of lung cancer diagnoses and staging (all phase 1 & 2 projects, April 2019 – March 2024), by invitation model

LHC model	Attended initial CT scan	Lung cancer diagnoses	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Virtual[114]	*145,279*	***2,308***	***1.59%***	***72.8%***	*22.8%*	*4.3%*
Face-to-face	*15,505*	***424***	***2.73%***	***61.3%***	*17.2%*	*21.5%*
Total	***160,784***	***2,732***	***1.70%***	***71.0%***	***22.0%***	***7.0%***

[113] 8,620 participants attended a virtual LHC and then a face-to-face LHC. Anecdotally, this may happen when the project is not able to collect all the required information virtually, so the participant would be invited to a subsequent face-to-face appointment where additional information could be collected e.g., to measure height / weight.

[114] 23,131 initial CT scans and 540 lung cancer diagnoses were for participants who attended a virtual LHC and then a face-to-face LHC.

Combined analysis examining the overlap of LHC model and participant demographic characteristics on the TLHC pathway can be found within Appendix 6**.**

6.4.2 Advantages and disadvantages – LHC model

	Virtual	Face-to-face
Advantages	**More time efficient to deliver**: LHC appointments are reportedly shorter (on average) than when conducted face-to-face, meaning more participants can be seen. *"Doing it virtually has been quite good for the service, in that we can do a lot more consultations. Because, obviously, they don't take as long."* [Project Lead] **Greater participant convenience**: participants do not need to travel to take part in an LHC, making participation easier. This is particularly the case if participants are working or would need to travel a long distance. *"It seems quite convenient for a lot of patients, because they haven't got to go anywhere. We can book them [at either] 4:30 at the end of the day or 8 o'clock at the beginning of the day, especially if they're working. Because it's 55 to 74. So, a lot of the patients are still working."* [Project Lead]	**Opportunity to deliver spirometry and other tests**: this can identify incidental findings and enable further tailored advice from LHC nurses. **Stronger smoking cessation offer**: the offer of smoking support is seen as more effective when delivered face-to-face, building on the momentum of the LHC and leading to better smoking cessation uptake. *"If you're doing a virtual LHC with… a current smoker [and] they don't [get referred for] the scan, you don't ever get that face-to-face opportunity to do anything about [being] a current smoker. Whereas [with our model], we will always have that face-to-face opportunity to address that very prevalent reason for why someone might go on to develop lung cancer."* [Project Lead] **Can deliver a 'one-stop-shop' model**: as delivered within two projects. A key advantage of this is a very small CT scan DNA rate.
Disadvantages	**Spirometry and other tests cannot be performed**: this was regarded as a missed opportunity for participants. Spirometry was intended to be part of the LHC before the COVID-19 pandemic meant projects had to deliver virtual LHCs. **The smoking cessation offer is weaker:** smoking cessation advice is regarded to be more effective if delivered	**Lesser participant convenience**: the need to travel to a face-to-face appointment can make attendance more challenging, particularly when participants have work commitments, mobility or health issues, or are dependent on public transport. **Less time efficient**: face-to-face appointments take longer on average to deliver.

	Virtual	Face-to-face
	face-to-face. Virtual LHCs mean this is not possible and instead participants are referred or signposted. *"I think the main thing, actually, I regret is that we haven't been able to do more smoking cessation at the time because I think that's better face to face."* [Clinical Director] **Less predictable attendance**: participants not attending because they forgot their appointment or it being no longer convenient is suggested to be more common for virtual appointments. *"Sometimes it's difficult to get hold of people. You know, you're phoning people up. It's not always convenient. People don't always answer when they say they're going to answer."* [Clinical Director] **Access barriers:** some participants may not have the necessary equipment and/or feel uncomfortable taking part virtually. Similarly, there is anecdotal evidence to suggest virtual appointments are difficult for hearing impaired individuals.	

6.5 CT scanning model

6.5.1 TLHC MI analysis – CT scanning model

This section examines what can be learned from analysing the different CT scanner location models using both the MDS and TLHC MI dataset. Both the MDS and MI is used for this analysis due to no record-level submitting projects using the acute CT scanning model, therefore MI data from aggregate-level submitting projects is used to supplement this analysis.

The data in Table 6.8 shows that:

- **Community-based CT scans made up the majority of initial CT scans performed**: Over four-fifths (85%) of initial CT scans took place in projects using community-based scanners.[115] This contrasts with just 15% taking place in projects which used acute-based scans.
- **CT scan drop-off is the highest for projects using acute-based CT scanners**: There is a -9pp drop-off from those who are referred and eligible and those who receive an initial CT scan for Acute models. This compares with a -1pp drop-off for those using a community-based CT scanner. This trend may be explained by some of the factors identified in the table in Section 6.5.2 below.

Table 6.8: Breakdown of CT scan eligibility, attendance and conversion, by CT scanner location

CT scanner location	Attended LHC appointment	Eligible for a CT scan	Attended initial CT scan	Conversion (eligible)	Conversion (realised)	Drop off
Acute	*49,587 (16%)*	*28,868 (17%)*	*24,526 (15%)*	***58%***	***49%***	***-9%***
Community	*269,584 (84%)*	*137,753 (83%)*	*136,258 (85%)*	***51%***	***51%***	***-1%***
Total	***319,171 (100%)***	***166,621 (100%)***	***160,784 (100%)***	***52%***	***50%***	***-2%***

Lung cancer diagnosis

Looking at the data in Table 6.9, the following key messages emerge:

- Most (85%) lung cancer diagnoses happened in projects using community-based scanners.
- The lung cancer conversion rate is slightly higher for community-based scanners (1.73%) vs acute-based scanners (1.52%).
- However, the proportion of lung cancer diagnoses at Stage 1 & 2 is 10pp higher for acute-based scanners (79.4%) vs community-based scanners (69.7%).

Table 6.9: Breakdown of lung cancer diagnoses and staging (all phase 1 & 2 projects, April 2019 – March 2024), by invitation model

[115] 36,285 (23% of total initial CT scans) initial CT scans took place in projects which primarily used community scanners, but also used acute scanners. As community scanners were primarily used and that it is not possible to understand which scanners were used within the MDS, these have been recorded as community.

LHC model	Attended initial CT scan	Lung cancer diagnoses	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Community	*136,258*	***2,358***	***1.73%***	***69.7%***	*22.5%*	*7.8%*
Acute	*24,526*	***374***	***1.52%***	***79.4%***	*18.4%*	*2.1%*
Total	***160,784***	***2,732***	***1.70%***	***71.0%***	***22.0%***	***7.0%***

6.5.2 Advantages and disadvantages – CT scanning model

	Acute / fixed	Mobile / community
Advantages	**Greater efficiency:** Acute-based scans using in-house staff were suggested to take less time than in a community scanner from an outsourced company, with additional time needed on quality assurance. This has the potential to realise efficiencies. *"I think the big positive for us is that we staff it in-house as well and so, productivity is higher so we do a scan in 10 minutes, whereas, mostly outsourced companies will use a template of 20 minutes. So, we can do twice as many scans with our staff."* [Clinical Director] **Scanner capacity utilisation:** when there is a CT scan DNA or a lower number of high-risk participants, scanners can be used for other non-TLHC purposes, improving their cost efficiencies. **Technical assistance**: if there are technical issues, for example with the scanner or with IT equipment, these can typically be handled more quickly than on a mobile unit based off site. **Accessibility of venue**: hospitals tend to be well-connected by public transport. Participants can sometimes align scan appointment with other hospital appointments. **Disability access**: can be more manageable in a hospital setting e.g. step-free access, hoists, additional space for	**Capacity**: third party mobile unit solutions provide capacity (e.g. scanner, radiography, or respiratory nursing) which most in-house settings do not have available for the TLHC programme. Outsourcing and using a community model allow in-house teams to focus on regular clinical work and meeting diagnostic targets. **Greater convenience and access for participants**: scanners can be located within more remote and deprived areas in convenient community locations, reducing barriers to access. This is particularly advantageous for more difficult to engage cohorts. *"It's brilliant that we're able to take the scanner to the patients in the community, particularly because we're focusing on the most deprived cohorts of the population really."* [Clinical Director] **Flexibility**: a scanner's location, and duration in that place, can be changed in response to delivery, e.g. if there is a higher LHC to CT scan conversion than anticipated. *"We changed one or two of the [scanner] sites when we found better sites. So, we used a retail site... The site they offered us was actually just behind [the store]. It wasn't very obvious. So, we had more DNAs to that site that any others. So, we found a better site at a retail park, a bit more accessible."* [Clinical Director] **Service logistics:** it is logistically easier for radiography teams to programme a single protocol onto a scanner and then conduct scans for the same programme for a whole day. In-house scanners need to be constantly re-programmed. This can mean less waiting

	Acute / fixed	Mobile / community
Disadvantages	wheelchair access. For any unwell participants, it can be beneficial to have clinical support on hand if required. **Experience of venue**: some participants prefer the more spacious and air-conditioned hospital settings, compared to mobile units which can be smaller and cramped.	time for participants than in a hospital setting, as there are fewer delays. **Free community parking**: unlike hospital sites, many community venues have free parking onsite (e.g. supermarket car parks) which benefits both participants and staff.
	Capacity: this model only works if the project has sufficient capacity (scanner, radiography staff) within Trusts to accommodate the service. **Hospital location**: can be far from a person's home; community scanning allows the unit to be brought much closer to where people live. This can discourage attendance in those from deprived areas and those who may not think they need a scan in the first place. **Expensive hospital parking**: can act as a barrier for both participants and staff. Hospital sites can also be confusing and hard to navigate. *"[Location is] quite a big place. It takes about 45 minutes to get from the very outskirts to the town centre to the hospital. And then, you know, people can't park at the hospital. [We] wouldn't have got people coming in in the same way."* [Clinical Director] **Difficulty scanning some specific cohorts**: delivering scans to some specific cohorts, such as the prison	**Management and cost of third-party suppliers**: this can be more challenging than managing in-house staff. For example, some suppliers require a face-to-face interpreter to scan participants with English as an additional language (rather than using Language Line which is used in-house). Some outsourced teams also insist on longer appointments, which is more costly. **Logistics across multiple sites**: Some projects had one van across multiple sites. This required careful planning to work out the van's location, and to send invitations and book LHCs at suitable times accordingly. **Logistics of mobile scanners**: Moving scanners requires additional logistical considerations and costs that fixed scanners do not have, such as generators and wireless connectivity considerations. **Costly to use**: Scanners needs to be used at (or close to) maximum capacity to be cost-effective, with less scope for using them for other non-TLHC clinical work.

	Acute / fixed	Mobile / community
	population, are much more difficult to deliver to compared with a mobile scanner. **COVID-19 risk**: during the pandemic, particularly during lockdowns, hospitals were often perceived to be higher risk, discouraging some attendees from visiting.	*"It's not as good when you've got your mobile trucks with clinic space which is quite expensive to run, and a CT scanner which you need to sweat in terms of an asset. So, it's not quite as good in terms of productivity with that model."* [Clinical Director] **More challenging to use for follow-up scans**: It is not always practical or economical for scanners to return to each location for follow-up scans. This can increase the burden on participants by requiring them to travel further to a different site than their initial scan. *"Another con is that follow-up scans can't always be in the same location as we started and having that scanner in that close proximity to the patients, brings a sense of entitlement sometimes to the patients as well. They expect it to be there for the next round of scanning and are very reluctant to move elsewhere."* [Project Lead] **Participant access**: there are steps into some mobile units, and lifts can be too small for some wheelchair users. Similarly, transport services for participants are not available to community scanners as they are for Trust-based scanners, posing a barrier to access. **Location challenges:** There can be some difficulties in finding appropriate venues that are visible and accessible in some areas. Some services have experienced complaints (e.g. noise complaints) from local residents, when units are setup, which can require moving the unit. Some mobile scanners have ended up using hospital premises (e.g. car parks) as a result. **Experience of location**: Depending on where the unit is located, there can be no amenities like a coffee or food shop, or toilets.

	Acute / fixed	Mobile / community
		There is sometimes no suitable waiting area, which can be a problem in bad weather.

6.6 Did programme design and delivery enable the most at-risk, including seldom heard groups, to participate?

The TLHC Standard Protocol outlines that programme delivery must "include measures to improve uptake and reduce inequalities (while honouring the principle of informed choice)". This is consistent with NHSE's 'Core20PLUS5' approach, which aims to reduce health inequalities for people living within the most deprived areas and other groups with poorer health outcomes, including ethnic minority groups. Recognising the overlap of lung cancer diagnoses and health inequalities, early cancer diagnosis is one of five clinical areas of focus for the approach.[116] [117] Reflecting this, tackling health inequalities is an important component of the TLHC programme and has been prioritised throughout the period of programme delivery. This section explores the level of programme engagement and participation amongst different demographic groups.

6.7 A note on data analysis in this section

This section makes use of GP Patient Survey (GPPS)[118] 2022 data and Office for National Statistics (ONS) Population Estimates data to generate estimates of the TLHC eligible population and their demographics within each project area (see Chapter 1 and Appendix 4 for more information).

The data from projects reporting record-level data in the MDS is compared to the eligible population estimates to understand the demographic characteristics of participants who attend a LHC, if they broadly represent the eligible population and whether any demographic sub-groups are under or overrepresented at different stages of the pathway. Given potentially small base sizes for some demographic characteristics within project footprints, this analysis has been aggregated and reported in total across all included record-level projects.

Throughout the rest of Section 6.9, data presented on lung cancer diagnoses is only presented for those projects reporting record-level data as demographic data is unavailable for projects reporting aggregate data. Lung cancer diagnosis data is from NCRAS linked data (see Chapter 1) and covers April 2019 to August 2023.

6.8 A note on demographic data completeness and quality

Demographic data completeness is not consistent across all demographic characteristics or across metrics. For example, data completeness for attendees' gender when they attend the LHC is very high (99.9%+ complete), whereas for invitees' ethnicity, 36% of the responses are 'Not known'. This means that the level of confidence we have in the data varies between demographics. Where data completeness is an issue, caution is noted when interpreting the data.

Data completeness for LHC attendees is consistently higher than for invitees (for example, participant ethnicity is not known for 36% of invites; the equivalent figure for LHC attendees is just 7%). This is very likely because a participant's demographic characteristics are verified or populated during the booking

[116] https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/incidence#heading-Five [Accessed: September 2024]

[117] https://www.england.nhs.uk/about/equality/equality-hub/national-healthcare-inequalities-improvement-programme/core20plus5/ [Accessed: May 2024]

[118] GPPS is a national random probability survey, which provides confidence that patients invited to complete the survey are representative of the English population aged 16+ registered with each GP practice. The data is weighted to further ensure that those taking part are representative of the eligible population. This data is therefore suitable for use in these estimates, as the definition of eligibility for the TLHC programme includes a requirement that the individual is registered with a GP practice.

and triaging process. Such updates also back-fill 'Not known' data for a participant's entire record. It can therefore be presumed that most participants with 'Not known' recorded at invite did not access the service.

Greater confidence can be placed in the accuracy of demographic data for attendees than people who were invited but did not attend. We work on the assumption that the 'Not known' invitees would follow an even distribution, were their demographic features to be recorded. As such, uptake figures may not be fully accurate but can be used to determine broad demographic trends.

6.9 Did the programme attract those most at risk of developing lung cancer, including those living in areas of deprivation, vulnerable populations, and minority groups?

The section explores LHC uptake, CT scan conversion rates, and lung cancer diagnosis rates for different demographic sub-groups of those invited to take part in the programme. The sub-groups included in this analysis are deprivation (using Index of Multiple Deprivation (IMD) quintiles)[119]; age; gender; and ethnicity. Analysis of the impact of the TLHC programme on key lung cancer outcomes for different demographic sub-groups is covered in Chapter 8.[120] The main findings from this section are summarised in Table 6.10 below.

Table 6.10: Summary overview of key programme metrics, by different demographic characteristics

Demographic	Eligibility	Invites	Uptake of LHC	Uptake of scan	Lung cancer conversion rate
Deprivation	Proportionally more of the TLHC eligible population lives in deprived areas (quintile 1) than the general population	Compared to the local eligible population, more people living in areas of deprivation were invited to TLHC	LHC uptake is lower in those living in the most deprived areas	Participants living in deprived areas are more likely to be eligible for an initial scan but less likely to attend it	The lung cancer conversion rate is higher for those from the most deprived areas[121]
Age	There are more eligible individuals within the younger age	TLHC invites sent broadly reflect the eligible	Older participants are more likely to take up the LHC offer than their	Older participants are more likely to be deemed high risk and therefore eligible for an initial CT scan.	Lung cancer conversion is higher for the older age group

[119] The IMD is the official measure of relative deprivation for small areas in England. IMD ranks every Lower Layer Super Output Area (LSOA) in England from 1 (most deprived area) to 32,844 (least deprived area) based on seven domains (Income deprivation; Employment deprivation; Education, skills, and training deprivation; Health deprivation and disability; Crime; Barriers to housing and services; Living environment deprivation). Areas are then ordered. This analysis focused on IMD quintiles, with quintile1 being the most deprived and quintile 5 the least deprived. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

[120] Definitions for the key lung cancer outcomes are detailed further in Chapter 8, Section 8.1.

[121] This means that - of those who attend a baseline CT scan - participants from more deprived areas are more likely to receive a cancer diagnosis.

	bracket than the older, in line with general population estimates	population in terms of age	younger counterparts	But there is little difference in likelihood to attend an initial CT scan once deemed eligible	
Gender	Males make up a slightly higher proportion of the TLHC eligible population than females, in line with lung cancer incidence rates	Reflecting eligibility data, males make up a slightly higher proportion of TLHC invites than females	LHC uptake is the same for both males and females	Males are more likely to be eligible for an initial scan and are slightly more likely to attend it	Lung cancer conversion is higher for females, and females who receive a lung cancer diagnosis are more likely to do so at an early stage
Ethnicity	Most of the eligible population are White (96%)	People from an ethnic minority background may be more heavily represented in TLHC invites than in the eligible population, though this may be as a result of data completeness issues for invitees' ethnicity[122]	There is a higher LHC uptake rate amongst White participants	White participants are slightly more likely to be eligible for an initial CT scan and are slightly less likely to attend that scan	Lung cancer conversion is higher for White participants

Throughout this chapter, the key findings are summarised, whilst references are provided to the detailed data tables and figures which can be found in Appendix 3.

6.9.1 Deprivation[123]

Looking at the data in Appendix 3 (Figure 1.1 and Tables 1.1 & 1.2), the following key points emerge:

- **More people in the TLHC eligible population live in areas of high deprivation than the general population:** According to the GPPS estimates, 43% of the eligible population live within the fifth most deprived areas.

[122] The ethnicity is 'not known' for 38% of invitees in the MDS, though reduces to 6% for LHC attendees.

[123] Throughout this section, IMD quintiles are used to classify individuals living in the most deprived areas (with quintile 1 being the most deprived and quintile 5 the least deprived), as defined by the IMD ranking of their home postcode. It should be caveated that – given IMD is constructed at the area-level – this does not necessarily mean that every person living in a highly deprived area experiences deprivation.

- **Deprivation levels are high amongst those invited to take part in the programme:** Looking at those invited to an LHC, 46% live within the most deprived quintile. This reflects the fact that Phase 1 project areas were selected based on lung cancer incidence, which is highest in areas of high deprivation.

- **LHC uptake is lower in the those living in the most deprived areas:** only 34% of those living in the most deprived areas took up the offer, compared to 40% in the other areas. As a result, a lower proportion of LHC attendees living in the most deprived areas (42%) take part when compared to those invited.

- **Participants from deprived areas are more likely to be eligible for an initial scan but less likely to attend it:** Participants living in the most deprived areas were 16pp more likely to be eligible for an initial CT scan compared to those living in the less deprived areas (63% vs 47%). Participants living in the most deprived quintile are – however – less likely to attend their CT scan (57% of whom attend) compared to those living in the less deprived quintiles (47% of whom attend). This equates to a 6pp drop off in CT scan attendance for those living in the most deprived areas, compared to no discernible drop off for those living in less deprived areas.

Lung cancer diagnosis

Table 6.11 below shows the lung cancer conversion rate through the TLHC programme for those living in the most deprived areas compared to less deprived areas, as well as the proportion diagnosed at early stage, late stage, and unstaged.

- The **lung cancer conversion rate is higher for those from the most deprived areas** (1.81%) compared to those from less deprived areas (1.54%). This means that - of those who attend a baseline CT scan - participants from more deprived areas are more likely to receive a cancer diagnosis. This aligns with the finding earlier in the pathway that those from the most deprived areas are more likely to be deemed high risk at their LHC.

- Those participants who are diagnosed with lung cancer from the most deprived areas are **slightly more likely to receive an unstaged diagnosis** (11.4% compared to 10.3% for the less deprived cohort).

Table 6.11: TLHC lung cancer conversion rate and staging breakdown, by deprivation[124]

All	Attended baseline LDCT up to Aug 2023	Lung cancer diagnoses Apr-19 to Aug-23	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Total	101,954	1,563	**1.53%**	64.8%	24.3%	10.9%
Quintile 1	45,251	818	**1.81%**	64.4%	24.2%	11.4%
Quintiles 2-5	48,327	744	**1.54%**	65.3%	24.3%	10.3%
Not known	8,376	>10	N/A	N/A	N/A	N/A

6.9.2 Age

For sub-group analysis and comparison with the GPPS population estimates[125], age has been split into two brackets: 'younger' (55-64) and 'older'' (65-74), with '75' and 'Other' sub-groups also delineated.[126]

Looking at the data in Appendix 3 (Figure 1.2 and Tables 1.3 & 1.4), the following key points emerge:

- **There are more eligible individuals within the younger age bracket than the older**, according to the GPPS eligible population estimates (56% versus 44% respectively). This reflects the fact that there is a much larger population in England aged 55-64 than 65-74, likely driven by increasing mortality in the older age group.[127]
- **TLHC invites sent broadly reflect the eligible population in terms of age:** 55% younger and 45% older.
- **Older participants are more likely to take up the LHC offer than their younger counterparts;** LHC uptake is 39% for the older age group, compared to 33% for the younger age group. The older age group therefore makes up a larger proportion of LHC attendees compared to eligible estimates.
- **Older participants are much more likely to be deemed high risk and therefore eligible for an initial CT scan;** 67% of the older age group are eligible for a scan, compared to 45% of the younger age group. It is logical that a higher proportion of older individuals are eligible for a CT scan, given the importance of smoking length/volume in calculating the risk scores and that the risk of lung cancer also increases with age.

[124] This table uses IMD quintiles to classify individuals living in the most deprived areas as defined by the IMD ranking of their home postcode. Quintile 1 refers to the fifth most deprived areas in the country, and quintile 5 refers to the fifth least deprived), It should be caveated that because IMD is constructed at the area-level it does not necessarily mean that every person living in a highly deprived area experiences deprivation.

[125] The GPPS survey asked respondents their age using age brackets, with 55-64 and 65-74 compatible with the TLHC eligible population definition.

[126] As shown in Table 6.12, over 8,000 individuals have been invited for a scan despite being outside the eligible age threshold. This is likely mostly due to data quality issues. Individuals aged 75 likely turned this age during pathway delivery, which is in line with the Standard Protocol.

[127] ONS 2022 Population Estimates show that there are 7,680,162 people aged 55-64 in England, compared to 5,658,340 people aged 65-74.

- **There is little difference in likelihood to attend an initial CT scan once deemed eligible**, based on age. CT scan drop-off is similar across both age brackets (-2pp for younger and -1pp for older).

Lung cancer diagnosis

Table 6.12 below shows the following key points:

- The **lung cancer conversion rate is higher for the older age group** (1.62%) compared to the younger age group (0.90%). This again aligns with the finding earlier in the pathway that older participants are more likely to be deemed high risk of lung cancer at their LHC.
- Younger participants are more likely to receive an unstaged diagnosis (15.1% compared to 10.6% for the older cohort).

Table 6.12: TLHC lung cancer conversion rate and staging breakdown, by age

All	Attended baseline LDCT up to Aug 2023	Lung cancer diagnoses Apr-19 to Aug-23	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Total	101,954	1,563	**1.53%**	64.8%	24.3%	10.9%
55-64yrs	36,929	331	**0.90%**	59.5%	25.4%	15.1%
65-74yrs	52,826	858	**1.62%**	64.9%	24.5%	10.6%
75yrs	2,711	40	1.48%	67.5%	27.5%	5.0%
Other	2,910	61	2.10%	67.2%	26.2%	6.6%
Not known	6,578	273	4.15%	70.0%	21.6%	8.4%

6.9.3 Gender

Looking at the data in Appendix 3 (Figure 1.3 and Tables 1.5 & 1.6), the following key points emerge:

- **Males make up a slightly higher proportion of the TLHC eligible population than females:** (53% versus 47%). This broadly echoes incidence data: across the UK, 52% of lung cancer cases are in males whilst 48% are in females.[128] Differences in smoking patterns are likely a key contributing factor to this. ONS data from the Opinions and Lifestyle Survey, General Lifestyle Survey and General Household Survey suggest that a higher proportion of women in older age groups in England have never smoked, as compared to men (for example, in 2022, 60.8% of women aged 60 and above said they had never smoked, compared to 46.3% of men).[129]
- **Reflecting eligibility data, males make up a slightly higher proportion of TLHC invites than females**: 52% of those invited to the programme are male, compared to 48% female.

[128] See: https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/incidence#heading-Zero [Accessed: May 2024]
[129] See: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/drugusealcoholandsmoking/datasets/adultsmokinghabitsingreatbritain [Accessed: May 2024]

- **LHC uptake is the same for both males and females**: both groups demonstrate a LHC uptake rate of 38%.

- **Males are more likely to be eligible for an initial scan and are slightly more likely to attend it:** 57% of males who attend an LHC are eligible for a CT scan, compared to 51% of females. Males are also very likely to attend their scan; this group shows no discernible drop-off in CT scan attendance, compared to a 3pp drop-off for females.

Lung cancer diagnosis

Table 6.13 below shows the following key points:

- The **lung cancer conversion rate is higher for females** (1.87%) compared to males (1.27%). This is surprising, given males are more likely to be deemed at high risk of lung cancer and more likely to attend their baseline CT scan. Note that this analysis does not control for other demographics which could be influencing this descriptive finding (for example, if female participants are also older, on average). It should also be noted that no difference has been observed in the number of lung cancer diagnoses between males and females in the impact evaluation (see Chapter 5).

- **Female participants who receive a lung cancer diagnosis are more likely to do so at an early stage** (67.2% compared to 62.1% for males). This is driven both by a lower likelihood of receiving a later stage diagnosis, and a lower likelihood of receiving an unstaged diagnosis.

Table 6.13: TLHC lung cancer conversion rate and staging breakdown, by gender

All	Attended baseline LDCT up to Aug 2023	Lung cancer diagnoses Apr-19 to Aug-23	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Total	101,954	1,563	**1.53%**	64.8%	24.3%	10.9%
Female	44,574	833	**1.87%**	67.2%	23.0%	9.7%
Male	57,379	730	**1.27%**	62.1%	25.8%	12.2%
Not known	5	0	0.00%	-	-	-

6.9.4 Ethnicity[130]

Looking at the data in Appendix 3 (Figure 1.4 and Tables 1.7 & 1.8), the following key points emerge. It should be noted that “Not known” rates are very high for ethnicity, so the following should be interpreted with caution:

- **Most of the eligible population are White (96%),** according to GPPS eligible population estimates. This is a much higher proportion than the national average. Data from the 2021 census shows that 81.7% of the population in England and Wales identified their ethnic group

[130] Given the small base sizes for some ethnic minority groups, data has been aggregated for all ethnic groups except the White ethnic group.

within the overarching “White" category, although this varies considerable by region (from 36.8% in London to 90.6% in the North East).[131]

- The data suggests people from an ethnic minority background may be more heavily represented in TLHC invites than in the eligible population, though data completeness for invitees’ ethnicity means this finding should be treat with caution.[132]
- There is a higher LHC uptake rate amongst people from a White ethnic group compared to invitees from an ethnic minority background (64% compared to 31%). Consequently, people from an ethnic minority background make up just 7% of attendees at LHCs.
- White participants are slightly more likely to be eligible for an initial CT scan than people from an ethnic minority background (54% compared to 50%)
- White participants are slightly more likely to drop out and not attend their CT scan than people from an ethnic minority background (-3pp compared to -1pp).

Lung cancer diagnosis

Table 6.14 below shows the following key points:

- The **lung cancer conversion rate is higher for White participants** (1.73% compared to 0.68% for Other ethnicities). This aligns with earlier pathway findings that White participants are slightly more likely to be deemed high risk at their LHC.
- White participants are more likely to receive a cancer diagnosis which is unstaged (11.2% compared to 7.5% for Other ethnicities).

Table 6.14: TLHC lung cancer conversion rate and staging breakdown, by ethnicity.

All	Attended baseline LDCT up to Aug 2023	Lung cancer diagnoses Apr-19 to Aug-23	Lung cancer conversion rate	% diagnosed at Stage 1 and 2	% diagnosed at Stage 3 and 4	% Unstaged
Total	101,954	1,563	**1.53%**	64.8%	24.3%	10.9%
White	83,807	1450	1.73%	64.8%	24.1%	11.2%
Other ethnicities[133]	5,892	40	0.68%	67.5%	25.0%	7.5%
Not known	12,255	73	0.60%	64.4%	28.8%	6.8%

Caution should be applied due to low base sizes for ‘Other ethnicities’.

[131] https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/bulletins/ethnicgroupenglandandwales/census2021#how-ethnic-composition-varied-across-england-and-wales [Accessed: May 2024]

[132] The ethnicity is ‘not known’ for 38% of invitees in the MDS, though reduces to 6% for LHC attendees.

[133] Other ethnicities have been grouped and aggregated due to individual ethnic groups having small base sizes.

6.10 How were the most at-risk groups targeted and how effective were different engagement strategies?

As demonstrated, there are differences in how demographic sub-groups engage with the TLHC offer, and their subsequent likelihood of receiving a lung cancer diagnosis. Those from more deprived areas appear to be especially disengaged from the current programme, with lower LHC uptake and CT scan attendance despite effective distribution of invitations and their greater likelihood of being identified as high risk. This is particularly concerning given lung cancer conversion rates are higher for those from the most deprived areas, indicating that it is critical to achieve strong uptake amongst this group. Another key area is ensuring that those from ethnic minority backgrounds take up the LHC offer at the same rate as those from White ethnic backgrounds, as this is currently unequal.

6.10.1 Engagement strategies

Projects have deployed a wide range of engagement strategies, particularly aiming to support people from more deprived localities and those from ethnic minority groups to attend an LHC and any scans. There is some crossover with the analysis of implementation models earlier in this Chapter; the following section emphasises how specific approaches have been taken to help drive more equitable programme engagement. It should be noted that there was very limited evidence of projects having conducted robust impact analysis of the effects of these outreach initiatives; most insights they offered were based on their own observations.

- **TLHC service delivery model:** Design of the service is considered to be very important in enabling equal uptake. Whilst few projects deployed a fully face-to-face or “one-stop-shop” model, those that did felt firmly that this model best meets the needs of the eligible population. Given the older age of participants, the higher levels of deprivation and therefore the likelihood of participants having more complex needs, a fully in-person service delivered by highly qualified nurses can enable engagement whilst reducing the likelihood of non-attendance at a CT scan.

“Doing that assessment face to face with a skilled nurse who’s qualified and experienced in working with people, versus have a telephone call with somebody who has not necessarily got that same level of experience, is hugely impactful in terms of targeting inequalities… It’s that recognition that everyone needs a different approach, and a personalised care approach.” [Project Lead]

- Projects also cited the value of making repeated engagement attempts, including letters, telephone calls, follow-up calls for DNAs and “second chance letters” to give eligible individuals – particularly those who may be from seldom heard groups – another chance to participate if they did not engage with the offer in the initial cycle.

“We had done what we called second chance letters. So, we'd returned to an area of poor uptake to say, 'You know, this is another chance for you to take it up.' That kind of thing, and that definitely pulled in a few more people and I think it is that persistent, just going back time and time again.” [Project Lead]

- Others noted the importance of choosing the right community locations for mobile vans (with easy public transport options), and the critical importance of offering materials in multiple languages. Ensuring accessibility of mobile vans, availability of an interpreter, and facilities such as hearing loops were also seen as important.

"[We've deployed] tailored communication to specific ethnic groups, language specific, so our communication was effective […] we probably underestimated how much communication was required, and as the programme has progressed, we've tried to do more in terms of the marketing of it." [Trust stakeholder]

- **Trusted individuals:** This approach involves engaging respected members of the community to promote the service, adding legitimacy and allaying fears. Community leaders or respected individuals will vary depending on the target cohort, but can include religious leaders, pharmacists, or members of the emergency services.

- **High footfall locations:** Targeting locations such as shopping centres, supermarkets, sports stadiums, pubs, bingo halls, petrol pumps, community events such as fairs, and libraries. Engagement formats include leafleting, billboards, hosting stalls and giving talks. One challenge has been ensuring that individuals are eligible for the service at these locations, particularly as people may be visiting from outside the catchment area. Not all venues were deemed a success; for example, one project noted that attempting to engage potential participants at football matches was not effective.

"We did promotion and engagement in local shops to really help word of mouth. In the most deprived area in our patch, we went to the local shopping centre where we know there is heavy traffic of those people that we needed to reach – people who were heavy smokers – so we did as much as possible to try to encourage people to present." [Project Lead]

"Nobody wanted to know anything before a football match… People just want a pint and [to] go to the match, they don't want to talk about health." [Project Lead]

- **Workplaces:** Some projects have targeted workplaces where there may be higher proportions of eligible individuals. One project used this as an opportunity to discuss and gather ideas on the best community locations to situate the mobile van, and the content of written communications such as invitation letters.

- **Community and voluntary partnerships**: Examples of partnerships include with Age UK, mental health organisations, charities supporting people experiencing homelessness, and food banks. This route provides opportunities to engage with individuals who may be particularly vulnerable and need additional support to access the service.

- **Community connectors:** One project mentioned that they had involved the community connector service hosted by the local authority, given the connectors' pre-existing links into different communities and their ability to promote the service.

- **Transport:** In recognition of areas of high deprivation in most of the project footprints, interviewees mentioned how important it is to consider transport options for appointments. Even where public transport options are readily available, the cost of transportation may be a barrier for individuals. In these instances, several projects noted that they can offer to pay for a taxi for the individual to participate.

"People are genuinely making the decision about whether to take the bus to the hospital or to spend that money on another need." [Cancer Alliance stakeholder]

- **Learning disabilities and neurodivergence:** A small number of projects noted how service delivery has been modified for people with learning disabilities and neurodivergence. This includes considering how to identify these individuals in order to provide appropriate support, the

modification of invitations, and arrangements for attending the service such as the timings of appointments.

> **"We're doing some specific work about how we target people with learning disabilities, including trying to make sure that they receive the invitation in the right way, whether that's the easy-read invitation or whether that's videos explaining it. Also, identifying people on the learning disabilities register within GP practices"** [Project Lead]

> **"We've got the trucks, the generators. So, thinking about how we try and provide different opportunities and options for [neurodivergent] people… so, it might be about inviting them at a specific time of day when it's going to be quieter and there's less people physically in the environment."** [Project Lead]

- **Prison settings:** One project piloted the TLHC intervention within a local Category B prison, launching in December 2022. The ambition was to address health inequalities experienced by the prison population.

6.10.2 Deployment of different engagement strategies

As has been shown, a range of different engagement approaches have been used by projects. There have been enablers and challenges in implementing these approaches.

Some projects perceived there to be a trade-off between delivering the programme at pace, as mandated by the national programme team and informed by national target setting, whilst simultaneously engaging with the most vulnerable and seldom-heard groups. With LHC uptake rates lower in more deprived groups and ethnic minority communities, there is an inherent incentive to engage with "easier to reach" communities in order to meet uptake and CT scan conversion targets. Presented with substantial operational challenges, including working in a pandemic context, and needing to setup services entirely from scratch with little precedent, some projects felt that it had not been feasible to prioritise addressing health inequalities to the extent they would have liked.

> **"When you see that you've got relatively good uptake compared to other projects, you focus your attention elsewhere, because there is that national push to get through your patients as well. That's sometimes to the detriment of doing the harder to reach groups that won't see the same yield, because you'll ultimately get penalised for not getting through your numbers."** [Cancer Alliance stakeholder]

> **"Because we've been pushed so much to get scan numbers through, that has been the concentration. It's got** [sic] **those numbers through the door and there's not been the time or capacity to really concentrate on health inequalities. We have done little bits when we can."** [Project Lead]

Another challenge has been in determining how best to advertise or communicate about a service which is not yet universally available. For example, some projects noted that launching local television campaigns risked creating problems in neighbouring areas which were not yet part of the programme. Examples included residents querying when they would be able to attend, and whether it could be guaranteed they would be invited to participate before they "aged out" of the programme. In many instances, project staff have not been able to answer these questions due to a lack of clarity about future roll-out plans.

Projects saw value in laying groundwork before a service enters a new local area, including organising for a communications and engagement drive to coincide with the sending of invitations. The importance of working with the Cancer Alliance to understand local demographics prior to engagement was also cited as an enabler. However projects also reported the difficulties they had in predicting which engagement approaches would be successful; some noted that there was limited consistency from month-to-month in what approaches were having results.

> **"You might get the odd month when you think, 'Oh, this is working,' and then the next month it's back to exactly how it was. So, nothing we've tried seems to be working. So, there's obviously some, sort of, barriers there, but all the usual things aren't getting through there."** [Project Lead]

Projects consistently reported the limits to their capacity to systematically monitor changes in their service's metrics before and after different engagement interventions. The strategies discussed in this section were *perceived* by interviewees to have been beneficial, but this cannot be verified in the data. Interviewees cited barriers to conducting more detailed local monitoring and analysis, predominantly due to a lack of capacity and a prioritisation of programme delivery. The need to deliver a programme at pace can work against undertaking a longer running and considered impact evaluation of outreach activities. There are ethical considerations in conducting such an evaluation i.e. withholding treatment from some eligible participants to establish a robust counterfactual group; and, such analyses can be expensive, or impractical due to data access limitations

6.10.3 Engagement strategies to minimise pathway drop-off and drive LDCT scan uptake

There is a very low drop off between those referred for a baseline scan and those that attend one (-1pp drop-off – see Appendix 3 for more information). However, there is evidence that the drop off is higher for people from particular demographic groups. For example, there is a -6pp drop off for those living in the most deprived areas. Projects described a range of approaches they had taken to try to address this gap.

Projects which conduct LHCs and baseline CT scans on different days (almost all projects) have higher CT scan drop-off rates than for those implementing a "one-stop-shop" model (see Section 6.1). This is because DNA rates are very low when the scan is delivered immediately following a face-to-face LHC.

Projects noted the challenge of DNAs at CT scan appointments, and they shared some example initiatives designed to boost uptake of the scan. Examples included offering to pay for taxis, providing reassurances that support could be offered to assist those with mobility issues, sending text message reminders, and arranging for a nurse to call before the scan to alleviate any concerns (particularly during the pandemic period). For those who did not attend follow up scans, including the three-month surveillance scan, again nurse engagement can provide a useful opportunity to give additional reassurances.

> **"We struggle because we are a static scanner. Patients do have to travel to us for their scan. We do have some exceptionally poor areas and we do have a lot of patients with low expectations with their health. It is money in a taxi that they can't justify or do. We do offer to pay for taxis but even if we remove all barriers, it'll come down to things like 'I don't want to leave my dog' it is that simple for a lot of patients."** [Project Lead]

> **"There have been a number of conversations where the teams have spoken with the patients, explained what is expected, what is a CT scan. We've posted pictures, leaflets and there are a number of videos out there. I think some of the fear is, 'What is a CT scanner machine?' Because some patients have thought it was do you know the big, sealed units, the MRI type… I think some of that has helped to allay some fear."**
> [Project Lead]

Ultimately, projects were unable to provide robust evidence to indicate which engagement strategies worked, and at what cost.

The implications of the programme for different demographics subgroups are discussed further in other parts of this report. An exploration of participant experiences of the programme, for different subgroups, is included in Chapter 7. A discussion about the extent to which the programme led to different lung cancer outcomes, for demographic subgroups, is included in Chapter 8.

6.10.4 Behavioural research to improve uptake

In order to gain more robust evidence to explore ways improve uptake of the TLHC service, the programme commissioned behavioural science research through the Behavioural Insights Team (BIT) and the NHS England Behavioural Science Unit. One key recommendation was that re-branding the TLHC programme could help improve comprehension of the TLHC offer and what to expect from the initial appointment. Alternative programme and appointment names were tested through an online experiment, in the form of a survey. The research recommended changing the programme name to 'lung cancer screening' as it consistently performed better than the other names, whereas the current programme name was consistently among the worst-performing names. The research recommended keeping the current appointment name (lung health check) as it was preferred by participants and well understood when the programme name was 'lung cancer screening'.

The programme name is due to be changed to 'lung cancer screening' in the coming months, in the hope that this will improve uptake and comprehension of the programme. The national programme team are now exploring further research questions and experimental design with the Behavioural Science Unit. It is likely that this will focus on the type of reminders, wording used in communications assets, and engagement that would help improve uptake of the programme in current smokers.

7 Participant experience of TLHC

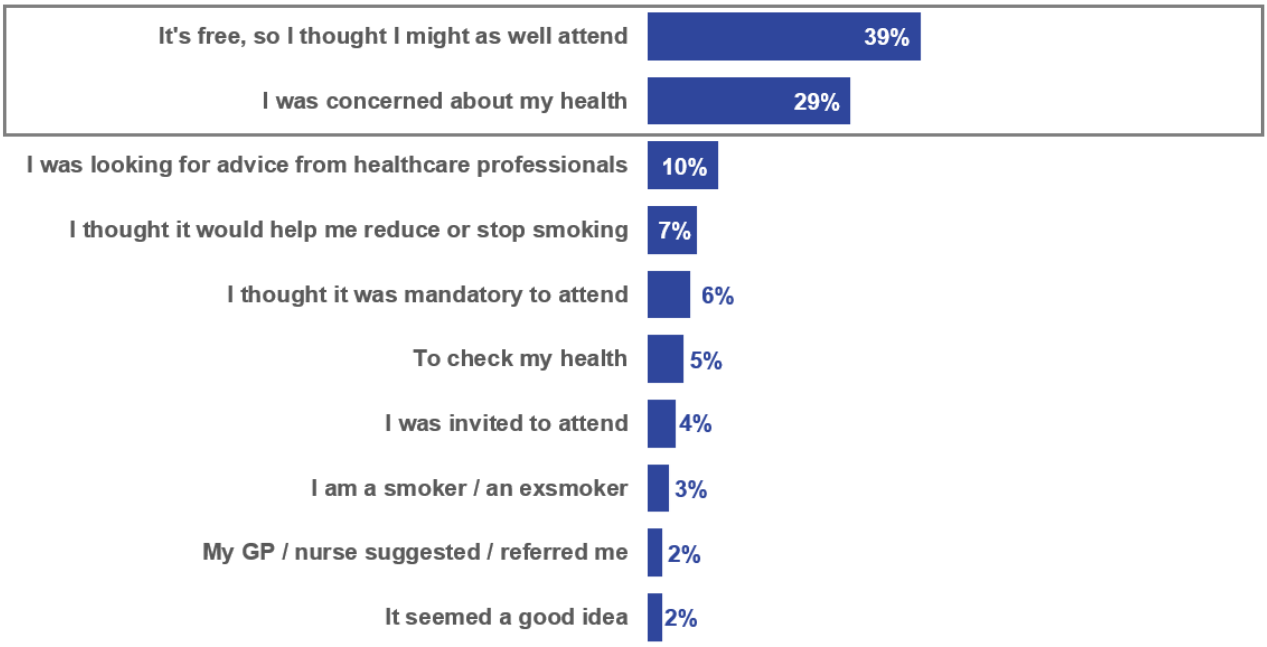
The participant experience surveys and qualitative fieldwork with participants are the main data sources used in answering this evaluation question. Further information about these methods is included in section 2.2 and Appendix 8. Four key aspects of participant experiences are explored: motivation to take part in the programme; barriers to engagement and/or attendance; experience of participating in the programme; and overall satisfaction with the programme.

As highlighted within the methodological limitations, section 2.3, the survey fieldwork took place between June 2021 and September 2022 and the qualitative interviews took place between October 2021 and June 2022. Findings should therefore be interpreted with this in mind, as more recent programme developments or changes to service delivery may not be reflected.

7.1 What motivated participants to engage with the TLHC programme?

From the participant experience survey, 39% of those who had a lung health check stated that they attended because it was free so they thought they might as well attend. Meanwhile, only 29% attended the lung health check because they were concerned about their health.

Table 7.1: Reasons for attending the Lung Health Check



Base: All participants who had a Lung Health Check (11,988)
Q5.Why did you decide to attend the Lung Health Check?

These findings were reflected across all four waves of the qualitative interviews, in which participants mentioned a range of reasons for taking up the LHC offer, grouped into three categories:

- An awareness that their smoking behaviour (current or historical) or work history may have impacted on their lung health, and wanting to have this investigated;
- A general desire to make the most of additional healthcare services when they are offered; and
- The convenience of having an appointment in their local area.

There was also a sense from some attendees that the LHC filled an important gap between GP and specialist services:

> **"Sometimes you feel as though you're left in limbo with what you're getting from your GPs or specialists… With somebody else intervening to do [these] tests, it might help progress things for people with lung conditions."** [TLHC participant]

The vast majority (72%) of survey respondents **had not heard about the Lung Health Check Service before attending**. Among those that had heard something (23%), four per cent mentioned seeing information online and four per cent saw posters or leaflets about it in their GP practice.

Those who took part in the qualitative interviews tended not to have seen **promotional materials** about the LHC service, and most reported that they first heard about the service when they received their invitation to take part. This finding may, at least in part, be explained by the fieldwork having been carried out relatively early in the evaluation (between October 2021 and June 2022). However, a couple of participants saw advertising for the service at their GP surgery, and one participant mentioned that they had seen a 'very large' billboard advertising the LHC service in their local community. They described this billboard as being very useful, because when they drove past it with others in the car, they had an opportunity to mention the service and encourage friends and relatives to participate as well.

Attendees tended to describe the booking process as simple and easy to access, even for those who might struggle with using the internet or other technology.

> **"It was so easy – I am computer literate… but I think it was quite simple; anybody could have followed that link and done the appointment booking."** [TLHC participant]

For those who took part via an opt-in method, both phoning-to-book and clicking a link in a text message were mentioned as useful and convenient ways to engage in the service. However, there were also concerns from some that a text message could be part of a phishing scheme.

> **"To be getting random text messages and emails or letters, inviting you for various procedures – no, I don't think it's a good idea at all."** [TLHC participant]

7.2 What were the barriers to engagement / attendance?

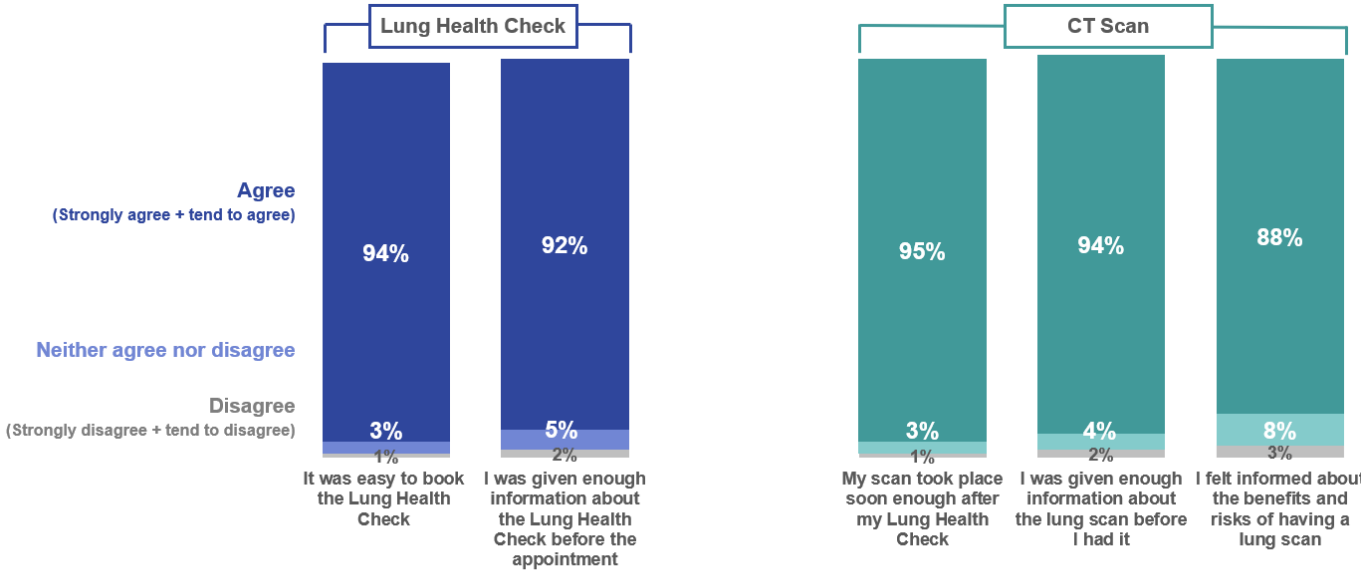
Encouragingly, the vast majority of those that had an LHC, found it **easy to book** (94%). Only a small proportion disagreed with this statement (1%). However, there were some key differences by ethnicity; those from an ethnic minority were less likely to agree with this statement (88% compared to 94% of those from a White background).

As with ease of booking, most agreed that they were **given enough information about the LHC before the appointment** (92%), with only 2% disagreeing with this statement.

For those that went on to have a CT scan, they were asked how much time passed between their LHC and the scan. The vast majority (95%) **felt that their scan took place soon enough after their initial check**; only 1% disagreed. Just over a third (36%) were seen within a week of their LHC, of which 17% were seen on the same day, and a further 54% were seen over a week, but less than a month, later. This means that 90% of participants were seen within a month of their initial LHC.

As with the LHC, most people **felt they were given enough information ahead of the CT scan** (94%). However, when asked whether they felt **informed about the benefits and risks,** this dropped slightly to 88%, suggesting that more of a focus could be placed on these aspects in the information provided before the scan.

Table 7.2: Experience at Lung Health Check and CT scan



Base: All participants who had a Lung Health Check (n= varies per statement, min = 5,594)
Q8. To what extent to do you agree or disagree with the following statements about your Lung Health Check? / Q16. To what extent do you agree or disagree with the following statements about your lung scan?

Again, these findings are broadly reflected in the data from qualitative interviews with attendees: while attendees generally felt positive about the LHC programme, there was a small number of participants who had more negative views about aspects of the service. For example, some said that they had initially ignored the LHC invitation because it had come from a part of the NHS that they were unfamiliar with, which made them concerned it might be a scam. One participant said they felt that, once they reached a certain age, there had been an 'onslaught' of invitations for various tests and checks, from NHS departments they had never heard of, which they described as 'over the top'. Others reflected this point saying that they assumed, if the service were important, their GP would have told them about it. This suggests that **GP involvement in the LHC invitation process could be improved in some areas**, to help improve people's awareness of health check programmes.

> **"My doctor has never mentioned it, or referred me for it, so I ignored it. You have a relationship with your doctors the way you don't with the hospitals."** [TLHC participant]

Participants mentioned **concerns about COVID-19** in the first two waves of the fieldwork, but these concerns had faded by the time of the third and fourth waves. This may be attributable to the change in the UK government's COVID-19 strategy and easing of restrictions. Where concerns about COVID-19 were mentioned, this tended to be in relation to visiting hospitals, rather than GP surgeries or other healthcare sites. Those who were not concerned tended to express the view that healthcare professionals would be taking appropriate steps to protect themselves and the people in their care, so the environment would be relatively safe.

> **"I've always been careful throughout the pandemic. I would hope that if I were visiting someone who is a health professional, they would take the same precautions I take myself to make sure that everyone is safe. So, I wouldn't have any issues with having the appointment in person."** [TLHC participant]

Attendees mentioned some nervousness about what might be found as a result of their taking part in the LHC service, but generally felt that they would prefer to find and treat a health issue sooner rather than later.

"Early detection has got to be better than late." [TLHC participant]

7.2.1 Non-engagement and attendance data collection

The non-attendee data collection identified the most common reasons for non-engagement with the TLHC programme (defined as the individuals who are invited to a LHC but do not respond to their invitation(s)) and non-attendance of the LHC (defined as the individuals who accepted an LHC invitation but did not attend or cancelled their LHC appointment).[134]

Looking at non-engagement with the TLHC programme, Figure 7.1 below shows the most common reasons reported for non-engagement. Of the 10,761 individuals whose reason for not engaging with the programme was known, the most common reason was that they 'did not fit the eligibility criteria for a LHC (age or never-smoker)' (7,897, 73%). The second most common reason was that individuals 'felt they did not need or see the benefit of a LHC (e.g., no issues with their lungs)' (1,767, 16%). These findings suggest the largest causes of non-engagement are participant ineligibility, likely due to inaccurate or poor-quality patient GP data on smoking status, as reported previously. Similarly, even when an eligible participant has been invited, overcoming perceptions that there is little benefit in attending a LHC unless you are experiencing health issues is a key barrier to engagement.

Figure 7.1: Most common reasons for non-engagement with TLHC, as a percentage of known reasons

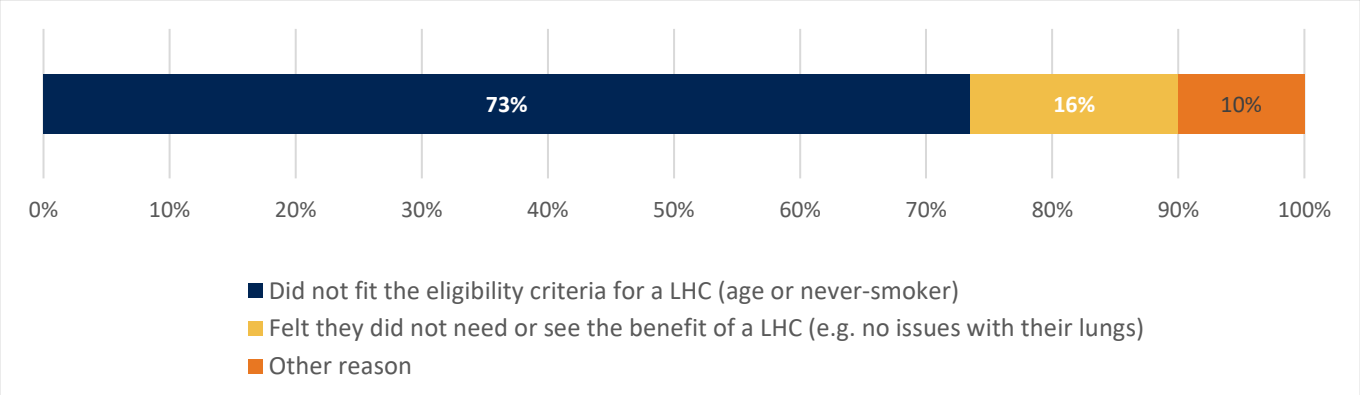


Figure 7.2 below shows the most common reasons for non-engagement with the TLHC programme by invitation model and LHC model. The reasons given for non-engagement with projects with different invitation models were very similar. Looking at LHC models, projects operating with face-to-face LHC models had no individuals reporting 'did not fit the eligibility criteria for a LHC (age or never-smoker)' which was the most common reason overall, however, only one project that participated in the data collection used a face-to-face LHC model.

[134] This data collection was carried out between May 2022 and April 2023 with a subsample of Phase 1 and 2 projects. More information on the methodology can be found in Appendix 7.

Figure 7.2: Most common reasons for non-engagement with TLHC, as a percentage of known reasons, by Invitation model and LHC model

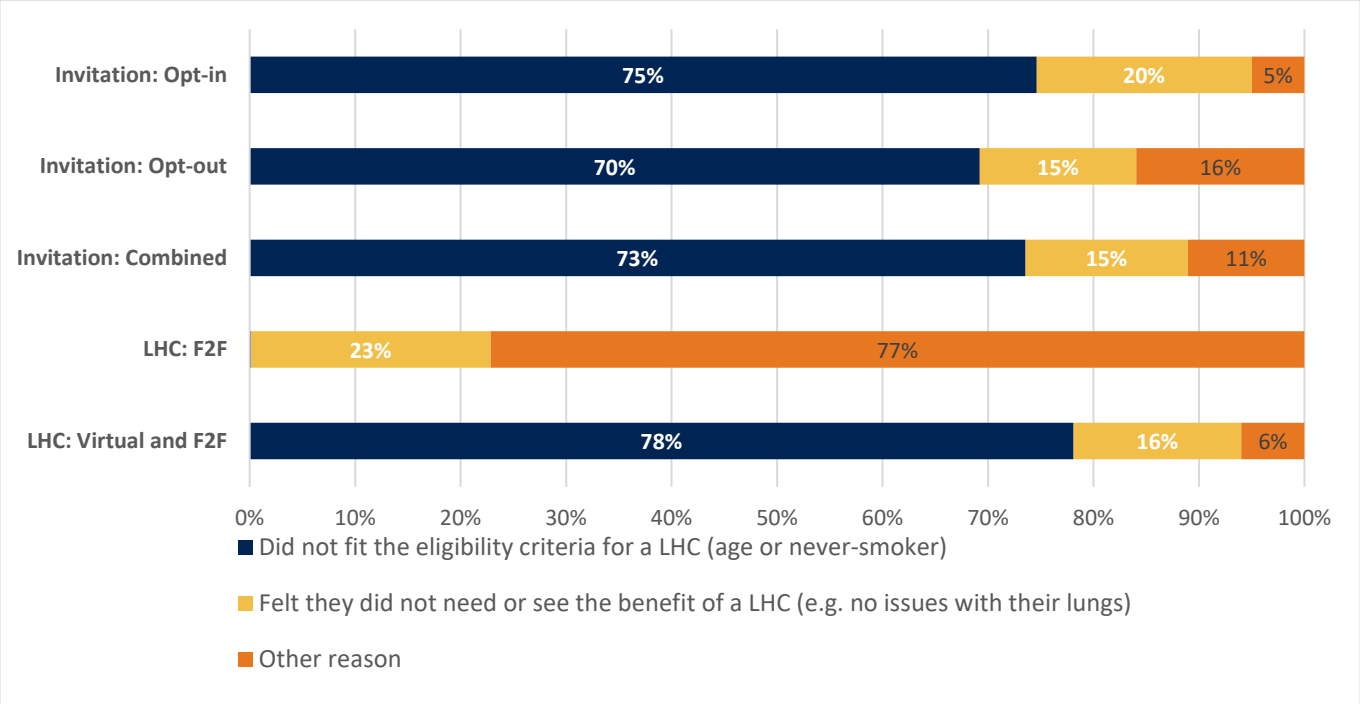


Figure 7.3 below shows the most common reasons reported for non-attendance at an LHC. Of the 3,756 individuals whose reason for not attending their LHC was known, the most common reason was that 'the pre-booked appointment was inconvenient (opt-out)' (1,003, 27%)[135], followed by the individual having 'Other commitments / change of plans' (850, 23%). Following these, the reasons cited were that the individual 'Forgot their LHC was booked' (755, 20%), and that they were 'No longer interested or feel they need the LHC' (559,15%).

Similarly to non-engagement, the findings suggest that perceptions that there is little benefit in attending a LHC unless you are experiencing health issues is a key barrier to engagement.

[135] The 'the pre-booked appointment was inconvenient (opt-out)' option was initially created for Opt-out model projects, though Opt-in and combined models reported this too.

Figure 7.3: Most common reasons for non-attendance with TLHC, as a percentage of known reasons

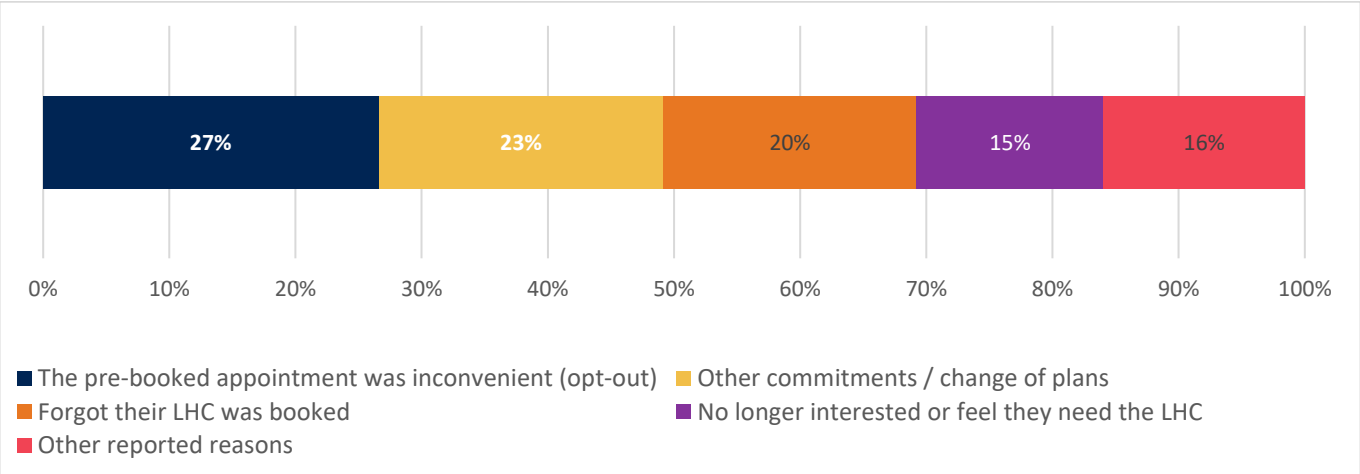
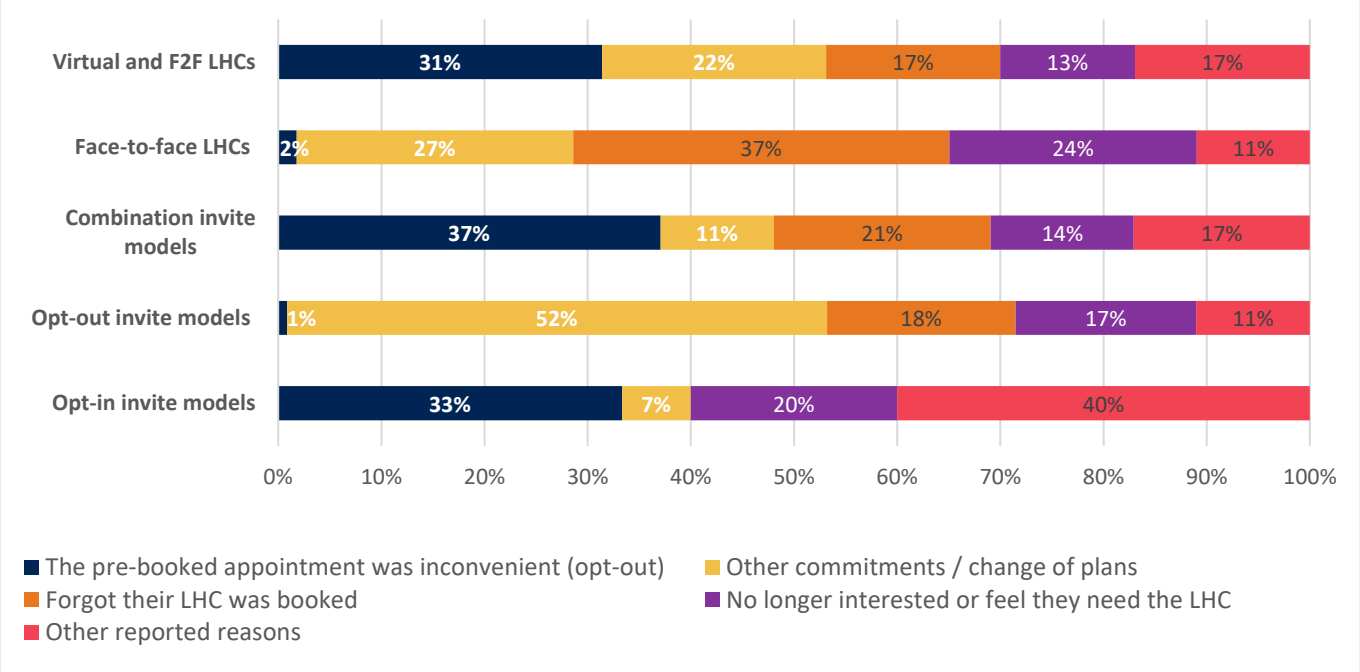


Figure 7.4 below shows the most common reasons for non-attendance in the TLHC programme by invitation model and LHC model. Looking at LHC model, sites offering face-to-face LHCs reported the reason 'forgot their LHC was booked' considerably more than sites offering both virtual and face-to-face (37% and 17% respectively). Conversely, face-to-face LHC sites reported the reason 'the pre-booked appointment was inconvenient (opt-out)' much less than sites offering both virtual and face-to-face models (2% and 31% respectively).

Figure 7.4: Most common reasons for non-engagement with TLHC, as a percentage of known reasons, by Invitation model and LHC model



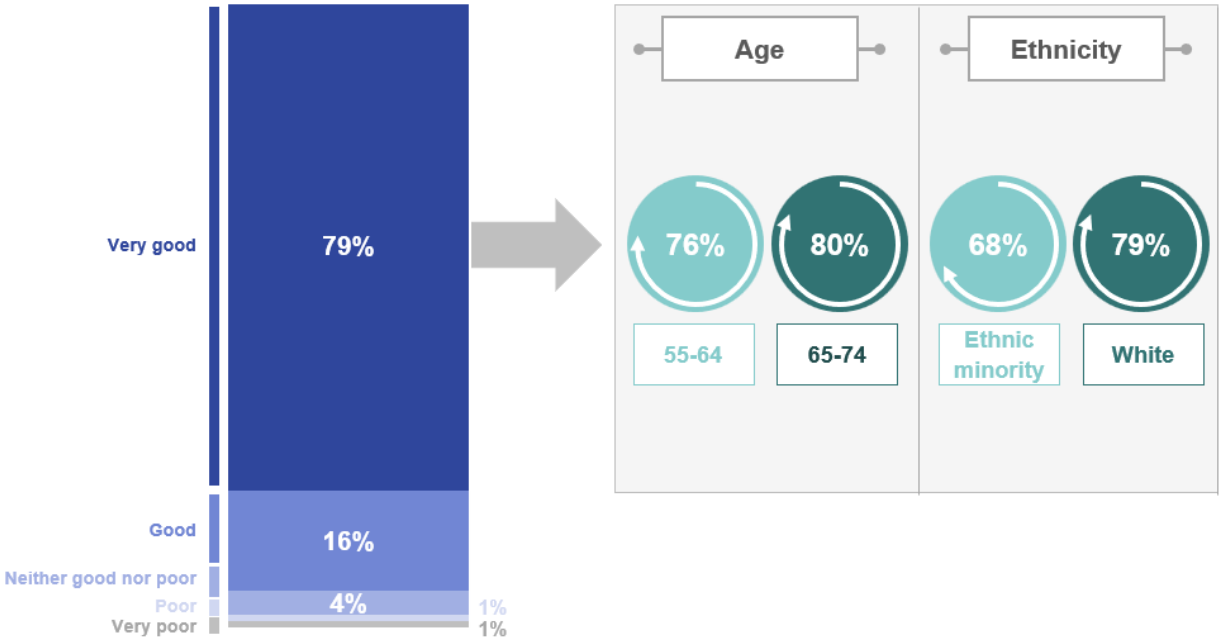
7.3 What was the experience of those participating in the programme?

7.3.1 Overall experience

Overall experience of the whole LHC service is overwhelmingly positive, with 95% reporting a positive experience ("Very good" 79%, "Good" 16%). There are some clear differences by demographic groups. For example, some groups are less likely to rate their experience as "very good", including those in the

younger eligible age bracket (76% of those aged 55-64 vs 80% of those aged 65-74[136]) and those from an ethnic minority background (68% vs 79% of White ethnic groups[137]). This pattern hints to a varied experience by demographic.

Figure 7.5: Overall experience at Lung Health Check



Base: All participants (11,877), aged 55-64 (n= 4,564), 65-74 (n=6,903), ethnic minority group (n=385), white ethnic group (n=11,236)
Q17.Overall, how was your experience of the Lung Health Check service?

In the qualitative interviews, some participants said that, while their experience was generally positive, they would have liked some additional information at the outset about what the LHC process would (or would not) involve, such as procedures other than the initial appointment and CT scan. In some cases, participants had expected additional tests such as blood tests or other physical examinations, which did not eventuate.

There were mixed views about having the LHC appointment virtually. Some participants found this to be convenient. It was easy to fit into a busy schedule; they were able to have the appointment from any location that suited them, and did not have to travel anywhere to see a healthcare professional in person; and they understood from the information they were sent that the assessment was very similar in nature to what would happen if they were to attend in person (i.e. largely a conversation, rather than physical tests).

> **"It would depend on where it was, to be honest with you. Pre-pandemic times, I would have been there without question. But in these times, we're all having to be a bit more careful. Because it was a telephone conversation, I had no qualms about it. If it were in person, I don't think I would have attended to be honest with you."** [TLHC participant]

Some participants would have preferred to have their appointment in person. Reasons for this included a general preference for in-person appointments, with some saying they found it easier to concentrate and

[136] CI 95% [79.1-80.9]
[137] CI 95% [78.3-79.7]

understand information in a face-to-face conversation; and a suspicion from some that a phone appointment could not really be as effective as an in-person assessment. One attendee said they felt dissatisfied by the service because they did not understand how an assessment over the telephone could be effective.

> **"It was the line of questioning, the lack of clarity, lack of visibility of how points were scored."** [TLHC participant]

Some participants who would have preferred an in-person appointment indicated they would be willing to travel outside of their local area to be able to access an in-person appointment.

> **"I think you can be put more at ease when you've got somebody in front of you, because you can make biased opinions of somebody over a phone. Any venue would be suitable, so long as you could have a private conversation."** [TLHC participant]

There was also disappointment expressed by some participants at not being invited to attend a CT scan, saying that they felt this, or other physical tests, would have helped set their mind at ease more effectively than a conversation about their lung health. This was not the case for all attendees, however, with a recognition from some that unnecessary tests placed additional burden on the NHS and may take capacity away from someone with an actual need for it.

> **"If you don't need it, what's the point [of being referred for it]? Someone else may need it more than me."** [TLHC participant]

Participants who were invited to attend a CT scan generally reported good experiences accessing the CT scanning locations. Some mentioned difficulties with parking or getting into the mobile unit due to a lack of accessible features such as a ramp, but this was not consistent across the board, with other attendees reporting that staff had provided the appropriate adaptations to allow them to access the unit.

> **"I was very happy with how the staff treated me on the day. They looked after me very well. For example, they had steps there and I'm not great on steps and they said that they would get the lift out. It was very pleasant."** [TLHC participant]

Although feedback about LHC staff was generally good, there was a small number of attendees who reported poor experiences with staff. One participant said that when they attended their CT scan, they were initially greeted by a nurse and directed into the room with the scanner; however, the person performing the scan did not speak to them at all or communicate in a way that the attendee could understand.

> **"I went into the room and this man in there, he never spoke one word. He just sort of pointed and grunted, and I hadn't a clue what he was on about."** [TLHC participant]

There was also feedback from a small number of attendees about the follow-up care (or lack thereof) that they received after attending their CT scan or other onward referrals. Some participants had not received the results of their CT scan at all, while others found out their results months later at an unrelated appointment with their GP or specialist, who had been sent the outcome letter instead.

> **"I wouldn't have minded if the woman had said to me – you will hear within the next four weeks, but when she said you'd hear early next week and I didn't (…) I was worried."** [TLHC participant]

> **"I've never even heard how the lung scan went – I've heard nothing at all."** [TLHC participant]

Some attendees expressed disappointment at not receiving guidance on (or a referral to) smoking cessation services, while others preferred not to discuss smoking cessation at all, taking the view that

smoking is a personal choice. One participant also mentioned that they do not consider themselves to be a smoker. The participant said that they smoke cigarettes 'casually', around once a fortnight, and have done for the last 30 years; however, they objected to being classified as a smoker and were concerned about this being part of their NHS record, as they felt it was misleading and inaccurate.

> **"I feel like now I have been categorised as someone who smokes, all my life."** [TLHC participant]

7.3.2 Likelihood of encouraging a friend to attend

Similar to overall experience, people were largely very positive, with nearly all claiming that they would encourage a friend to attend (96%). Less than 1% would discourage a friend. This is consistent across a number of key groups, including ethnicity and gender. Similar to overall experience, those aged over 60 are more likely to encourage a friend to attend than those aged 59 and under (97% compared to 94%).

Those who took part in the qualitative interviews also tended to say they would recommend the service to friends or family in a similar situation.

> **"People tend to fall through the net, if you like, but as they see [the leaflet] … it may jog them to do something."** [TLHC participant]

> **"The service opened my mind and I can now give advice to other people. For example, a friend of mine smokes like a chimney. So now, I'm keeping at him to stop the smoking and all this stuff."** [TLHC participant]

7.4 Overall, were participants satisfied with the programme?

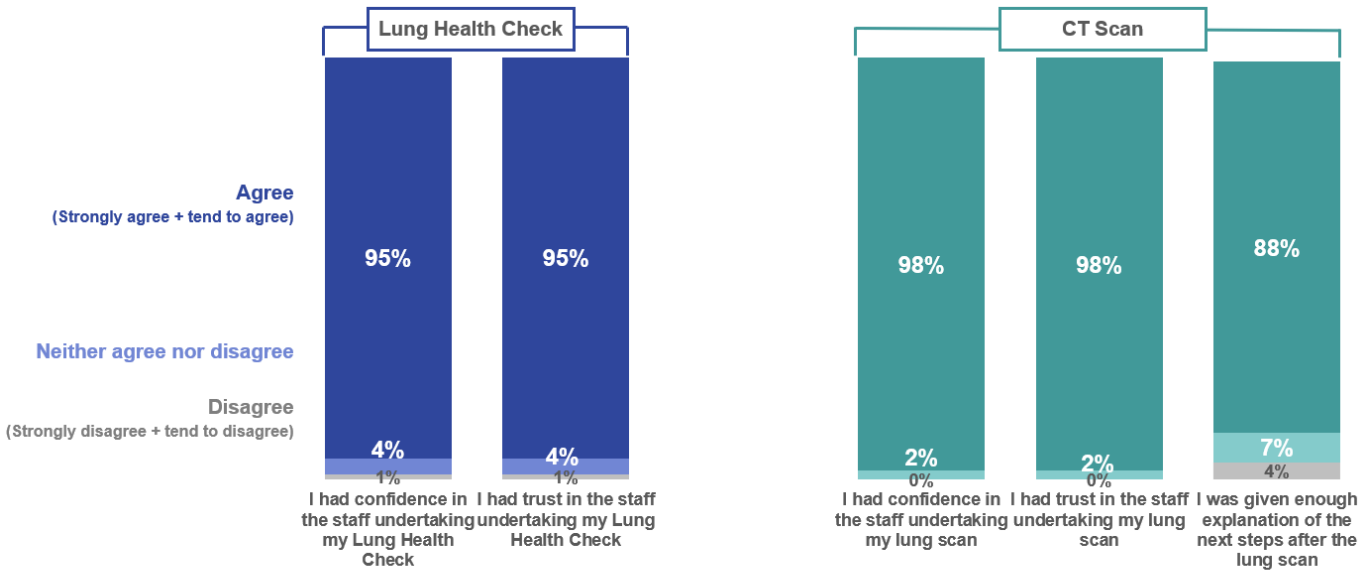
On the whole, people were very satisfied with the programme. At an overall level, nearly all had confidence (95%) and trust (95%) in the staff undertaking their LHC. This was very similar at the CT scan, with an even higher proportion agreeing that they had confidence (98%) and trust (98%) in the staff undertaking their scan.

However, we continue to see some distinctions between key subgroups. For both trust and confidence, those from a White ethnic background were more likely to agree with the statements than those from an ethnic minority background (confidence: 95% compared to 90%, trust: 95% compared to 89%).

Nearly all were satisfied with the next steps they were told about during their LHC: 93% agreed that the next steps were clearly explained. The only key subgroup difference for this metric is by gender; women are more likely than men to agree that the next steps were clearly explained (94% compared to 93%).

However, there is work to be done following the CT scan as a smaller proportion agreed that the next steps were clearly explained (88%). This is consistent across subgroups.

Figure 7.6: Experience at Lung Health Check and CT scan



Base: All participants who had a Lung Health Check (n= varies per statement, min = 5,576)
Q8. To what extent to do you agree or disagree with the following statements about your Lung Health Check? / Q16. To what extent do you agree or disagree with the following statements about your lung scan?

In the qualitative interviews, participants described their overall experience of the LHC service as positive and helpful. They praised the professionalism and friendliness of TLHC staff; the turnaround times between agreeing to take part in the programme and having their appointment(s); and the convenience of access to scanners, either at a fixed or mobile location.

> **"I can't think of any improvements to the service. Everything seemed to go right and it seemed well run so I don't see any need to improve it."** [TLHC participant]

> **"I have difficulty getting in contact with the doctor so I think the fact someone was interested in my health was somewhat uplifting."** [TLHC participant]

8 TLHC programme outcomes

This section presents the results of the impact evaluation of the programme. It explores the effect of the programme on the number of lung cancers diagnosed in the target population, diagnostic staging outcomes, and lung cancer mortality rates between 2019 and 2022. The impacts of the programme are inferred from comparisons between areas benefitting from the programme and a set of comparison areas sharing similar characteristics. Full technical details of the analysis are provided in Appendix 5.

8.1 Key findings

The analysis suggests that the TLHC programme had the following impacts:

- **The TLHC programme was effective in diagnosing additional lung cancers in pilot areas**. It is estimated that an additional 1,168 lung cancers were diagnosed in pilot areas between 2019 and 2022 that would otherwise would have been diagnosed at a later stage or not diagnosed at all.[138]

- **The TLHC programme was effective in meeting its objectives relating to the number and share of lung cancers diagnosed at an earlier stage.** It is estimated that an additional 781 lung cancers were diagnosed at stage 1 or 2 in pilot areas between 2019 and 2022 that would have otherwise been diagnosed at a later stage or not diagnosed at all. The programme also enabled the detection of an additional 341 lung cancers at stage 3 or 4. The share of total lung cancers diagnosed at stage 1 or 2 rose from 24% to 39% between 2019 and 2022 in pilot areas (with no clear improvement trajectory in non-pilot areas sharing similar characteristics). This is likely driven by the share of early-stage cancers diagnosed amongst those participants attending LHCs.

- The introduction of the programme is likely to place **additional short-term demands on NHS resources by increasing the number of lung cancer diagnoses**. This effect is likely to be temporary as the system reaches a new equilibrium in which a higher share of those with lung cancer are diagnosed at earlier stages, likely leading to a future reduction in demand for late-stage cancer treatment. Evidence from the evaluation indicates that the number of additional lung cancers diagnosed begins to fall three years following the introduction of the pilot. For the purposes of future capacity planning, it may be reasonable to expect that additional demand for diagnostic and treatment capacity will persist for at least four to five years. However, it should be noted that the programme was targeted at those areas with the highest lung cancer mortality rates, and the roll-out of a lung cancer screening service to other areas might reasonably be expected to produce smaller demands on NHS resources.

- **Earlier diagnostic staging has not yet led to improved lung cancer mortality outcomes over the timescale of the study.** This is in line with clinical expectations given the timescales required to observe improvements in mortality rates due to earlier diagnosis of lung cancer.

- **The increased volumes of lung cancer diagnoses were predominantly concentrated among those individuals identifying as White British.** Within TLHC intervention areas, the number of lung cancers per 10,000 increased more within White British groups than in other ethnic groups

[138] Note, the sum of additional stage 1 and 2, and stage 3 and 4 diagnoses does not equate to the sum of additional cancers. This is a form of 'aggregation bias', where the disaggregated data (i.e. considering each stage individually) does not perfectly match the aggregated data as each disaggregation has a different sample size, distribution and trend over time, leading to different model estimates.

compared to comparison areas. Descriptive analysis indicates that the likely widening of this gap is due to increases in the number of lung cancers in White British groups, whilst the number of lung cancers in other ethnic groups showed no deviation from prior trends. This raises some questions as to how all groups within the target population can be effectively engaged.

- **The programme did not lead to any other positive or adverse impacts across subgroups.** While there was a larger increase in the number of stage 1 or 2 cancers diagnosed amongst those aged 66 to 76 than amongst those aged 55 to 65, this is likely largely attributable to higher prevalence amongst the older cohort.

8.2 Methodological approach

The findings of this analysis were based on the following methodological approach:

- **Measurement of outcomes:** Individual level data from the NCRD (extracted 30th October)[139] and the ONS Civil Registration Death dataset were compiled to provide annual counts of the number of individuals aged 55 to 76 diagnosed with lung cancer (by stage) and the number of deaths due to lung cancer in each Middle Layer Super Output Area (MSOAs)[140] in England. Differences in the size of the target population in each area were accounted for by dividing these counts by the total resident population aged 55 to 76 (as estimated by the 2021 Census of Population). This provided data on the number of lung cancers diagnosed and deaths due to lung cancer per 10,000 residents aged 55 to 76 between 2016 and 2022 in each MSOA.

- **Selection of comparator areas:** A robust assessment of impact requires comparisons between areas that benefitted from the programme and other areas that did not (to establish what may have occurred in its absence). However, as pilot areas were largely chosen because they exhibited the highest rates of lung cancer mortality, simple comparisons between pilot and non-pilot areas would likely lead to biased estimates of impact. As illustrated in Appendix 5, pilot areas were characterised by higher rates of lung cancer and deaths due to lung cancer within those aged 55-76 and were on average located in more deprived areas.

  This issue was mitigated by using statistical techniques to 'match' each pilot MSOA to non-pilot MSOAs that shared similar pre-programme characteristics in terms of:

  - 2016 to 2018 trends in the prevalence of lung cancer diagnoses between 2016 and 2018, diagnostic staging outcomes and lung cancer mortality rates amongst those aged 55 to 76.

  - Other local factors that might be expected to influence lung cancer diagnosis and mortality outcomes including the size of the population aged 55 to 76, local deprivation levels, density of GP surgeries (which partly determines the likelihood that the pilot programme will be implemented locally), radon potential levels (a main risk factor for lung cancer in non-smokers), and the share identifying as White British (a group more likely to exhibit behaviours associated with higher risk of lung cancer, such as smoking).

[139] The NCRD data was extracted on the 30th October. Cancer registrations in England can take up to five years after the end of a calendar year to reach 100% completeness. This is because of the continuing accrual of late registrations. Further changes may still occur after five years following later diagnostic testing. These late changes are uncommon.

[140] A small geographical area used for the reporting of Census statistics with a typical population of 5,000 to 15,000 residents.

As demonstrated in Appendix 5, this procedure was effective in identifying a matched sample of MSOAs sharing similar characteristics to pilots prior to the introduction of the pilot. Areas benefitting from parallel programmes likely to affect lung cancer diagnosis or mortality outcomes were also excluded from the analysis to prevent the impacts of the pilot being conflated with those associated with other initiatives.

- **Difference-in-differences:** The selection of comparator areas addressed observable differences between pilot and non-pilot areas. However, there may be unobserved differences between areas that could also influence comparisons (e.g. managerial characteristics of relevant NHS Trusts). The effects of the TLHC pilot were estimated using Staggered Difference-in-Difference models comparing the relative pre- and post-programmes trajectories of pilot areas and the matched comparison areas. These models are robust to both unobserved differences between areas that do not change over time as well as unobserved 'shocks' affecting all areas (e.g. COVID-19). The results were also subject to a variety of robustness checks, including tests of how far pilot and non-pilot areas exhibited similar trends prior to the intervention (parallel trends) and placebo tests.

8.3 Impacts on lung cancer diagnosis volumes

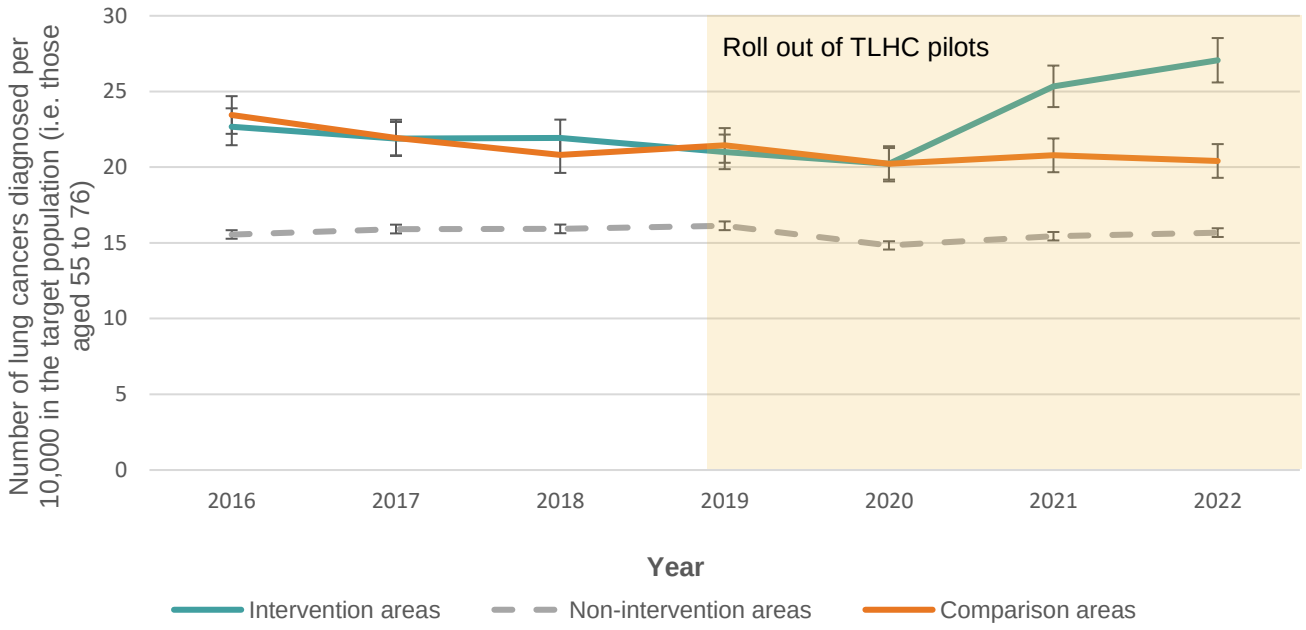
8.3.1 Descriptive trends in overall lung cancer diagnosis volumes

Figure 8.1 shows trends in the number of lung cancers diagnosed per 10,000 people aged 55 to 76 for intervention MSOAs and matched comparison areas between 2016 and 2022:

- **Pre-programme trends:** The number of individuals diagnosed with lung cancer per 10,000 residents aged 55 to 76 showed similar trends in pilot and comparison areas between 2016 and 2018 (around 22 per 10,000 residents over the period in both sets of areas).

- **Post-pilot trends:** Trends across the two areas began to diverge markedly in 2021, coinciding with mainstage delivery of the pilot programme. Lung cancer diagnosis rates increased notably in pilot areas (to 25 per 10,000 residents), while declining in comparison areas.

Figure 8.1: Trend in the number of lung cancers per 10,000 people for those aged 55-76 within the intervention and non-intervention areas between 2016 and 2022



Vertical bars represent the 95% confidence interval.
Source: Ipsos analysis of National Cancer Registration Dataset. Sample size: TLHC intervention areas, n=537; matched comparison areas, n = 537 non-intervention areas, n= 4,843. The number of lung cancers per 10,000 in the target population was computed as the number of individuals in the target population (55 to 76 years old) who received a lung cancer diagnosis divided by the total number of individuals in the target population (55 to 76 years old).

8.3.2 Causal impact of TLHC pilots

Figure 8.2 presents the estimated impact of TLHC on the number of lung cancers diagnosed in the target population in the MSOAs where the TLHC programme was rolled out over time. The findings show that:

- **Overall effects:** The TLHC programme led to an increase in the number of lung cancers diagnosed within the target population in pilot areas between 2019 and 2022 that would not have otherwise been diagnosed until a later date or not diagnosed at all. On average, it was estimated that the introduction of the TLHC programme led to an additional 4.5 cases of lung cancers being diagnosed per 10,000 people per annum in the target population. This result was significant at the 99% level of confidence.

- **Effects over time:** As illustrated in Figure 8.2, the effects of the TLHC programme on overall numbers of lung cancer diagnoses appears to strengthen in the first two years following its introduction, peaking at an additional 6.4 lung cancers diagnosed per 10,000 residents aged 55 to 76. This effect begins to decline in the third year. This is consistent with expectations that the introduction of the TLHC programme would lead to a temporary increase in lung cancer diagnosis volumes before returning to a new equilibrium with a higher share of cancers diagnosed at earlier stages.

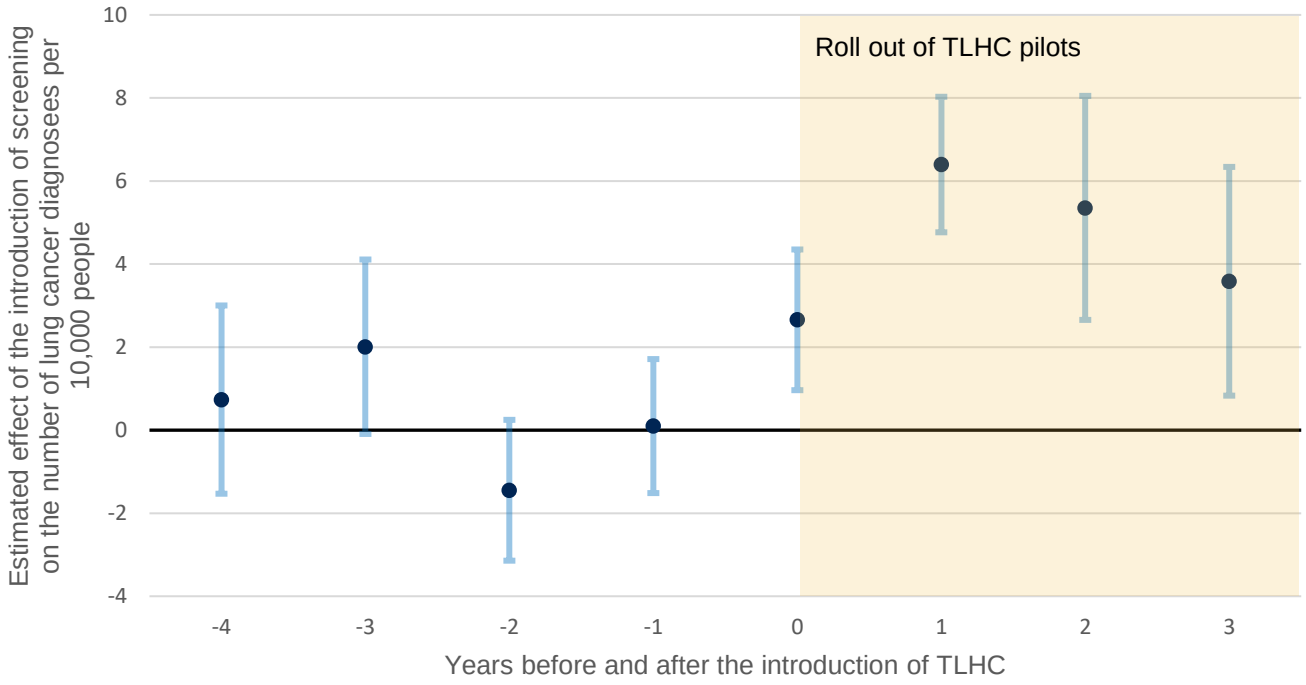
- **Implications for capacity planning:** The findings confirm that the introduction of the TLHC programme will lead to an increase in demand for NHS diagnostic and treatment capacity. For the purposes of future capacity planning, it appears reasonable to anticipate that these additional demands will persist for at least four to five years following the introduction of screening. It should be noted that the programme was targeted at those areas with the highest lung cancer mortality

rates, and the roll-out of a lung cancer screening service to other areas might be reasonably be expected to produce smaller demands on NHS resources.

- **Total number of lung cancers diagnosed:** It was estimated that the programme led to an additional 1,168 (lower bound 675, upper bound 1,662) cases of lung cancer that otherwise would not have been detected over the period.[141]

- **Overdiagnosis:** It should be noted that a significant proportion of the additional lung cancers may never have caused harm to the participants and may never have been diagnosed. Determining the proportion of cancers which would be considered over-diagnosed typically requires long term follow-up that is beyond the scope of this evaluation. Results from the NLST suggest that 4.5 years post-screening overdiagnosis rates were at 18.5%, falling to 3%after 9 years.[142] Similar results were observed in the NELSON trial, where over-diagnosis rates were 19.7%4.5 years post-screening.[143]

Figure 8.2: Estimated effect of the introduction of TLHCs on the number of lung cancers diagnosed per 10,000 residents aged 55 to 76



Vertical bars represent the 95% confidence interval. Points in the shaded region represent post- intervention periods and should be interpreted as differences in the number of lung cancer diagnoses in the target population per 10,000 between intervention and comparison areas with respect to the final year before the intervention started (which varies by MSOA). These points can be considered the impact of the TLHC programme.

[141] This was estimated by multiplying the estimated additional cases of lung cancer per 10,000 by the number of people (in ten thousands) in participating CCGs for each of the four years of delivery, producing an annual additional number of lung cancer cases identified. The point at which each CCG began participating in TLHC was accounted for in this calculation. Population estimates of those aged 55-76 were obtained from the 2021 Census. The 95% confidence interval was used to provide a range of values in which there is 95% confidence that the true number of additional cancers lies between.

[142] Patz *et al.* (2014) Overdiagnosis in low-dose computed tomography screening for lung cancer, *JAMA Internal Medicine*, 174(2), 269-274.; Aberle *et al.* (2020) Lung Cancer Incidence and Mortality with Extended Follow-up in the National Lung Screening Trial, *Journal of Thoracic Oncology*, 14(10), 1732-1742.

[143] de Koning *et al*. (2020) Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trail, *The New England Journal of Medicine*, 382(6), 503-513.

Points to the left of the shaded region represent the pre-intervention periods and are be interpreted as the as differences in lung cancer cases in the target population per 10,000 between intervention and comparison areas with respect to the previous year.
Estimated using Callaway and Sant'anna (2021) doubly robust estimator, standard errors clustered at the MSOA level. Number of observations = 7,252. Full table of statistical results can be found in Appendix 5.
Source: Ipsos analysis of National Cancer Registration Dataset and ONS Civil Registration – Deaths.
Parallel trends test indicates that all pre-intervention points are jointly insignificant. Full statistical outputs can be seen in Appendix 5.

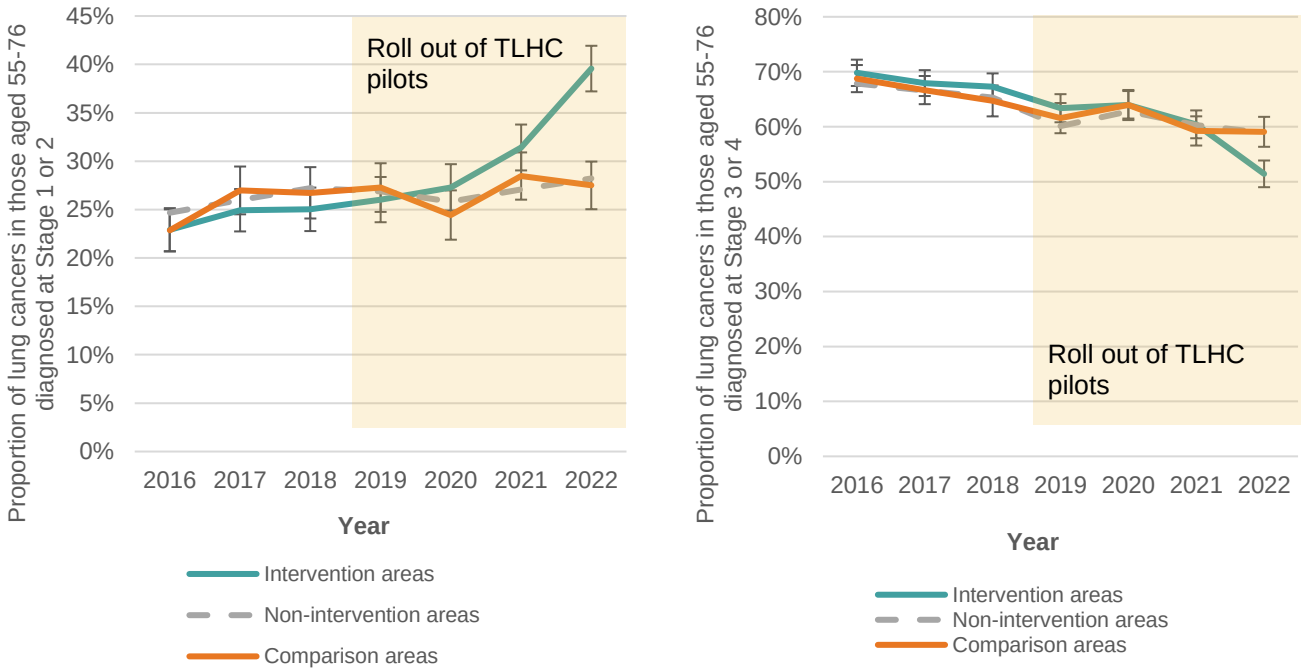
8.4 Impacts on diagnostic staging

8.4.1 Descriptive trends in diagnostic staging

Figure 8.3 clearly illustrates that the objectives of the programme to increase the share of lung cancers diagnosed were met:

- **Pilot areas:** The average share of lung cancers diagnosed at stage 1 or 2 in pilot areas rose from an average of 24% between 2016 and 2018 to just over 39% in 2022. The share of lung cancers diagnosed at stages 3 or 4 fell from an average of 67% prior to the programme to 51% in 2022.
- **Matched comparison areas:** By contrast, matched comparison areas saw no improvement trajectory between 2016 and 2022, which is in line with national trends.

Figure 8.3: Proportion of lung cancers diagnosed at stage 1 or 2, and 3 or 4, for those aged 55-76 in TLHC intervention areas and matched comparison areas, 2016-2022



Vertical bars represent the 95% confidence interval.
Source: Ipsos analysis of National Cancer Registration Dataset. Incidence by stage was computed as the number of individuals amongst the target population (55 to 76 years old) with a lung cancer diagnosed at stage 1 or 2 or stage 3 or 4 divided by the target population.
Sample size: TLHC intervention areas, n=537; matched comparison areas, n = 537 non-intervention areas, n= 4,843

8.4.2 Causal impacts of TLHC pilots

The findings of the analysis indicated that:

- **Early-stage cancer diagnoses:** The introduction of the TLHC programme led to the diagnosis of an average of 3.1 additional cases of lung cancer at stage 1 or 2 per 10,000 residents per annum (cancers that would not have otherwise been diagnosed or would have otherwise been diagnosed at a later stage). This equates to an estimated 781 (lower bound 500, upper bound 1063)

additional cancers diagnosed at stage 1 or 2 that would likely have been diagnosed at a later stage or may not have been diagnosed at all in the absence of the programme.[144]

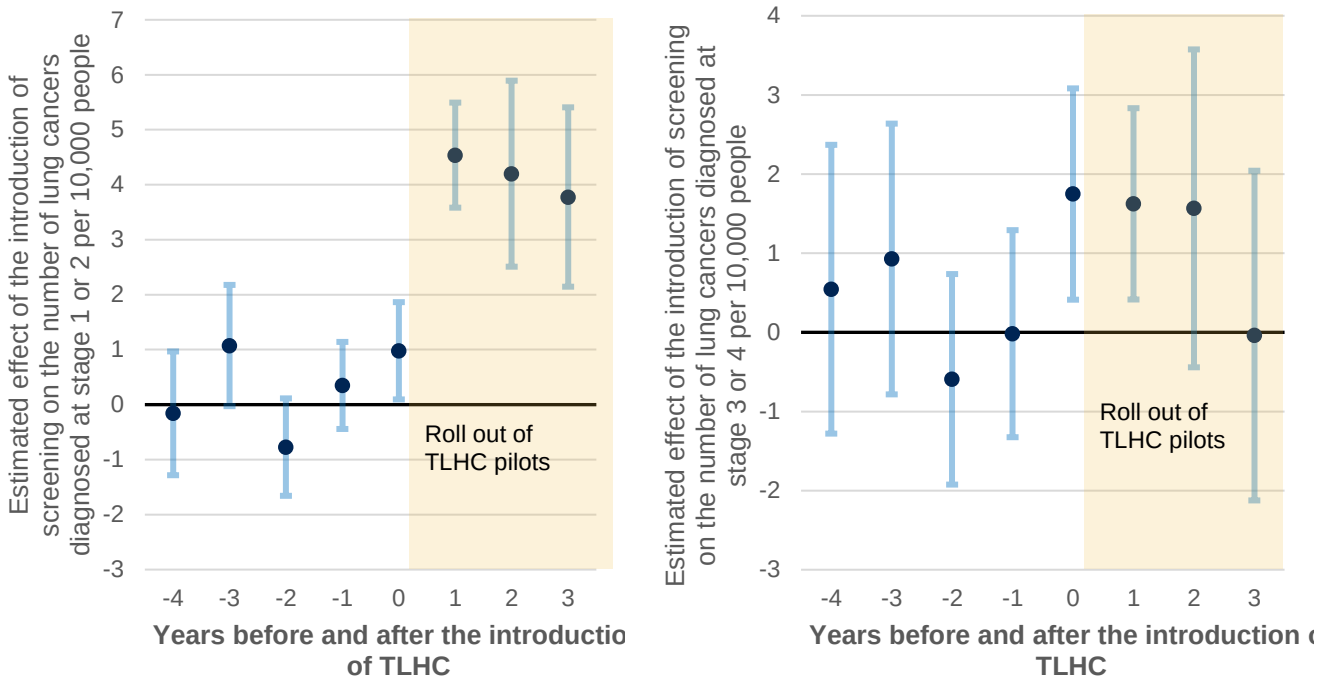
- **Effects over time:** As illustrated in Figure 8.4, the impact of the TLHC programme strengthened in the first two years following its introduction, identifying a comparatively large number of cancers in a previously unscreened population. These effects began to weaken in the third-year post roll-out, possibly as the size of the unscreened population beings to diminish and the intervention was rolled out to new cohorts that had aged into the target group. This is shown by the rate of increase beginning to fall in Figure 8.2. However, the degree to which a new long-term equilibrium had been reached by this stage is unclear.

- **Late-stage cancer diagnoses:** The introduction of the TLHC programme also led to a temporary increase in the number of lung cancers detected at stage 3 or 4, concentrated in the first three years after roll-out. This equates to an estimated 341 (lower bound 91, upper bound 599) additional cancers diagnosed at stage 3 or 4 that would not have otherwise been diagnosed over the four years of programme delivery.

- **Effectiveness relative to trials under controlled conditions:** The findings suggest that around 80%of the additional lung cancers detected were at stages 1 or 2. This indicates that the roll-out of the TLHC programme in uncontrolled healthcare settings has achieved levels of effectiveness at the upper end of the range implied by prior randomised control trials. The UK NSC 'Targeted screening for lung cancer in individuals at risk' report provides a meta-analysis of previous lung cancer screening Randomised Control Trials (RCTs) (including DANTE, DLCST, LSS, LUSI, MILD, NELSON and NLST) that shows that stage 1 and 2 cancers made up between 47%and 86%of lung cancers diagnosed (in the intervention arm).

[144] Calculated by multiplying the number of MSOAs in each CCG by the estimated impact of the intervention on the number of stage 1 or 2 diagnoses to give an annual number of additional stage 1 or 2 diagnoses. This is then multiplied by the number of years that the CCG has been participating in the TLHC programme for to estimate the additional number of cancers across the programme.

Figure 8.4: Estimated effect of the introduction of TLHCs on the number of lung cancers diagnosed at stage 1 or 2 and stage 3 or 4 per 10,000 residents aged 55 to 76



Vertical bars represent the 95% confidence interval. Points in the shaded region represent post- intervention periods and should be interpreted as differences in the number of lung cancer diagnoses in the target population per 10,000 between intervention and comparison areas with respect to the final year before the intervention started (which varies by MSOA). These points can be considered the impact of the TLHC programme. Points to the left of the shaded region represent the pre-intervention periods and are be interpreted as the as differences in lung cancer cases in the target population per 10,000 between intervention and comparison areas with respect to the previous year.
Estimated using Callaway and Sant'anna (2021) doubly robust estimator, standard errors clustered at the MSOA level. Number of observations = 7,252. Full table of statistical results can be found in Appendix 5.
Source: Ipsos analysis of National Cancer Registration Dataset and ONS Civil Registration – Deaths.
Parallel trends test indicates that all pre-intervention points are jointly insignificant. Full statistical outputs can be seen in Appendix 5.

8.4.3 Non-staged cancers

The patient level data from the NCRD contains information on the stage at which lung cancers are diagnosed. However, within the records for the target population within the intervention and non-intervention areas, across all years, approximately 10%of all diagnoses were either not stageable, had insufficient information to stage or had missing values[145]. For the purposes of this analysis, diagnoses that were not stageable and had insufficient information to stage are referred to as 'non-staged cancers' and missing values are excluded from the analysis. The main reason for not being given a lung cancer diagnosis was that there was insufficient information at the time of diagnosis (92%of cases).

Given the scale of this group it was included as one of the outcomes explored alongside the number of stage 1 and 2, and stage 3 and 4 cancers diagnosed to explore how far the TLHC programme impacted the number of non-staged lung cancers, and whether improvements in reporting brought about by the programme enabled better classification of these lung cancers. However, the findings of the analysis

[145] For the purpose of this analysis, missing values are instances where cell is empty (there is no value in the cell) as opposed to a reason for the stage not being provided.

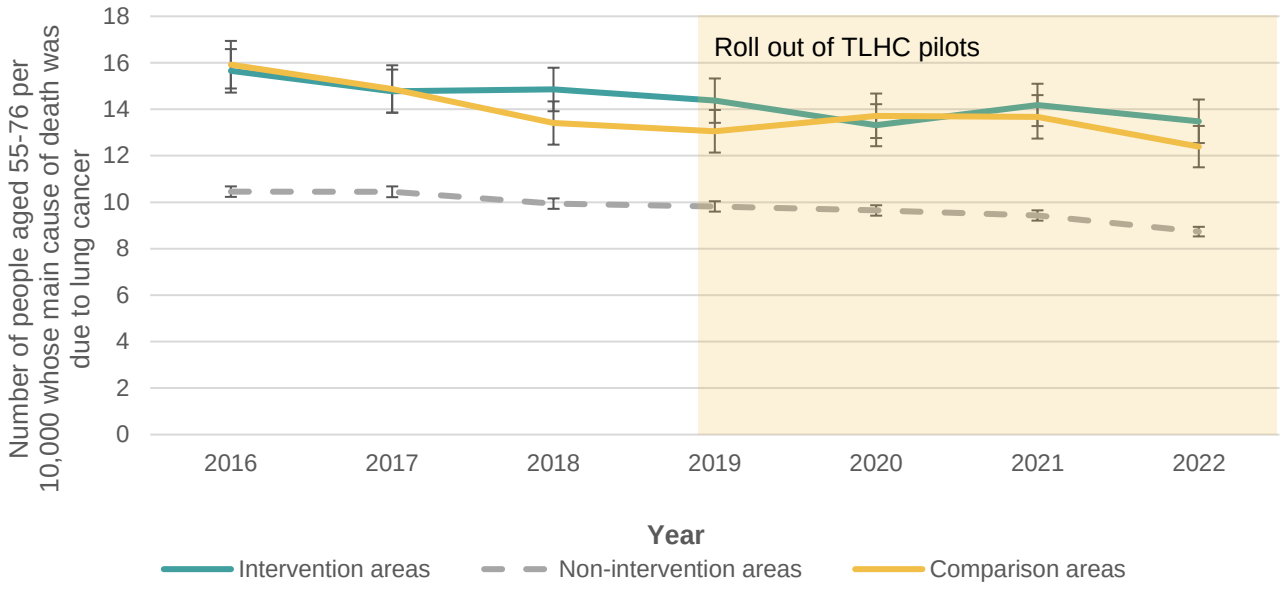
indicated that the programme led to no statistically significant effect on the number of non-staged cancers diagnosed.

8.5 Impacts on lung cancer mortality rates

8.5.1 Descriptive trends in lung cancer mortality rates

Figure 8.5 show trends in the number of deaths due to lung cancer in the target population in pilot and matched comparison areas. Lung cancer mortality rates fell steadily in pilot areas between 2016 and 2022 (from 15.7 to 13.3 deaths per 10,000 residents aged 55 to 76). However, similar trends were observed both in the comparison areas as well as nationally.

Figure 8.5: Trend in the number people whose main cause of death was due to lung cancer per 10,000 people for those aged 55 – 76 within TLHC intervention and non-intervention areas between 2016 and 2022



Vertical bars represent the 95% confidence interval.
Source: Ipsos analysis of ONS Civil Registration – Deaths. Sample size: TLHC intervention areas, n=537; comparison areas = 537; non-intervention areas, n= 4,843. The mortality rate due to lung cancer was computed as the Number of individuals in the target population (55 to 76 years old) who have died with lung cancer recorded as the underlying cause of death divided by the total number of individuals in the target population (55 to 76 years old).

8.5.2 Impact of TLHC pilots

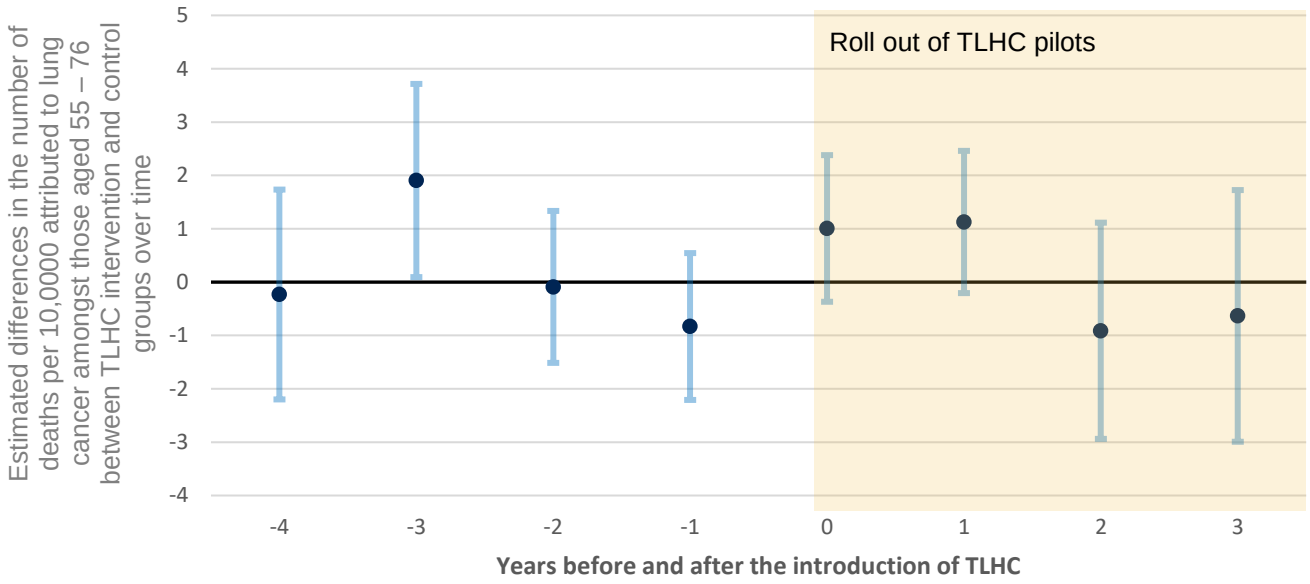
Figure 8.6 below shows the estimated impacts of the TLHC programme on the number of deaths due to lung cancer in the target population:

- **Overall effects:** The introduction of the TLHC programme had no statistically significant effect on the number of deaths due to lung cancer in the target group between 2019 and 2022.[146]

[146] It should be noted that in year 1 (the second post-intervention period), a statistically significant impact (at the 95% confidence level) is detected. Additional analysis was undertaken to explore this result, including running the analysis using additional outcomes to delve deeper into mortality within the TLHC intervention areas: all-cause mortality in the target population, all deaths due to cancer and all deaths due to cancers of unknown origin within the target population. The results of the additional analysis did not suggest the total number of deaths in TLHC areas have increased with respect to the comparison areas. Therefore, the observed increase in the number of deaths due to lung cancer in the second post-intervention period cannot directly be attributed to the TLHC programme. This is further discussed in Appendix 5.

- **Explanatory factors:** There are several potential explanations why significant reductions in mortality due to lung cancer are not found within this analysis:
  - Screening programmes often take several years before impacts on mortality are observed owing to lags associated with the progression of the disease and mortality outcomes. As such, a material effect on mortality may not be expected at this stage for clinical reasons. Evidence from three RCTs have demonstrated a longer-term reduction in lung cancer mortality with low dose computed tomography (LDCT) lung cancer screening: the National Lung Screening Trial (NLST),[147] NELSON,[148] and MILD,[149] indicating that these types of outcomes would be expected in the longer term.
  - However, it is not possible to rule out the possibility that wider pressures on the NHS have limited the extent to which it has been possible to realise the clinical benefits of earlier diagnosis. As highlighted in later chapters (see Figure 8.11 and 8.12), performance against the 62-day waiting time target for treatment has deteriorated from 2020 onwards. It is possible that wider capacity pressures have delayed treatment for some participants receiving LHCs, eroding the potential benefits of an earlier diagnosis.

Figure 8.6: Estimated effect of the introduction of TLHCs on the number of deaths attributed to lung cancers amongst those aged 55 - 76



Vertical bars represent the 95% confidence interval. Points in the shaded region represent post- intervention periods and should be interpreted as differences in the number of lung cancer diagnoses in the target population per 10,000 between intervention and comparison areas with respect to the final year before the intervention started (which varies by MSOA). These points can be considered the impact of the TLHC programme. Points to the left of the shaded region represent the pre-intervention periods and are be interpreted as the as differences in lung cancer cases in the target population per 10,000 between intervention and comparison areas with respect to the previous year.
Estimated using Callaway and Sant'anna (2021) doubly robust estimator, standard errors clustered at the MSOA level. Number of observations = 7,252. Full table of statistical results can be found in Appendix 5.
Source: Ipsos analysis of National Cancer Registration Dataset and ONS Civil Registration – Deaths.
Parallel trends test indicates that all pre-intervention points are jointly insignificant. Full statistical outputs can be seen in Appendix 5.

[147] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4356534/ [Accessed 08/02/2024]
[148] https://pubmed.ncbi.nlm.nih.gov/31995683/ [Accessed 08/02/2024]
[149] https://pubmed.ncbi.nlm.nih.gov/30937431/ [Accessed 08/02/2024]

8.6 Impacts by subgroup

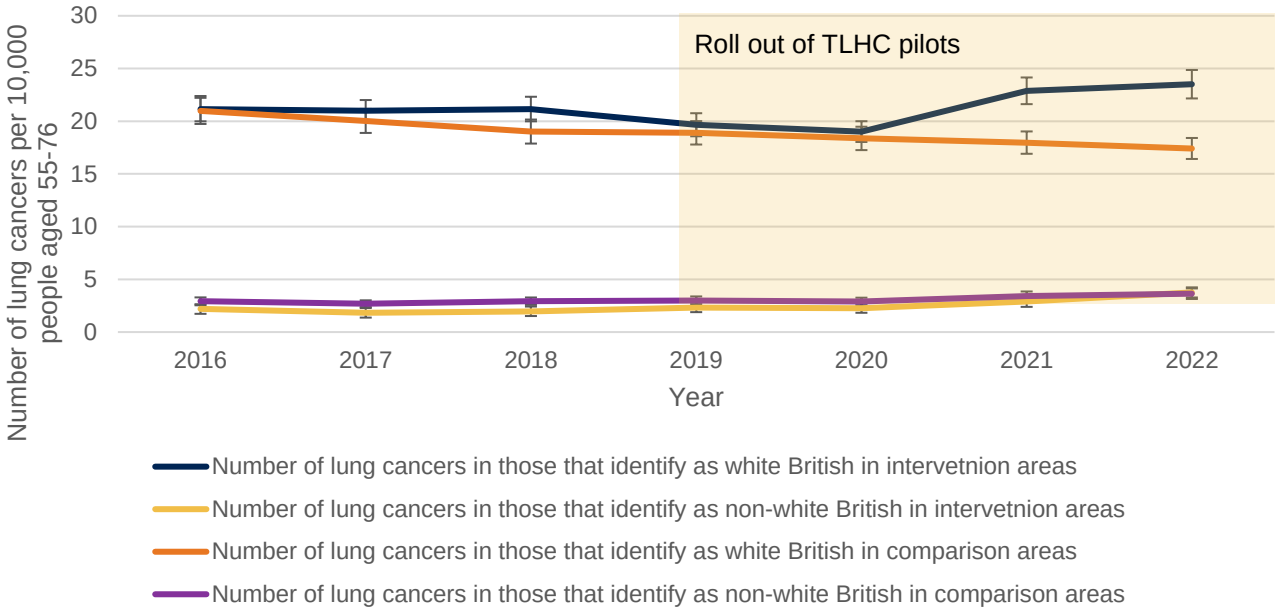
The analysis was also used to explore the relative effectiveness of the programme across subgroups. The findings of these analysis are set out in Figure 8.7 and show:

- **Ethnicity:** The impacts of the programme were predominantly concentrated amongst those identifying as White British (as opposed to other ethnic groups).[150] Over the first four years of programme delivery, the introduction of the TLHC programme led to 3.9 more lung cancer diagnoses per 10,000 among White British people than amongst those in other ethnic groups. As illustrated in Figure 8.7, the overall increase in lung cancers diagnosed associated with the introduction of the TLHC programme appears to be almost entirely driven by an increase in the number of diagnoses among those identifying as White British.

  This result is partly explained by differences in the prevalence of lung cancer across the two groups as being from other ethnic groups display a lower lung cancer incidence rate compared to those that are White British.[151] This is explained by Arnold *et al.* (2010) who suggest that those that identify as White British are more likely to engage in unhealthy behaviours such as smoking, poor diet and carrying excess bodyweight.[152] Additionally, those that identify as White British exhibit greater LHC uptake rates compared to those that identify as being from other ethnic groups (64% compares to 31%), suggesting greater engagement with the TLHC pilots (Section 6.9.5). Section 6.9.5 also identifies that lung cancer conversion is higher for those that are white (1.73%) compared to those that are from other ethnic groups (0.68%) (see Table 6.14). This therefore raises some questions as to how all groups of the target population can be effectively engaged.

[150] A binary white British, other ethnic group classification was adopted as more granular ethnic classifications of this varied group contained a significant amount of zero values.
[151] Delon, C. *et al.* (2022) Differences in cancer incidence by broad ethnic group in England, 2013 – 2017. *British Journal of Cancer*, 126, 1765 – 1773.
[152] Arnold. M., Razum. O. and Coebergh, J.W. (2010) Cancer risk diversity in non-western migrants to Europe: An overview of the literature, *European Journal of Cancer*, 46,14,2647-2659..

Figure 8.7: Number of lung cancer diagnoses per 10,000 people aged 55-76 who identify as White British or other ethnic groups in intervention and comparison areas, 2016 to 2022



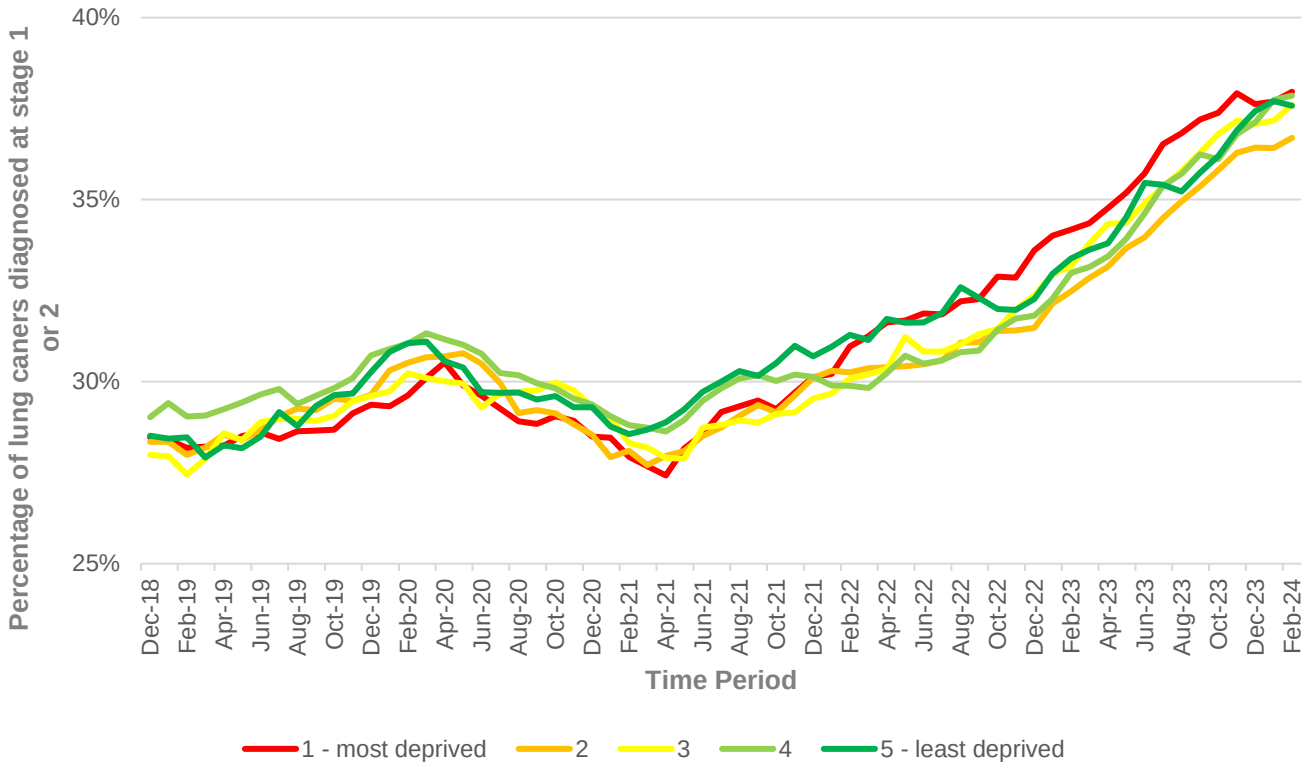
Vertical bar represents the 95% confidence interval.
Source: Ipsos analysis of National Cancer Registration Dataset. Sample size: intervention, n=537; comparison areas, n= 537.

- **Age:** The findings indicated that the introduction of the TLHC programme led to the diagnosis of 1.4 more lung cancers at stage 1 or 2 per 10,000 individuals among those aged 66-76 than among those aged 55-65 (predominantly arising from additional non-staged diagnoses). This result is likely to reflect higher rates of prevalence among older populations.[153]

- **Deprivation:** The findings indicated that the introduction of the TLHC programme was equally effective in the 20%most deprived areas and the 80% least deprived areas.[154] Nevertheless, the pilots were likely to help narrow the gap between the most and least deprived areas as they tended to be targeted at more deprived areas (48% of the MSOAs within pilot areas were in the 20% most deprived nationally). Analysis in Section 6.9.2 also indicates that among those invited to a LHC, 46% live within the most deprived quintile. Furthermore, lung cancer conversion rates are higher among those in more deprived areas (1.81%) compared to those in less deprived areas (1.54%). It therefore could be argued that TLHC may have contributed to the observed national increase in the proportion of lung cancers diagnosed at an earlier stage in most deprived areas (see Figure 8.8). However, there are some questions as to how far this improvement might persist across more deprived areas if a lung cancer screening service is rolled out nationally.

[153] Di Girolamo.C *et al*. (2018) Characteristics of patients with missing information on stage: a population based study of patients diagnosed with colon, lung or breast cancer in England in 2013, *BMC Cancer*, 18,482.)
[154] The binary classification of IMD quintile 1 compared to quintiles 2-5 was chosen to align with NHSE analysis.

Figure 8.8: 12-month moving average of lung cancer early diagnosis rate by deprivation quintile



Source: NHSE Analysis of Rapid Registration Data.
Note: this chart presents national trends overtime in lung cancer diagnosis rates by IMD quintile. The sub-group analysis undertaken differs from the above, in that it seeks to explore whether there were differential impacts within TLHC intervention areas, to explore were the impacts of TLHC equitable.

8.7 Which other health conditions were detected during the TLHC intervention and how often did these occur?

The evaluation framework cites the following secondary outcome:

1. Increased identification of incidental findings in TLHC participants

This section assesses the evidence collected throughout the evaluation to examine whether this outcome has been demonstrated. It provides an overall assessment of the achievement of this outcome, followed by summaries of the evidence collected against key indicators of this outcome using the approaches outlined within the TLHC Impact protocol (2023).

8.7.1 Overall assessment

The indicators presented below demonstrate supportive evidence that the secondary outcome for **increased identification of incidental findings in TLHC participants** has been realised. Three-quarters of participants who receive an initial LDCT scan had one or more incidental finding(s) reported. The three most commonly reported incidental findings were coronary calcification (56.35% of participants), aortic valve calcification (29.80%) and moderate or severe emphysema (15.64%).

Analysis of other cancer diagnoses show **1,673 participants who received a LHC and were assessed as high risk[155] were diagnosed with 1,693 other (non-lung) cancers between February 2020 and August 2023**. **Of these cancers, 481 (28% of all diagnoses) were diagnosed within three months of the participant's last TLHC event**. While the data does not show whether cancers were diagnosed via TLHC (and therefore their attributability to the programme), diagnoses that took place close to TLHC events are more likely to have been detected because of the TLHC programme, or as a result of participants' improved health behaviours which participation in TLHC may have encouraged. In addition, the analysis illustrates the most common tumour group sites are urological (680 diagnoses, 40% of all other cancers), upper gastrointestinal (254, 15%), and colorectal (178, 11%).

The qualitative data collected throughout the evaluation from project stakeholders reflects that the number of incidental findings was higher than initially anticipated. The additional strain placed on primary and secondary care services to manage incidental findings has been a recurring theme throughout the evaluation.

8.7.2 Increased identification of incidental findings in TLHC participants

This subsection examines the indicators outlined within the protocol to assess whether this secondary outcome has been realised.

Rate of identification of incidental findings found during CT scans

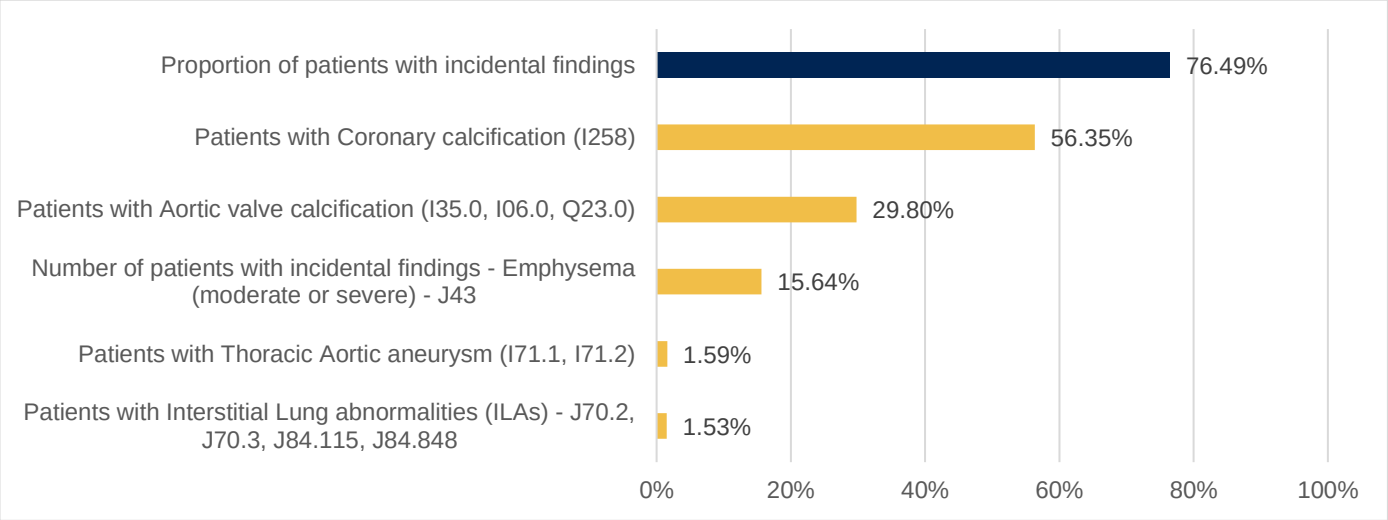
For this indicator, the following key points emerge:

- Three-quarters (124,652, 76.49%) of participants who received an initial LDCT scan had one or more incidental finding(s).
- More than half of participants who received an LDCT scan had a finding reported of coronary calcification (91,826, 56.35%); three in ten had aortic valve calcification (48,557, 29.80%); and three in twenty had moderate or severe emphysema (25,492, 15.64%).
- After this, thoracic aortic aneurysms and interstitial lung abnormalities were the next most common with 1.59% (2,598) and 1.53% (2,494) of LDCT participants respectively. The rest of the incidental findings were reported in <1% of LDCT participants, including other cancers which are discussed further below (470, 0.29%).

Further analysis of incidental findings presented cumulatively and by Cancer Alliances can be found in **Chapter 3**.

[155] Note this data is only available for projects reporting record-level data.

Figure 8.9: Incidental findings reported in Phase 1 and 2 projects (April 2019 – March 2024), as a proportion of initial LDCT



Source: TLHC MI dataset

Table 8.1: Number of incidental findings reported in Phase 1 and 2 projects (April 2019 – March 2024), as a proportion of initial LDCT

Data Item	Total (Phase 1 + 2)	As % of initial LDCT
Patients with Coronary calcification (I258)	91,826	56.35%
Patients with Aortic valve calcification (I35.0, I06.0, Q23.0)	48,557	29.80%
Number of patients with incidental findings - Emphysema (moderate or severe) - J43	25,492	15.64%
Patients with Thoracic Aortic aneurysm (I71.1, I71.2)	2,598	1.59%
Patients with Interstitial Lung abnormalities (ILAs) - J70.2, J70.3, J84.115, J84.848	2,494	1.53%
Patients with Liver or Spleen lesions (K768, D739)	1,411	0.87%
Patients with Bronchiectasis - J47	1,352	0.83%
Patients with Renal lesions (N28; N281; N288; N289)	1,330	0.82%
Patients with Adrenal lesions (A187; C74; C740; C741; C749; C797; D350; D441; E27; E278; E279; E351)	1,201	0.74%
Patients with Bone abnormalities (M89X)	1,059	0.65%
Patients with Osteoporosis (M80.0; M80.1; M80.2; M80.3; M80.4; M80.5; M80.8; M80.9; M81.0;M81.1; M81.2; M81.3; M81.4; M81.5; M81.6; M81.8; M81.9; M82.0*; M82.1*; M82.8*)	889	0.55%
Patients with Pleural affusions/thickening (J91X; J92; J920; J929)	814	0.50%
Patients with Mediastinal mass (C38.1-C38.3)	811	0.50%
Patients with Respiratory Bronchiolitis - J84.115	804	0.49%
Patients with Consolidation (ICD10 J181)	759	0.47%
Patients with Suspicious Breast Legion (N63X)	631	0.39%
Patients with Other Cancers - C00-D48 excluding C34	470	0.29%
Patients with Fractures with no trauma history (M84.4)	336	0.21%
Patients with Thyroid lesion (E07.9)	283	0.17%
Patients with Abdominal Aortic Aneurysm (I17.3, I17.4)	124	0.08%
Patients with Tuberculosis (A15-A19)	25	0.02%
Patients with incidental findings	**124,652**	**76.49%**

Source: TLHC MI dataset

Rate of diagnoses for other (non-lung) cancers in participants who received a LHC and were assessed as high risk

Where available, this indicator is measured using NCRAS data linked with record-level data from the TLHC MDS, reported by a subset of Phase 1 and 2 projects (reflecting 71% of first invites sent in the programme[156]). The following key points emerge:

- In total, the NCRAS linked data shows that 1,697 other cancers were diagnosed between February 2020 and August 2023[157] among 1,673 TLHC participants[158] who received a LHC and were assessed as high risk.[159] [160]
- Of these cancers, Urological was the most common tumour group site with 680 diagnoses (40% of all other cancers). This is over double the next most common group, Upper Gastrointestinal (254, 15%), followed by Colorectal (178, 11%), Haematological (151, 9%), Head and Neck (134, 8%) and Breast (117, 7%). The rest of the cancers each accounted for <5% of total diagnoses.
- Looking at timeframes since TLHC event to diagnosis, 481 other cancers (28% of all diagnoses) were diagnosed within three months of the participant's last TLHC event,[161] and 345 (20%) other cancers were diagnosed between three and six months after. While the data does not show whether these cancers were diagnosed directly as a result of the TLHC programme, diagnoses that took place close to TLHC events may be more likely to have been detected because of the TLHC programme than those diagnosed as a result of improved health behaviours which participation in TLHC may have encouraged.
- Looking at the cancers most frequently diagnosed within three months of a TLHC event, more Breast cancers were diagnosed within these timeframes proportionally (46% of all Breast cancer diagnoses), whilst comparatively fewer Colorectal and Head and Neck diagnoses happened within these time frames (22% and 25% respectively). All other cancer groups had relatively similar proportional diagnoses rates (27% to 34%).
- Small base sizes mean it is not possible to analyse diagnoses within these time frames by cancer staging. Future research should explore the staging of other cancers diagnosed by the programme further, such as by including other cancers within the impact evaluation analysis.

[156] Accounting for 513,491 out of 735,052 first invites sent in total.
[157] Non-lung other cancer data starts from February 2020 due to (record-level) TLHC-countable activity starting in Jan 2020 and cancer diagnoses usually being made following a time lag from TLHC activity.
[158] 24 participants had multiple diagnoses for other cancers, explaining the differences in these figures.
[159] This figure does not include other cancers detected via other screening programmes: Breast = 113; Colorectal = 61; Gynaecological = <10
[160] It is not possible within the NCRAS linked data to know whether cancers were detected or referred directly through the TLHC pathway, therefore a denominator has not been used with this data. This also means that the other cancers reported can not necessarily be attributed to the TLHC programme.
[161] The last TLHC event is either the participants' most recent LHC or CT scan, including follow-up and surveillance scans, via the TLHC programme.

Table 8.2: Number of other (non-lung) cancer diagnoses by tumour site group within participants who received a LHC and were assessed as high risk, by time frame from the participant's last TLHC event[162] to diagnosis

Tumour site group	Within 3 months (%)	3-6 months (%)	6-12 months (%)	1 year and longer (%)	Total
Urological	186 (27%)	141 (21%)	192 (28%)	161 (24%)	**680 (100%)**
Upper Gastrointestinal	75 (30%)	48 (19%)	71 (28%)	60 (24%)	**254 (100%)**
Colorectal	40 (22%)	35 (20%)	49 (28%)	54 (30%)	**178 (100%)**
Haematological	50 (33%)	33 (22%)	30 (20%)	38 (25%)	**151 (100%)**
Head and Neck	33 (25%)	28 (21%)	37 (28%)	36 (27%)	**134 (100%)**
Breast	54 (46%)	21 (18%)	23 (20%)	19 (16%)	**117 (100%)**
Skin	18 (34%)	<10 (13%)	13 (25%)	15 (28%)	**53 (100%)**
Gynaecological	<10 (15%)	13 (27%)	12 (25%)	16 (33%)	**48 (100%)**
Unknown	<10 (26%)	<10 (20%)	<10 (26%)	10 (29%)	**35 (100%)**
Brain/Central Nervous System	<10 (25%)	<10 (22%)	12 (38%)	<10 (16%)	**32 (100%)**
Sarcoma	<10 (7%)	<10 (33%)	<10 (33%)	<10 (27%)	**15 (100%)**
Total	**481 (28%)**	**345 (20%)**	**453 (27%)**	**418 (25%)**	**1,697 (100%)**

Source: NCRAS data linked with record-level data from the TLHC MDS

Perceived increase in identification of incidental findings and referrals to other services

Programme stakeholders, and project teams, interviewed across the course of this evaluation frequently reported on the theme of incidental findings. The main messages include:

- The proportion of TLHC participants who have incidental findings was higher than originally anticipated, according to project stakeholders. This led to projects seeking further guidance on the expectations for managing incidental findings. This was due to uncertainty about how to decide which more routine findings needed medical follow-up.
- The value for participants of diagnosing other conditions through the TLHC service was highlighted by project stakeholders, but the importance of balancing clinical diagnoses with participant wellbeing was also raised. For example, where a minor finding that cannot be meaningfully treated has been identified, this causes significant worry for the individual.

[162] The last TLHC event is either the participants' most recent LHC or CT scan, including follow-up and surveillance scans, via the TLHC programme.

"[I] see it as a good thing that they have found out something…. [and it's positive that] they'd be moving forward in the queue faster than if they just went to the GP when they had a problem because they already know something is wrong and can get a referral straight into the system." [Radiographer]

"[Coronary calcification] is a long-term risk factor for developing coronary artery disease, so it's very unlikely that… if they didn't get treated within a week it was going to make any difference. But it might make a difference to them over a year or five year or 10-year or 20-year period." [Clinical Director]

- The increase in referrals is discussed in detail in Section 8.10. The increased demand generated via TLHC as a result of the identification of incidental findings has been a key theme discussed throughout the evaluation. Particular concerns were with capacity within local systems, particularly within primary care, and secondary diagnostics and respiratory, to manage the referrals that come from TLHC. This view is consistent across project stakeholders.

"I don't think there is enough slack in the system to absorb a huge amount of extra activity that might be generated through the LHCs programme" [Cancer Alliance stakeholder]

The implications of managing incidental findings for wider programme roll-out are discussed in Chapter 10.

8.8 What was the entry and completion rate of smoking cessation courses and what were the outcomes?

The TLHC Standard Protocol outlines that all TLHC services should have sufficient capacity and infrastructure to deliver smoking cessation support and advice. This should include offering smoking cessation advice and treatment during the LHC appointment, to all participants that smoke (regardless of whether they are eligible for a CT scan).[163]

As part of this, a key evaluation question is: '***What was the entry and completion rate of smoking cessation courses and what were the outcomes?***'. Within the evaluation framework, this was broken down into two secondary outcomes:

1. TLHC participants accessing smoking cessation service (or other wider support service).
2. TLHC participants smoking stopped or reduced.

This section provides an overall assessment of the achievement of these outcomes, followed by summaries of the evidence collected against each outcome indicator, using the approaches outlined within the TLHC Impact protocol (2023).

8.8.1 Overall assessment

The indicators presented below demonstrate mostly supportive evidence that the secondary outcome for **TLHC participants accessing smoking cessation service (or other wider support service)** has been realised. The majority of current smokers were offered advice and support for smoking during their LHC, but the offer was not universal. Even fewer reported receiving a referral or being signposted to a

[163] Section 3.4.3 of the Standard Protocol: "Smoking cessation advice should be incorporated into written correspondence and should be face-to-face where participants attend. Enhanced smoking cessation interventions are also encouraged including the use of pharmacotherapy."

local service. However, of those who were referred or signposted, nearly all attended their first appointment, with the majority attending all appointments. Stakeholders suggested however that uptake from TLHC participants was lower than anticipated, and those that do engage are typically older with longer smoking histories.

The indicators presented below demonstrate supportive evidence, with caveats, that the secondary outcome for **TLHC participants smoking stopped or reduced** has been realised. While the attendee follow-up survey data shows that half of respondents who smoked at the time of their LHC report reducing or stopping smoking around three months after their LHC, qualitative data from a small number of smoking cessation staff interviews reported varying quit rates. These interviewees also suggested that referrals from TLHC participants was lower than from self-referrals.

Finally, examining changes in current smoker prevalence within the eligible age range in intervention areas shows an overall decrease since areas started delivering TLHC. Intervention areas that launched in 2021 experienced a larger decrease in current smoker prevalence since their pre-TLHC baseline and in the year the service launched compared to the non-intervention area. However, prevalence in intervention areas that launched in 2019 was changeable year-on-year. The analysis shows that prevalence slightly increased in intervention areas since their pre-TLHC baseline but decreased considerably from the year the service launched. This evidence is circumstantial and descriptive, rather than being attributable to the TLHC programme.

8.8.2 TLHC participants accessing smoking cessation service (or other wider support service)

This outcome can be divided into two stages: a) participants being offered support and treatment for smoking cessation as part of their LHC and b) accessing smoking cessation services.

Participants offered support and treatment for smoking cessation

While TLHC participants should receive smoking cessation advice and be offered treatment during their LHC, as per the Standard Protocol, the TLHC programme did not set out any particular objectives for this aspect of the pathway. Advice has typically taken the form of ‘very brief advice’ (VBA) delivered by the LHC nurse, which acts as a stepping-stone to encouraging the participant to engage with an expert smoking cessation professional later on.

Examining the **proportion of participants offered advice on quitting or reducing smoking during their LHC** using the attendees’ survey, Table 8.3 shows that that just under two-thirds (62%) of respondents who had smoked at least one cigarette in the past week were offered advice on quitting or reducing their smoking behaviour during their LHC. The number of cigarettes a respondent smoked in a week did not appear to influence whether they were offered advice.

Table 8.3: Number of attendees survey respondents offered advice on quitting or reducing smoking during LHC, by cigarettes smoked in the last week

Cigarettes smoked in the last week	No of respondents offered advice on quitting or reducing smoking	Total respondents	Proportion offered advice
None	543	8740	6%
1 to 10	521	855	61%
11 to 30	682	1081	63%
31 or more	156	259	60%
At least one	1359	2195	62%

Total	1902	10935	17%

Source: Attendees' survey Q9: Which, if any, of the following topics did you receive advice on at your Lung Health Check? (Base = 10,925 respondents)

Examining the **proportion of participants referred to smoking cessation services at LHC** using the attendees' follow-up survey, Table 8.4 shows that around one-third (32%) of respondents who smoked at least one cigarette in the past week had received a referral or were signposted to smoking cessation at their LHC. While this is notably lower than the proportion who reported receiving advice during their LHC appointment, it should be noted that respondents were sent the follow-up survey three months after the initial survey, so poor recall may account for a lower figure than anticipated.

Those who smoked more frequently appeared to be more likely to be referred or signposted, with 48% of those who smoked 31 or more cigarettes in the past week receiving a referral versus those who smoked 1-10 or 11-30 cigarettes (31% and 28%).

Table 8.4: Number of respondents to the attendees' follow-up survey reporting that they were referred or signposted to smoking cessation during LHC, by cigarettes smoked in the past week

Cigarettes smoked in the past week	No of respondents referred or signposted to smoking cessation at LHC	Total respondents	Proportion referred or signposted
None	58	1681	3%
1 to 10	46	149	31%
11 to 30	39	133	29%
31 or more	19	40	48%
At least one	104	322	32%
Total	165	2048	8%

Source: Attendees' Follow-up survey Q15: Were you referred or directed to a stop smoking service following your Lung Health Check? (Base = 2,048 respondents)

The qualitative data from project stakeholders and participants collected through the evaluation provides the following insights about **participants' experience being offered support and treatment for smoking cessation:**

- Project stakeholders stated that all current smokers would receive smoking cessation support, usually following the VBA model. Stakeholders highlighted that the purpose of VBA was to act as a stepping-stone to encouraging the participant to engage with an expert smoking cessation professional later on, rather than extensive support delivered during the LHC.

- Interviews with participants were generally positive about their experience of receiving advice about smoking cessation and/or being referred to a smoking cessation service. Reoccurring feedback was that LHC nurses provided positive encouragement to either stop or reduce smoking. If a participant was not ready to quit smoking outright, LHC nurses discussed ways of reducing smoking with them instead. A key component of this was that support was delivered in a non-judgemental way and this made participants feel more comfortable and willing to engage.

  "They didn't badger me or coerce me into doing anything that I didn't want to." [TLHC participant]

- A small number of participant interviewees did not receive advice or a referral for smoking cessation, despite being a current smoker. Some said this was surprising, as they had expected

or wanted to receive this advice and were surprised and disappointed to not have been offered this.

"I've been smoking since I was 17. They didn't even ask if I'd considered giving up smoking. I answered the questions; she said everything was fine; that was about it." [TLHC participant]

- Feedback from participants varied widely in relation to the perceived quality and usefulness of advice received at the LHC. Although participants who received advice generally felt that it was offered in a non-judgemental manner, the advice tended to be information the participants already knew. Some participants noted that they feel judged when a non-smoker discusses smoking with them, and others felt they were in control of their smoking behaviour so the advice was unwanted.

"I'm in my 60s and I've smoked most of my life – so you can imagine how many conversations I've had about smoking over the years." [TLHC participant]

Participants attend smoking cessation services

Table 8.5 and Table 8.6 show that 95% of **referred participants attended their smoking cessation appointment,** although this is based on a small number of respondents. Of these respondents, nearly nine in ten (87%) attended all appointments, with 13% only attending some of their appointments.

Respondents who received a LDCT scan were proportionally slightly more likely to attend their smoking cessation than not (97% to 94%)[164]. This aligns with the stakeholder feedback reiterating the role of sustained messaging about smoking cessation throughout the pathway to improve engagement.

Table 8.5: Number of respondents to the attendees' follow-up survey referred to and attended their smoking cessation appointments, by whether they attended all or some of their appointments

Whether attended all / some of their smoking cessation appointments they were referred for	No of respondents	Total respondents	Proportion
Attended all of their appointments	53 (87%)	64	83%
Attended some of their appointments	8 (13%)	64	13%
Did not attend any of their appointments	3	64	5%
NET: attended	61 (100%)	64	95%

Source: Attendees' Follow-up survey Q17: You said you had an appointment/s booked with the stop smoking service. Did you attend these appointment/s? (Base = 64 respondents)

[164] This is not based on significance testing, so should be seen as indicative.

Table 8.6: Number of respondents to the attendees' follow-up survey referred to and attended their smoking cessation appointments, by whether they had a LDCT scan

Had a LDCT scan	No of respondents attended their SC appointment(s)	Total respondents	Proportion
Yes	29	30	97%
No	32	34	94%
Total	61	64	95%

Source: Attendees' Follow-up survey Q17: You said you had an appointment/s booked with the stop smoking service. Did you attend these appointment/s? (Base = 64 respondents)

The qualitative evidence collected throughout the evaluation identifies the following themes to explain whether **participants successful complete smoking cessation courses:**

- Participant engagement with smoking cessation services was generally suggested to be lower than had been expected at the start of the programme, according to project leads. However, stakeholders recognised this was based on their perceptions as there was no data to benchmark this against.

- Overall, smoking cessation staff were positive about linking the TLHC programme to smoking cessation, as it provides a clear link between lung health and smoking which can help motivate individuals to quit. However, the relative complexity of managing referrals from TLHC compared to other services was noted. For example, participants can be confused about the referral on the first contact (e.g. they may have forgotten about it), and some individuals referred from TLHC can be more stressed than average as, in many cases, they have just been scanned.

"It's opened us up to people that didn't engage with the stop smoking service – the programme has brought awareness to people's lung health. To have a lung specialist nurse in front of you, saying that you need to quit, is very different than having our marketing over social media and in the local press and radio saying that you need to stop smoking… The increase in referrals we've seen from the programme shows how many people weren't engaging with us to start that attempt." [Smoking cessation staff]

- Consultations with a small number of smoking cessation staff suggest that smoking cessation service attendees who came following an LHC were typically older than the average service attendee. They presented as more 'engrained' smokers with longer smoking histories. When compared to self-referrals, they were suggested to be somewhat less motivated on average, with some thought to have agreed to attend because they were directly asked by an LHC nurse. Other than that, there were no other specific demographic differences from their wider cohort.

"Some people are saying they want to stop smoking while they're in front of a nurse, when they're questioning their lung health. By the time we get round to calling them, they're a bit coy – 'I can't remember that appointment' or 'Actually I'm not interested anymore'. There is a fair amount of that happening in this group." [Smoking cessation staff]

- Among those who were offered a referral to stop smoking services, some reported in the attendee follow-up survey that nothing had come of their referral: that having been told the local service would contact them to follow up after the LHC, they didn't hear anything further. Although some participants were able to cut down or cease smoking on their own, there was disappointment in local services failing to provide support that had been promised. In one case, a

participant who did hear from the stop smoking service later found out they were ineligible due to their local service having strict eligibility criteria at the time.

"I would expect them to say what sort of help you can get – if there's a group you can attend; if there's a nurse who runs a clinic; if you could have patches or tablets, and if they're free on the NHS or there is payment involved. Some sort of encouragement really." [TLHC participant]

8.8.3 TLHC participants' smoking stopped or reduced

This secondary outcome examines whether ***participants successfully complete smoking cessation courses*** and whether their smoking behaviour is stopped or reduced.

Table 8.7 shows the proportion of respondents to the attendees' follow-up survey who smoked at the time of their LHC and report that they have reduced or stopped smoking in the approximately three months since their LHC. Overall, more than half (55%) of respondents either reduced or stopped smoking since their LHC, with most of these reducing their smoking (36%) and the rest (19%) stopping entirely. Of those who didn't reduce or stop smoking, most (41%) said their smoking behaviour was about the same, with only a few saying they smoked more.

Table 8.7: Number of respondents to the attendees' follow-up survey who smoked at the time of their LHC and have changed their smoking behaviour in the approximately 3 months since their LHC, by change in smoking behaviour

Change in smoking behaviour	No of respondents	Respondents	Proportion
Smoke much less now	65	431	15%
Smoke a bit less now	91	431	21%
Smoke about the same amount now	178	431	41%
Smoke a bit more now	6	431	*
Smoke much more now	1	431	*
I do not smoke at all now, but I did smoke around the time of my Lung Health Check	82	431	19%
I don't know whether the amount I smoke has changed since my Lung Health Check	11	431	3%
NET: Smokes less now	238	431	55%
NET: Smokes more now	7	431	*

Source: Attendees' follow-up survey Q13: Compared with when you had your Lung Health Check, would you say you… (Base = 431 respondents)

The qualitative evidence collected throughout the evaluation identifies the following themes demonstrating whether **participants are successful in completing smoking cessation courses:**

- From a limited sample of qualitative interviews with smoking cessation staff, there were mixed opinions about whether participants referred via TLHC were more or less likely to have quit smoking at four weeks compared to the rest of the cohort.
- From referral to four-week quit rate, the qualitatively reported figures ranged between 10-32%. These should be treated as indicative only. For reference, in 2019/20, 51% of people using NHS

Stop Smoking Services self-reported that they had quit at four weeks, but this was only confirmed by carbon monoxide validation among 32% of service users.[165]

"You don't have a comeback for people in the older age groups, to say, 'Well, in ten years…' because they'll say, 'I've been smoking for 30 years and I haven't had anything yet!'… People of that older age group are more set in their ways." [Smoking cessation staff]

- It was also suggested that efforts to support participants to stop smoking can be undermined by positive results from the TLHC CT scan, as this could undermine the motivation to quit.

"The results might come back that their lungs are healthy, so they might decide '…actually, I don't need to stop smoking because my lungs are fine and there's no danger'." [Smoking cessation staff]

- Consistent with the rest of the data, interviews with participants showed their responses to support and subsequent behaviour changes varied. Some participants felt encouraged to try stopping smoking as a result of the advice they received and had been successful in cutting down or ceasing smoking altogether since they attended the LHC. Others were content to receive advice about stopping smoking and were offered multiple options for support, but had no intention of making a change as they saw little value in doing so:

"I have been smoking for 60 years. I enjoy smoking, so at the moment I don't have any desire to give it up. I declined all their help, and there was a lot to choose from. After smoking for so many years, any damage wouldn't be reparable – it would be like shutting the stable door after the horse has bolted." [TLHC participant]

Figure 8.10 shows **changes in current smoker prevalence rate in adults aged 55-74** in the combined intervention areas of all Phase 1 and 2 projects that launched in 2019 and 2021 versus the combined non-intervention area, using **GPPS data 2018-2023**. This evidence is circumstantial and descriptive, rather than proving causality or being attributable to the TLHC programme. The methodology of this analysis can be found in the TLHC Impact Protocol (2023). It illustrates following key points:

- The TLHC intervention was delivered within areas with higher smoking prevalence. The average current smoker prevalence between 2018 and 2023 were 4.5 pp higher in the combined 2019 intervention area and 3.7pp higher in the combined 2021 intervention area compared to the non-intervention area.

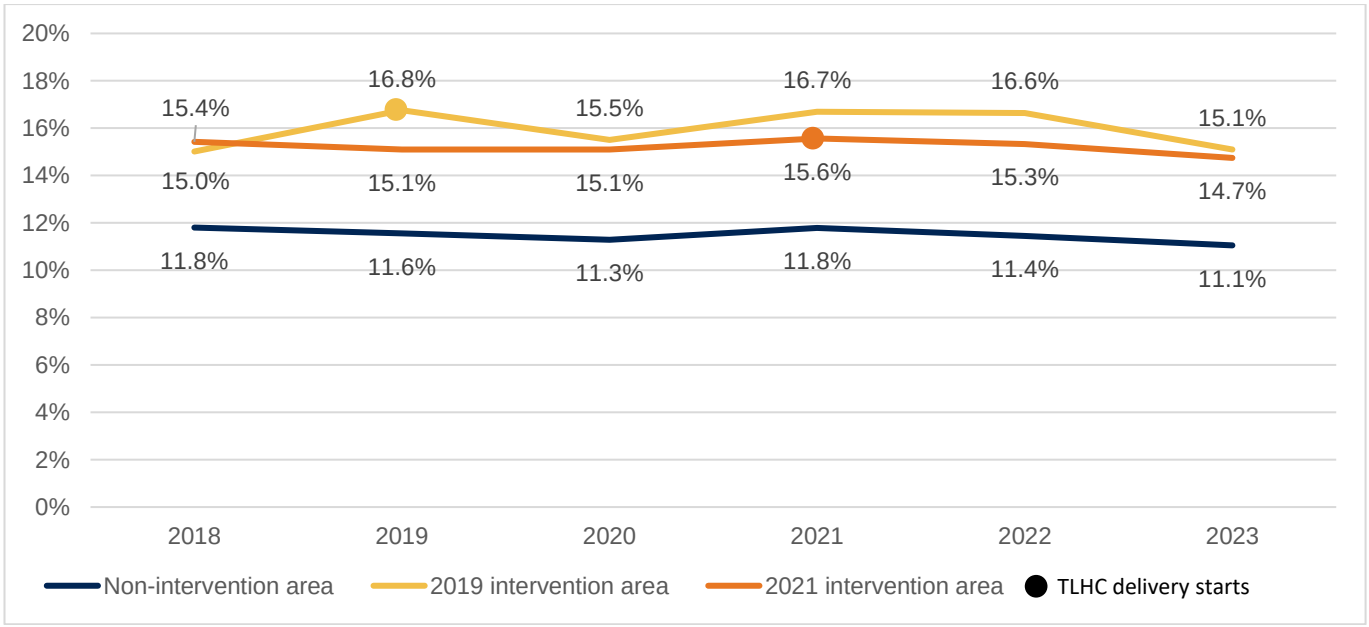
- While there has been an overall decrease in current smoker prevalence since intervention areas started delivering TLHC, year-on-year changes have varied. All areas experienced a notable increase between 2020 and 2021, which possibly suggests smoking rates were influenced by the COVID-19 pandemic and associated lockdowns.[166] Year-on-year changes appear the most changeable in the 2019 intervention area.

[165] NHS Digital. Statistics on NHS Stop Smoking Services in England. Available from https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-nhs-stop-smoking-services-in-england [Accessed: April2022]

[166] Looking at the whole adult cohort, during the pandemic the rate of current smoker prevalence slowed from a 5.2% a year decline between 2017-2020 to 0.3% a year between 2020 and 2022. Source: https://www.ucl.ac.uk/news/2023/dec/decline-smoking-england-has-stalled-pandemic

- Comparing changes in smoking prevalence in the intervention areas versus the non-intervention area shows varying trends, particularly depending on whether changes are measured from the year that the service began or from the pre-TLHC delivery baseline.
- Examining from when intervention areas started delivery shows:
  - A 1.7pp overall decrease between 2019 and 2023 in 2019 intervention areas, compared with a 0.5pp decrease in the non-intervention area.
  - A 0.9pp overall decrease between 2021-2023 in 2021 intervention areas compared to a 0.7pp decrease in the non-intervention area.
- Examining from the pre-TLHC delivery baseline shows:
  - A 0.4pp decrease in the 2021 intervention area (2020-2023) compared to a 0.2pp decrease in the non-intervention area;
  - A 0.1pp increase in the 2019 intervention area (2018-2023) compared to a 0.7pp decrease in the non-intervention area.

Figure 8.10: Current smoker prevalence in adults aged 55-74 in combined intervention areas vs non-intervention area (2018-2023)



Source: GPPS 2018-2023

8.9 How has the introduction of the TLHC programme impacted demand and activity for lung cancer services locally?

TLHC projects operated and interacted within their wider local system, including lung cancer diagnostic and treatment services. The evaluation framework set out that as the TLHC projects were funded and developed, their activities would contribute to:

1. Short to medium term growth in demand for lung cancer services.
2. Skills gaps and shortages, and pressures on providers' capacity, that, while challenged in the short term would, with time, reach balance.

This section assesses the evidence collected throughout the evaluation to examine whether these outcomes have been demonstrated. [167]

8.9.1 Overall assessment

- **Demand for lung (and other)[168] cancer services:** There is a perception, gathered from project stakeholders across the evaluation, that the introduction of the TLHC is associated with an increase in demand for lung cancer services. The MDS shows additional referrals generated through the programme. Examining the number of people starting lung cancer treatment via the 'urgent suspected cancer' (USC) route and performance against the 62-day standard for lung adds to this evidence. This analysis highlights that performance against the 62-day standard in lung cancer services in TLHC intervention areas declined at a greater rate than non-intervention areas between 2021 and 2023. This may be related to greater numbers of patients starting lung cancer treatment in these areas, particularly as the number of patients starting treatment via the USC route is not declining.

- **Skills gaps and shortages:** The most common training courses that LHC nurses, radiologists and administrative staff received were identified by self-reported project training data. Most skills gaps related to communicating with participants, rather than clinical skills. This suggests that staff may have already had attended clinical sessions and had their accreditation before being recruited. Qualitative evidence from stakeholders summarised that skills gaps and workforce shortages were reoccurring themes throughout the evaluation. Workforce shortages were particularly reported to be a challenge in radiology. While this did not prevent or pause delivery in any area, local skills gaps during set-up were seen to make recruitment more challenging.

- **Managing additional activity:** Qualitative evidence from project stakeholders suggests that local providers have generally been able to manage additional activity. Some 'pinch points' have been created by TLHC, but this has generally been manageable. New activity generated by TLHC has been predominantly early-stage treatments (such as surgeries), meaning the types of treatment that providers have been delivering has changed.

8.9.2 Short- to medium-term growth in demand for lung cancer services

[167] The evaluation framework also cited 'fewer emergency diagnoses (via A&E)' as a secondary outcome, with the 'proportion of lung cancer patients who first presented as an emergency via A&E' as the key indicator. Due to the relatively low number of patients entering via this route and the suppression of values <10 in the data, it has not been possible to present this analysis.
[168] Please see Section 8.8 on incidental findings, including other cancers diagnosed.

Changes in lung cancer treatment rates and performance

This subsection analyses Cancer Waiting Times (CWT) data to understand whether TLHC led to any detectable changes to lung cancer treatment rates and the performance standards as a result of the increase in lung cancers being detected via the programme. CWT is a national dataset that tracks patient care activity from referral, diagnosis and treatment, and is used to monitor cancer waiting times performance targets at the national, provider and commissioner level.[169]

Within CWT, suspected lung cancers detected via the TLHC programme are recorded using the 'referral from a National Screening Programme' route since April 2024.[170] Before this, the Standard Protocol advised projects to record these patients under the 'consultant upgrade' route[171]. The analysis below focuses on the 'urgent suspected cancer' (USC) referral cohort only, broadly reflecting suspected cancers detected via GPs.

Figure 8.11 shows the number of patients who started lung cancer treatment via USC between April 2018 and March 2024 in TLHC intervention areas and non-intervention areas. Similarly, Figure 8.12 below this shows the 62-day performance standard for lung cancer services[172] in TLHC intervention areas and non-intervention areas for patients starting treatment via the USC route[173].

The key findings from the analysis are:

- The data highlights two key changes in trends in the number of people starting lung cancer treatment since 2018:
    - Between Q1 and Q4 2020, there was a notable drop in the number of people starting treatment in all areas, likely as a result of the COVID-19 pandemic and associated lockdowns.
    - Between Q2 2022 and Q3 2023, there was a large increase in the number of people starting lung treatment, particularly between Q2 and Q4 2022, before steady declines in rates back to levels similar to before this period, across all areas. While the data does not explain this sudden increase, it may again be linked to the COVID-19 pandemic and people not accessing healthcare while the pandemic and associated restrictions were in place, leading to a sudden increase afterwards.
- Looking at the number of people starting lung cancer treatment from the USC route in the intervention areas vs non-intervention areas, the data shows limited divergence in trends between 2018 and 2024. The only divergence is between Q3 and Q4 2022, where the number of

[169] NHS England. Cancer Waiting Times. https://www.england.nhs.uk/statistics/statistical-work-areas/cancer-waiting-times/. Accessed: July 2024.
[170] NHS England (March 2024). Annex: National cancer waiting times: coding targeted lung health checks referrals. Available from: https://www.england.nhs.uk/long-read/annex-national-cancer-waiting-times-coding-targeted-lung-health-checks-referrals/#1-source-of-referral-for-targeted-lung-health-checks-participants
[171] NHS England (November 2022). Targeted screening for lung cancer with low radiation dose computed tomography. Standard protocol prepared for the Target Lung Health Checks Programme. Available from: https://www.england.nhs.uk/wp-content/uploads/2019/02/B1646-standard-protocol-targeted-lung-health-checks-programme-v2.pdf
[172] The 62-day standard is a NHS cancer waiting time target that states that 85% of patients should begin cancer treatment within 62 days of an urgent referral. The start point of this measure is the date of the urgent referral and the end point is the start of treatment.
[173] Due to the way CWT provider data was collated, USC route lung cancers are the only route included within this data, meaning consultant upgrade and other routes are not included within this analysis.

patients starting treatment in the intervention areas slightly increased while it slightly decreased in the non-intervention area, before returning to similar trends in the following quarters.

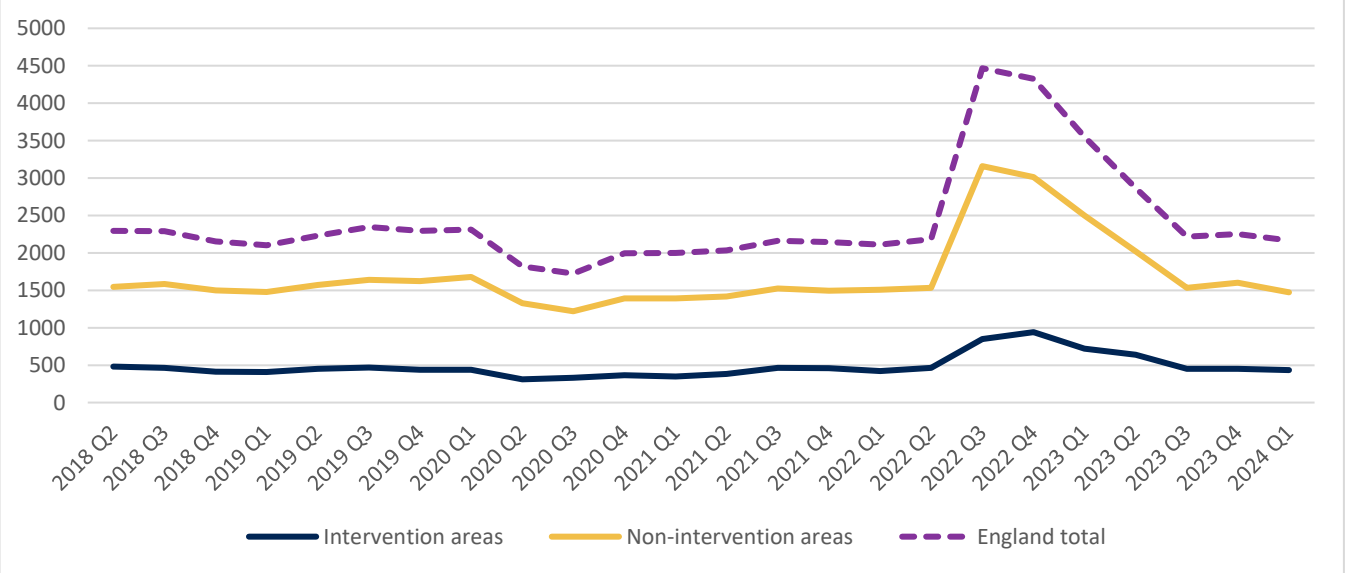
- These findings are not as anticipated, as the number of patients starting treatment via the USC referral was hypothesised to reduce in the intervention area. This is because it was expected that a greater proportion of lung cancers are detected via TLHC and at an earlier stage therefore resulting in fewer patients presenting to their GP for a USC referral.

- Looking at the 62-day performance standard for patients starting lung cancer treatment, the intervention area has consistently had a lower proportion of patients who were diagnosed within 62-days (meeting the standard) than the non-intervention area, except in Q1 2019, however all areas have been consistently below the 85% target.

- Examining performance rates more closely, similar rates between the intervention and non-intervention area are observed until Q2 2021, with the intervention area and non-intervention area averaging within 2pp of one another. However, from Q2 2021 the intervention areas performance declines at a greater rate and stays notably lower than the non-intervention (averaging 7pp lower) until Q3 2023, before returning to similar trends.

- The changing of performance standards supports the hypothesis that the programme increased demand on lung cancer services as a result of more patients starting treatment having been detected via TLHC, in addition to a consistent number of patients starting treatment via USC, resulting in more patients falling outside of the standard.

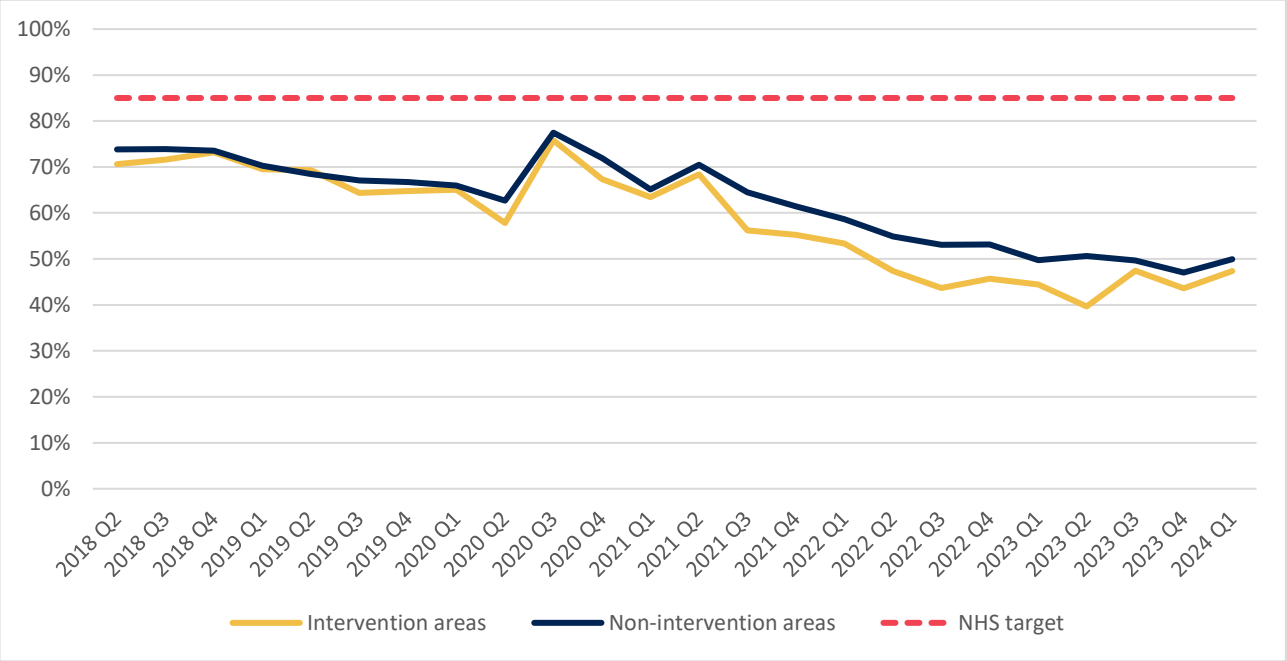
Figure 8.11: Number of patients starting lung cancer treatment via the urgent suspected cancer referral route (2018-2024), by quarter[174]



Source: Cancer Waiting Times

[174] Phase 3+ TLHC projects are separately analysed from the intervention and non-intervention areas and are included in the England total.

Figure 8.12: Proportion of lung cancer patients within the 62-day performance standard (2018-2024), by quarter



Source: Cancer Waiting Times

Referrals to other services from the TLHC pathway

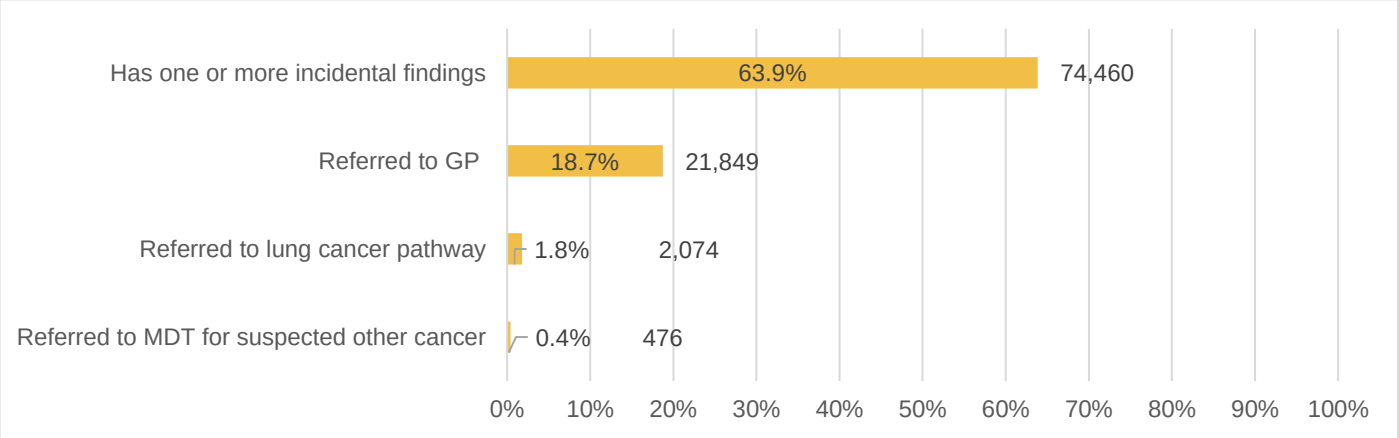
This indicator aims to understand the volume of additional onward referrals generated via the programme to be followed up, potentially leading to further demand on services.

Figure 8.13 shows the proportion of participants referred onward following their initial CT scan[175], using the MDS. This analysis should be considered indicative only, due to some concerns about data completeness for these metrics, meaning some figures may be lower than anticipated. It does however highlight the following key findings:

- Following the initial CT scan, nearly one in five (18.7%) participants were referred to their GP. A very small proportion (0.4%, or 476 participants) were referred to multi-disciplinary meetings (MDT) for a suspected other (non-lung) cancer.
- A very small proportion of initial CT scan attendees (1.8%, 2,076) were subsequently referred to a lung cancer pathway due to a suspected cancer.

[175] There were plans to present referrals to GP and secondary care following a LHC, as outlined in the impact protocol, though data completeness concerns means this analysis has not been presented.

Figure 8.13: Proportion of initial CT scan attendees a) with incidental findings to be followed up, b) referred to GP, c) referred to MDT and d) referred to lung cancer pathway



Source: MDS (Base = 116,614 respondents)

8.9.3 Skills gaps and shortages are filled

Number of training courses completed by TLHC staff

The programme stipulates that some TLHC staff are required to complete mandatory training to deliver the programme, as per the Standard Protocol[176].

As staff training data is not centrally held, Phase 1 and 2 projects were asked to provide aggregate data on the number of training courses completed by LHC nurses, radiologists and administrative staff per financial year between 2018-19 and 2023-24. This data should be considered indicative because not all projects submitted this data[177] and TLHC staff employed and trained by third-party companies as part of outsourced services[178] are not included.

Some of the key messages from the data are:

- ***LHC nurses***: 'Communicating with High-Risk Individuals' and 'Consent training' were the courses most commonly undertaken, with 239 and 238 nurses receiving this training respectively. This is followed by 'Ionising radiation (medical exposure) regulations for referrers'; 221 nurses undertook this training. Relatively fewer nurses undertook the 'Association of Respiratory Technology and Physiology' training, with 34 nurses in total reported.
- ***Radiologists****:* The 'British Society of Thoracic Imaging (BSTI) Lung Nodule Workshop' course was undertaken by 270 radiologists. Similarly, the PERFECTS EQA Scheme was undertaken by 251 radiologists.
- ***Administrative staff***: Similar to LHC nurses, 63 administrative staff undertook the 'Communicating with High Risk Individuals' training course.

[176] The training courses in the Standard Protocol include: 'High Risk Individual Training'; BSTI training; ARPT training; and IRMER registered.
[177] This data was collected from projects in a one-off data request in June 2024. Projects which submitted data were: Bradford; Coventry; Doncaster; Halton; Hull; Liverpool; Knowsley; Luton; Mansfield & Ashfield; Salford; Thurrock.
[178] Number of projects outsourcing their: Administration = 7/23; LHCs = 7/23; radiology reporting = 13/23.

In addition to the courses listed above, projects were given the option to report any other training their staff had received. For LHC nurses, commonly reported training included VBA training for smoking cessation, clinical and/or patient-management training (i.e., 'Good Clinical Practice' course) and leadership and/or administrative training (i.e., SystmOne training). For administrative staff, most additionally reported training courses related to patient management (i.e., 'Conflict & Resolution') and administrative training (i.e., SystmOne training). No additional training courses for radiologists were reported.

Perception of changes in skills gaps and shortages

Skills gaps and workforce shortages has been a reoccurring theme in fieldwork throughout the evaluation, although this does not appear to have prevented or slowed delivery. Some key themes are:

- During project setup and delivery, local skills gaps and workforce shortages were identified as a common barrier experienced by projects to establishing and maintaining their service. As discussed in Chapter 5, alongside the general challenges with recruitment timeframes, clinical workforce challenges were perceived to be stronger in some geographic areas, such as those without a teaching hospital or further away from a metropolitan city.

- Workforce shortages were seen to be most acute for radiology, with project stakeholders identifying this as one of the biggest challenges to the sustainability of the service. It was suggested that too few new radiologists are being trained nationally and that the timeframes to train mean that existing national radiology capacity challenges were unlikely to be resolved quickly.

- Shortages of LHC nurses were commonly identified throughout the evaluation. Key contributing factors for this were the lower appeal for fixed-term contracts and the repetitive nature of the LHC nurse role, meaning fewer potential applicants may apply.

  "It's definitely been the nurses that have been more reticent to join us or apply for the jobs in the first place because it's a [fixed term] contract." [Project Lead].

- A national shortage of radiographers was also reoccurring theme, with project stakeholders suggesting that some radiographers were moving to the private sector due to higher pay and longer-term contracts.

8.10 Are local providers able to respond to, and manage, this additional activity?

Qualitative evidence collected from project stakeholders suggests that local providers were able to respond to, and manage, additional activity generated by the TLHC programme.

According to projects, the programme led to a short-term spike in demand for lung cancer services, though demand normalised over time. It took time for services' infrastructure and workforce to be sufficiently developed to manage the required demand, thereby creating 'pinch points' and backlogs in some areas. The COVID-19 pandemic and associated drop in wider system activity was seen as a contributing factor to challenges faced by services.

> **"From the first year we started, the first six months of the year, I think we saw 340 patients. The second six months of the years, we saw 650. And that felt like, 'Oh my God, what have we done?' However, it does seem to have evened out a bit. This is on a background of an ever increasing demand for lung cancer and lung cancer treatment. So, even taking out the lung health check, our demand was going up."** [Trust Lung Cancer Lead]

Projects highlighted the importance of engaging with lung cancer services to help them manage additional activity. This included providing reassurances and progress updates on the activity coming from the programme but also supporting specialist diagnostic services to secure the necessary funding to manage additional activity, such as signposting them to the relevant specialist commissioners. Similarly, national and local modelling data was seen as a key data source to help overcome both concerns and prepare for increases.

> **"I think one of the main areas was lung guided biopsy and the impact on the diagnostic service… So, they did see an increase in the number of referrals coming their way... So, we did hear some noise about that. But then… we've engaged with them and directed them to [specialised commissioning], just to make sure that they get the right relevant funding if it's required from there, or through the right care contracts."** [Project Lead]

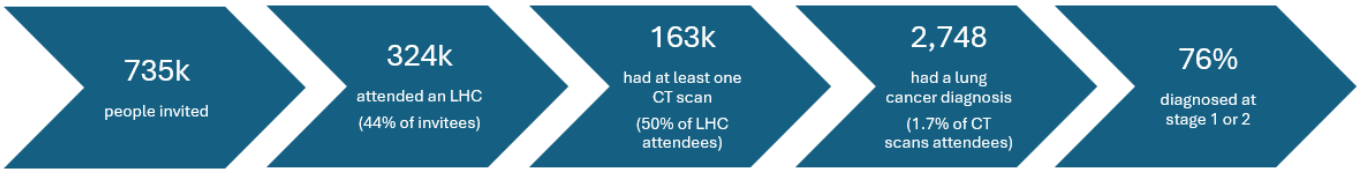
The programme's contribution to earlier detection meant that activity and treatment flows have been different through the TLHC programme compared to 'business as usual'. Services are performing a greater number of earlier stage treatments and surgeries and fewer later stage treatments, such as removing nodules rather than large resections of lungs. This is because TLHC participants are generally fitter, with an earlier stage lung cancer, than patients from other referral routes. Some services were sending business cases forward to increase relevant staff numbers, due to the increase in surgeries taking place.

> **"We're curing a lot more cancer than we ever did before, and I'm still excited about that. I am excited that the patients that come from the targeted lung health check are fitter, they have earlier stage disease, I can offer them treatment… So, it has changed me from a palliative care physician into a, 'we're going to do a scan and get you to a surgeon,' physician, which is just unbelievable."** [Trust Lung Cancer Lead]

9 Conclusions

9.1 This report in short summary

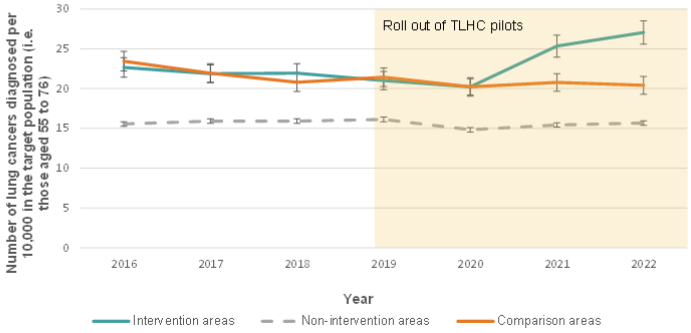
The TLHC programme (2019-2024) was established to test lung health checks in real-world settings to diagnose lung cancers earlier. It followed promising results from several small-scale trials and pilots. Pilot areas were selected based on lung cancer mortality rates. The pilot stage of the programme was delivered across three phases comprising more than 25 sites. It set out to achieve a range of outcomes. Most prominently, the programme sought to replicate the early diagnostic staging results seen at small scale in these larger scale, real world projects.



Phase 1 and 2 projects issued 1.22 million invites to 735,000 people. The uptake rate of Lung Health Checks (LHC) was 44%, which meant 324,000 people attended a LHC. This was higher than observed in the Manchester pilot study (a key benchmark), although there remain opportunities to increase this. Following this, 163,000 people had at least one CT scan (50% of LHC attendees). There are significant levels of attrition at each stage of this pathway, associated with demographic factors, and variants in the model. Most notably, despite the projects reporting a range of outreach activity, and inviting these groups at a disproportionately high rate, uptake of LHCs by people living in areas of high deprivation, and from other ethnic demographic groups, was lower than average.

A total of 2,748 people had a lung cancer diagnosis (a conversion rate of 1.7%) through the programme. Around three-quarters of these cancers were diagnosed at stage 1 and 2, which aligns with an important policy benchmark set out in the NHS LTP.

Trend in the number of lung cancers per 10,000 people for those aged 55-76 within the intervention and non-intervention areas between 2016 and 2022



Projects identified incidental findings (such as coronary calcification) in three-quarters of those who had a CT scan. In addition to this, in a smaller cohort of sites submitting patient level data (14 projects, accounting for 71% of first invites sent), 1,697 other cancers were diagnosed among 1,673 TLHC participants who received a LHC and were deemed high risk. Over one-quarter (28%) of these cancers were diagnosed within three months of participants' last interaction with the programme.

A robust quantitative impact analysis, comparing the diagnostic outcomes of pilot areas to those of carefully designed counterfactual areas, was conducted. This shows that the TLHC programme was effective in meeting its objectives relating to additional lung cancer diagnoses (as show by the divergence of the green and orange trend lines in the chart); and the number and share of lung cancers diagnosed at an earlier stage. It is estimated that an *additional* 781 lung cancers were diagnosed at stage 1 or 2 in pilot areas between 2019 and 2022. These are the cancers that would not have otherwise

been diagnosed until a later date or not diagnosed at all in the absence of the programme. The number of additional lung cancers diagnosed begins to fall three years following the introduction of the pilot.

The results of the impact analysis on staging are in line with expectations. The conversion rate (1.7% of those scanned) is within the range established by previous studies. The staging results as evidenced through the robust impact analysis also broadly replicate the results shown in smaller scale pilots – a key aim of the programme. The absence of an effect on mortality is consistent with clinical interpretation at this stage of the programme.

However, there are several areas for further study and development as the programme rolls out more widely. Improvements in earlier diagnostic staging were predominantly concentrated on individuals identifying as white British. Uptake in deprived areas and among ethnic minorities was lower than average, missing high-risk individuals, although the programme as a whole was delivered in some the most deprived areas of England and those from the most deprived areas have therefore benefited disproportionately. A detailed examination of the real-world costs of delivering the LHCs and scans found the LHCs generated high costs largely driven by the significant labour requirements. This was supported by testimony gathered from projects across the evaluation. LHC projects are challenging to set up and projects spent resource on engaging primary care, data sharing, clinical oversight and community engagement.

As well as demographic factors, variants of the model affected uptake too. Most significantly, while opt-out models for LHC invitation help in driving LHC uptake, they do not appear to result in the highest-risk attendees or the highest rates of lung cancer detection.

9.2 Discussion of key results

9.2.1 The influence of wider context on interpreting programme performance

To contextualise the discussion of overall performance, it is first necessary to consider the purpose of the TLHC programme, how that has changed over the course of the programme, and where it sits in the wider story of evidence and policy development in this field. There are three aspects to consider.

The developing understanding of the knowledge base on targeted lung health checks. The programme arrived at an exciting time for research in this field. A compelling case was emerging, gathered from a range of countries and health systems, that targeted lung screening of at-risk individuals was causally linked to improved diagnostic staging outcomes, and reductions in mortality from lung cancer. The findings from these varied studies provided the impetus for a group of clinical experts to develop the protocol and plan for a much larger rollout, which was the next natural step in the development of this intervention.

The encouraging early evidence base meant that the role of the TLHC programme, as it was designed in 2019, was therefore to confirm that consistent, directionally similar results could be shown when the intervention was tested at a much larger scale, and in a wide variety of settings. Most prominently, it has been noted that the cancer staging results should be confirmed (given the clinical confidence that, in time, these will lead to reductions in mortality).

Service context, and the impact of the pandemic. Over a programme of this length, being delivered in a busy public service, evolution is to be expected. The pandemic amplified this, and as with all health and care services from 2020 onwards, it influenced uptake and the design of the service, removing steps such as spirometry.

This aspect of the context means any evaluative assessment should be made in context, and with a thorough description of how the programme has interacted with wider events, service changes, and societal shifts. It makes assessing the impact of the programme on the wider service particularly challenging.

A fast-moving policy environment. The TLHC programme itself was designed, and launched, in relatively short order in 2019, driven in part by the LTP's ambitions for improved performance on earlier cancer diagnosis. The rapid scoping and design phase also meant that the standard approaches to making the case for a large public investment (such as business case development) were conducted within the analysis and case-making for the overall LTP investment. The programme's purpose has also been shaped by the NSC, and its decision to support wider rollout partway through the pilot. This significant decision meant the purpose of the TLHC programme was even further focused on learning for rollout.

This aspect of the context means any evaluative assessment should look for benchmarks to measure performance in places beyond traditional sources of programme governance. This means that the evaluation has drawn on a wider range of comparators, benchmarks and objectives to make an assessment. The overall assessment of the programme, and the design of the study to make this assessment, also includes whether it is generating learning that future TLHC sites can benefit from.

These considerations were built into the evolving theory of change for the programme and re-emphasised through senior stakeholder discussions as part of the interpretation of results. This discussion shapes the next question for consideration here; what is a fair benchmark against which to assess the performance of the TLHC programme.

9.2.2 Interpretation of programme results

The discussion above sets the scene for an assessment of the results of the programme.

Cancer stage at diagnosis. The cancer conversion rate of 1.7% is lower than the Manchester pilot study which is most commonly used as the benchmark for the TLHC programme. This may cause pause for thought, since it has been considered a key comparator, and influenced the design of the protocol for this programme. However, it should also be noted that each trial / pilot has a range of subtle differences to delivery model, the success of the rollout, and the underlying health of the population. This means comparing against a group of other pilots / trials provides a fairer assessment. Given the TLHC programme was based on learning from each of its predecessor initiatives, using a broader comparison group is logical. Based on this, the performance of the TLHC programme on cancer conversion rate is more encouraging. It shows that – in broad terms – the results from smaller stage trials/ pilots can be replicated at a larger scale, and in a busy service.

If this metric is to remain central, and performance against it measured during rollout, the programme will have to make advances on targeting, successful invitation, and scan conversion to maintain performance, as it moves to areas where there are likely to be lower rates of underlying ill-health.

Mortality. The improvements in cancer staging did not lead to improved lung cancer mortality in the timescales of the study. This is in line with clinical expectations. There is also emphasis placed on the staging results are considered by clinical experts to have a strong causal link to improvements in mortality being exhibited over a longer time period.

Wider benefits. Beyond the primary programme outcomes, there are an array of other benefits to consider. The ability of the evaluation to fully assess these benefits is hampered by limitations in the data collected. However, there are some key messages to consider. A large number of other cancers are likely to be associated with programme activities (that is, those people who attended LHCs going on to have a cancer diagnosis in a site other than lung). With over one-quarter (28%) of the 1,697 other cancers diagnosed within three months of the participant's last TLHC involvement, it is reasonable to suggest they are more likely to have been diagnosed due to the detection / referral by the programme, or through participants' adoption of more positive health behaviours (potentially prompted by the programme). This should be considered an encouraging additional legacy of the programme, and one to build on as it rolls out.

This finding contributes to the wider narrative of this programme taking a high-profile NHS initiative into areas of high deprivation, and high morbidity. The large quantity of incidental findings – found in three-quarters of CT scan attendees – which were identified are considered by clinicians to offer benefit for individuals' health, and long-term health service savings. It is a strong signal that the programme, with its high-profile NHS facilities can reach parts of the population with relatively high levels of morbidity and is a potential platform for further interventions for a group with high health risks.

Service pressures. Demand for treatment services has been shown to increase as the programme rolls out. There are additional referrals in programme areas (as expected) and a comparatively poorer performance on the 62-day standard specifically for lung cancer in programme areas compared to elsewhere. However, initial worries from projects and the national programme team that the LHCs may generate significant short-term demand for specialist treatment services, which destabilises carefully balanced health and care systems, have not been widely evident. There are many potential explanations for this, including projects' careful management of local demand through their staged rollout, and delays to the programme caused by the pandemic.

Variation in delivery model and uptake. Part of the purpose of the programme was to learn for wider rollout. In this context, a set of projects which have adopted the protocol in varied ways to suit their local requirements, or to address perceived local / pathway challenges, is to be welcomed. The evaluation has documented this variation across five years, and notes that most projects have pursued different models at different times. This makes teasing out the features of the protocol which seem to work challenging, however there are some patterns evident. This includes opt-out invitation models resulting in the highest LHC uptake and Community-based CT scanners resulting in fewer participants who are eligible for a CT scan not attending their scan. It is also notable that CT scan conversion rates have improved across the programme. This implies many projects have adapted their approaches as time has passed, and offers a bank of learning for future sites to benefit from.

Variation in primary outcomes. The programme's achievement of taking an effective intervention into some of the most deprived communities in the country is notable. Moreover, the evaluation has shown that the programme has sought to over-invite people for whom there are known barriers to their engagement in such initiatives (shown by projects sending disproportionately high invites to people from more deprived areas and in ethnic minorities). However, one of the evaluations key findings, strongly evidenced through the robust impact evaluation design, is that the improvements in diagnostic staging were limited to those identifying as White British.

This issue should be further explored with additional analysis/ research. For example, the finding is limited by the ability of this analysis to look at the other ethnic group (a highly diverse and varied group)

in more detail by the sample sizes. The analysis does not consider the crucial potential influence of intersectional demographic characteristics on outcomes.

There is much to learn from within the programme for future planning and policy. First, the uptake data suggests there are barriers for individuals from ethnic groups other than White British, eligible for LHCs, to engage with the programme and attend their LHC. Second, there is widespread testimony about a range of outreach activities designed to address this. This suggests that projects have recognised the challenge and the need to be proactive in addressing it. However, the evaluation has not been able to evidence widespread success. There are few examples of robustly evaluated outreach activities meaning evidence on how to address this is limited.

9.3 Programme legacy and scaling

Having surveyed, and discussed the key results from the evaluation, this concluding section will take these high level findings of the evaluation (how much TLHC delivery costs, how equally the intervention can be delivered, what are the most amenable contexts, how best to implement the intervention, and what impacts it has outside of the clinical trial context) and applies them to the future policy challenge of rollout. Within this context, there are three areas of questions:

- How to **design and lead the expansion**, including the design of the protocol, and the underpinning theory for how TLHC should be spread to new areas.
- What are the **infrastructural pre-requisites** which will hamper rollout if unresolved.
- How to communicate to the public and the health and care sector about the programme.

Each of these three areas of strategic concern is considered in turn, with evaluation learning presented alongside key considerations for future delivery and scaling.

The subsequent sections explore:

- The considerations for existing Phase 1 and Phase 2 projects, as these early adopter sites move into “business as usual” (BAU) service delivery;
- Future areas of research and evaluation.

9.4 Considerations for national policy and programme decision makers

9.4.1 Design and leadership of expansion

Pace of rollout

Key findings for rollout:

- The rapid pace of programme expansion, coupled with the anticipated changes to existing services that will be required to enable the transition to a national screening service, have been challenging for some project teams (working in the potentially more amenable circumstances of the pilot) to meet.
- Concerns, drawn from across the evaluation, include:
    - The risk that local setup in new areas will become rushed due to pressure to rapidly ensure the high levels of throughput required to access funding.

- Potentially increased likelihood of end-to-end service outsourcing, even where this might not be most appropriate, due to pressure to setup quickly. It is perceived that an in-house delivery model is typically more challenging and time consuming.

- A reduced focus on the most vulnerable or deprived populations, due to pressure to quickly achieve high LHC uptake rates.

- The risk of rolling out service delivery at a pace that secondary care (such as cardiothoracic teams) cannot maintain, thereby causing diagnostic and treatment backlogs in the system.

"That time spent setting the service up actually also gave us lots of opportunities to manage our stakeholders, get patient engagement, that kind of thing, and we don't have necessarily that same level of opportunity to do that because the pace at which the national team wants us to move now doesn't really allow for that." [Project Lead]

Considerations for those charged with leading rollout:

- The pace of programme expansion should continue to be closely considered alongside system capacity, particularly the capacity of secondary and tertiary care centres.
- The process for setting-up new services should be closely monitored to ensure the pace of roll-out does not impinge upon delivery of thorough local stakeholder and community engagement activities.
- The regional/ national capacity of third-party providers to deliver end-to-end services at significant scale (and their effects on supply of staff and infrastructure to the NHS) should be reviewed, to help prevent over-commitment with the associated risks of under-delivery.
- The programme should consider the relative benefits and drawbacks of increased programme outsourcing, particularly considering the potential risk to longer-term investment in NHS-owned capital, infrastructure, and staffing.

"We have to model backwards because, you know, we'd be shooting ourselves in the foot, wouldn't we, if you crashed secondary care while flooding them with patients. So, it's really difficult to… move at the pace the national team want us to move at." [Project Lead]

Design and stringency of protocol

Key findings for rollout:

- Thus far, there has been a relatively high degree of variation across projects in terms of how they coordinated and managed local delivery. Areas of variation include:

    - The level at which engagement with primary care has taken place (PCNs or practice-by-practice).

    - The lead provider for the service (tertiary, secondary, or primary care).

- Decision-making around which geographical areas will be covered by each new TLHC service, which has implications for which populations become eligible for the service at different times.
- Decisions around which delivery model to implement, including aforementioned variations such as opt-in or opt-out invite models, and community or acute CT scanning.
- Decisions about managing local roll-out.

- It is noted that these issues are less pressing following the early rollout phase of the programme.

Considerations for those charged with leading rollout:

- Leaders at the local level welcome clear and punctual communications from the central team about the likely parameters and features of a national screening service Standard Protocol, to enable a smoother transition of existing services to new ways of working and to give greater certainty for those looking to commission or expand new services.
- Perspectives vary widely in terms of the optimal way of delivering the programme; the national screening service will need to decide where variation can be allowed, versus where consistency must be prioritised.

"If you're going to have a national screening programme, you really need to be setting some, you know, ground rules as to how these will work, otherwise you'll never get that consistency." [Clinical Director]

Procurement and pooling of resources

Key findings for rollout:

- Procurement of service providers has predominantly been managed at the local level for Phase 1 and 2 projects. Some stakeholders felt this has created inefficiencies by undermining the potential purchasing power of the NHS. It has also created "blind spots" for the NHS organisations commissioning these providers, in terms of the capacity of third-party providers to deliver against their contractual obligations.

"I think we need to start looking at a bit of shared resource there. Even for basic things like the project management and the procurement... Like at the moment we've got no data analysts, we've got no project manager." [Project Lead]

- Several projects have expressed concern that the replication of predominantly outsourced models may not be possible everywhere if private companies reach their capacity to manage further contracts.

"While the outsourcing clearly are doing a great job, they also are not going to be able to fulfil… the commitment of the contract… we knew how many other contracts as an organisation they are signing everywhere else." [Cancer Alliance Lead]

Considerations for those charged with leading rollout:

- There will be a longer-term centralised role required to provide ongoing support to Cancer Alliances in managing procurement. Whilst contracting with third party providers will continue to be led by provider organisations, there needs to be national involvement in conversations with key suppliers, to help avoid a 'cliff-edge' in supply.
- One approach could be establishing collaborative procurement approaches for outsourcing key elements of the pathway such as scanning and reporting, to help deliver economies of scale.
- National analysis which provides anticipated throughputs in each year to 2027/28 and the level of outsourcing required to meet those numbers would be welcomed by local actors.
- As the programme transitions into a national screening service, local stakeholders would value more information about the plans for centralising functions such as project management and data analysis. It is acknowledged that this centralisation may not be possible.
- Projects suggested that eligible participant lists should be extracted at a national level, rather than on a practice-by-practice basis, once the programme becomes a national screening service. This would ensure better alignment with other screening programmes, reduce the burden on GPs, and ensure greater consistency and efficiency.

"I think that feed of data from primary care needs to be automated as well, before it becomes a national screening programme." [Cancer Alliance Lead]

Modelling for optimal delivery

Key findings for rollout:

- The demographic character of the population affects eligibility and uptake. This evaluation has identified how uptake varies, which should influence modelling and planning in new areas.
- Based on evidence, including from this evaluation, it is logical to assume that:
  - The eligible population, as a proportion of the total population of new areas, is likely to decline over time (as the programme expands to less deprived areas, or older participants – with higher smoking rates age out of programme eligibility).
  - Uptake of the offer, amongst eligible individuals, may increase over time, as the programme rolls out to less deprived areas that have shown higher uptake.
  - CT scan eligibility is likely to decrease over time, due to lower proportions of current smokers within those who live in less deprived areas.

Considerations for those charged with leading rollout:

- More bespoke estimates should be used in planning for replicating the service in other parts of the country, rather than the standard assumptions of 50% LHC uptake and 54% CT scan conversion, used for Phases 1 and 2 (based on the Manchester Lung Health Check pilot). These estimates can build on data collected and reported through this evaluation.

- Areas in Phases 1 and 2 were predominately selected based on lung cancer incidence, meaning their eligible populations are generally more deprived than the rest of the country. This should also influence future uptake and scan conversion estimates.

"When we first embarked on doing our development of plans, the national programme team used some form of data to say, '50% would uptake into the programme and 56% [sic] were compared to the scan.' I think that work needs remodelling again and I think we need to know what we know so far to try and help, what does that look like moving forward for the future?" [Project Lead]

- Alongside demand modelling, it will be important for Cancer Alliances to decide how the TLHC intervention model should be tailored within their locality. For example, CT scan uptake to date has been lower than expected. This may suggest that the more deprived areas currently within programme delivery may require more intensive implementation models (e.g. "one-stop-shop") whereas less intensive models (e.g. virtual LHCs) may work better in the longer-term, as the programme rolls out to less deprived areas. Consideration will include, for example, what proportion of resources should be reserved for community engagement.

Demand management

Key findings for rollout:

- Project stakeholders expressed concerns about workforce capacity for managing the downstream activity triggered by the programme.
    - Respiratory teams were significantly impacted by the pandemic and have since faced considerable staff turnover, for example early staff retirement. Diagnostics is also a significant area of concern. There is a finite resource of professionals who can deliver specialist diagnostics procedures, particularly interventional radiology and endobronchial ultrasound (EBUS). Even before wider expansion, some project stakeholders commented that participants were facing long waits for diagnostics.
    - Other areas of concern include thoracic surgery and pathology.
- Broadly speaking, projects appear to have kept pace with demand created through the programme, but there is concern amongst project stakeholders that rapid expansion will create significant pressure, particularly on the limited tertiary services available.

"I don't think there is enough slack in the system to absorb a huge amount of extra activity that might be generated through the LHCs programme" [Cancer Alliance stakeholder]

"If you look at downstream effects, radiology and pathology is difficult. Surgery less difficult but I think that's only so because we're ahead of the game in our planning, and so, we have not struggled to recruit surgeons, but if every single Cancer Alliance was wanting 3 surgeons, they aren't in the system." [Clinical Director]

Considerations for those charged with leading rollout:

- NHSE should seek to f Cancer Alliance and project stakeholders' concerns about how enough specialists will be trained and made available to the NHS within the available timeframes of programme expansion. NHSE should recognise that outsourcing –for example for radiology – is not perceived as a "fix-all" given capacity limits; some stakeholders also expressed concern that outsourcing degrades NHS in-house provision and capabilities.

"The biggest priority is the highly specialised aspects of it. So, radiologists, thoracic surgeons, theatres… respiratory consultations… it just takes such a long [time] training a radiologist, for example… obviously there are private providers for outsourcing CT scan reporting. They're very successful and they have huge amounts of radiologists who are contributing to that. But, there is a real risk that that's to the detriment of the NHS provision." [Clinical Director]

- There is also a need for greater standardisation of incidental findings management as the programme transitions to a national screening service, particularly given the complexity of lung cancer screening and the wide range of possible conditions that can be detected.

"When you're scanning pretty much 10-12 different organs, how are you going to deal with the findings from all of that? There are so many other pathologies, you know, so all of that needs to be standardised. Whereas, you walk into any GP practice anywhere in England saying, "Okay, I'm having cervical screening done", they will do exactly the same thing, you know, it won't be different." [Clinical Director]

9.4.2 Underpinning infrastructure

CT scanning capacity

Key findings for rollout:

- The TLHC Standard Protocol necessitates interval scanning where relevant (in the case of indeterminant results) as well as 24-monthly screening rounds for as long as the individual remains eligible for the programme. This cadence presents challenges for projects in managing CT scanning capacity, particularly where CT scanning is being implemented in community settings. Individuals will require follow-up scans at different time points. It is logistically challenging, or even impossible, to ensure the CT scanning vehicle can be in close proximity to all those who need to attend at a given time. Some stakeholders noted that this creates barriers to attendance.

"I think that often the logistics play a part in deciding how you expand because of these repeat cycles of scanning… So obviously if our van's, kind of, 40, 50 miles away, that's going to make it challenge-.... I mean, that will I think continue to be a bit of a challenge as we expand further and those geographical areas are further apart... we've only got one scanner, then it's difficult if it needs to be in 2 places at once." [Project Lead]

Considerations for those charged with leading rollout:

- Community Diagnostics Centres (CDCs) could provide useful additional capacity for local areas in meeting the scanning demands of the TLHC programme. Stakeholders felt these were likely to be suitable venues as they are/will be designed as accessible venues in easy-to-reach community settings. For example, CDCs could be used for interval scanning in instances when the main mobile unit is due to be far away from the eligible individual.

- However, there are some concerns that CDCs may not be able to accommodate delivering the programme in the way that has been envisioned. CDCs will be providing diagnostics support for many different services and therefore any TLHC activity will need to be scheduled alongside other commitments. Rather than providing the bulk of a TLHC service's scanning capacity, they may be better suited for addressing overspill from the main TLHC scanner or for delivering interval scans.

"We're going to be using the CDCs [for 6 months] because they're a lot more flexible, they can work more hours, they're there anyway. I think as they become more established it will be good because patients will recognise them as… a medical place to go. They'll know where it is rather than it being a van randomly here for a few weeks." [Project Lead]

"There's lots of talk around utilisation of CDCs. I think it's great to echo them as an opportunity. I think the challenges that I've got… is I don't think a CDC can block off all their capacity for six weeks at a time… because of all the other areas of services that need to be accommodated." [Project Lead]

Administrative data system

Key findings for rollout:

- The TLHC programme is not currently structured around a single, comprehensive patient administration system (PAS). Instead, projects have collected data using bespoke setups including commissioning an external provider to develop a PAS specifically for TLHC delivery. Some projects have largely relied on Excel. The extent to which projects have been able to automate aspects of the patient administration process varies, depending on the local decisions that have been taken.

- The national programme team recognises the need for a TLHC PAS, particularly as the programme expands and becomes a national screening service. This would enable alignment with the other national cancer screening programmes, as well as better consistency and data access across the programme. A business case was submitted in July 2024 to procure one or more "off-the-shelf" national TLHC ICT systems for management at a national level. At the time of writing (November 2024), this is pending approval and is expected to take two to three months.

Considerations for those charged with leading rollout:

- Serious consideration should be given to the business case to procure a suitable ICT system(s) for the programme. Several stakeholders felt that the central work being undertaken to develop the system was belated and that Phase 1 and 2 projects would have benefitted from this being setup and enabled from the outset (although the challenges of procuring a suitable ICT system, before commencing a pilot programme are noted).

"There was probably some national stuff that should have been set up in place, so you know, a national IT system… normally these things are established and set up before you actually roll the pilot out." [Project Lead]

"They need to get the national computer system up and running... I know they'll look into it, but it's 5 years too late." [Clinical Director]

- It was suggested that further centralisation of data collection should not be limited to the development of a PAS but should also include the data extraction required to produce participant invite lists (rather than doing this at the GP practice level).

"One thing that I think always hits me for sustainability is some centralisation and particularly starting with the data… other screening programmes are sent the information, that data mining and cleansing has already been conducted before, and then you are just concentrating on delivering the service." [Project Lead]

- Another suggestion was for further centralisation of risk score generation, which takes place during LHCs. At present, this is a largely manual process which introduces the potential for human error. An alternative, as part of a national screening service, could be the development of a centralised website to generate risk scores during LHCs. This could also offer the functionality of providing data returns.

Staffing TLHC services

Key findings for rollout:

- Project stakeholders have highlighted pinch points in terms of current and future staffing of TLHC services. The main points of concern are around LHC nurses, radiographers and radiologists.
- Nursing staff have generally been recruited from other services, particularly respiratory services, which creates staffing pressures in other parts of the system.
- There is a well-documented national and global shortage of radiographers and radiologists. Stakeholders have expressed concerns about the ability of the system to absorb the additional work that the TLHC service creates for these specialisms.

"We know that there's a national shortage. I think it's still as high as 11% for radiographers and radiologists… Sustainability of workforce is a massive, massive one of them… I think nurses is also something that we do need to consider because technically, even though we're looking at different models, we're still going to be taking nurses away from wards and other areas of servicing." [Clinical Director]

Considerations for those charged with leading rollout:

- NHSE will need to play a key role in modelling future workforce requirements over the next 15 years. NHSE has begun this work already, by feeding into to the NHS Long Term Workforce Plan and is continuing to model future staffing requirements, for example for radiologists and radiographers for diagnostics and therapeutics. A particular focus has been on determining the number of thoracic surgery training places required.

- Teams in NHSE responsible for national policy on workforce planning will be major stakeholders for wider rollout and development of a national screening service will require close collaborative working between the NHSE Cancer Programme, those working on workforce in NHSE, and the Department for Health and Social Care (DHSC).

9.4.3 Communications and engagement

General public

Key findings for rollout:

- To date, there has been no national communications campaign relating to the programme; this was partly to manage demand within the pilot.
- During the early stages of programme delivery, some invitees and even some staff including primary care staff, were concerned that the initiative was a scam. Whilst this issue appears to have lessened over time in project areas – likely due to word of mouth and local communications initiatives – project stakeholders still feel that enhanced communications at the national level would improve awareness and LHC uptake.

Considerations for those charged with leading rollout:

- A centralised communications campaign would raise awareness amongst the public. Organising this centrally would create efficiencies, which could either replace or supplement local communications initiatives. It should be carefully planned alongside demand modelling work. Any future large scale public communications should be accompanied by focused communications to those groups which have been shown through this evaluation to have lower uptake rates.

  "We have so many patients thinking that it's a hoax when we message them. They've never heard of the programme. And the more information and press coverage, or adverts that they can put on the telly, anything that helps to advertise that this is a screening programme that's coming, would drastically help us." [Project Lead]

- However, some stakeholders raised concerns about rolling out a full national communications campaign before national coverage has been achieved. Careful consideration would need to be given in terms of how best to communicate about eligibility (both geographically and in terms of age and smoking status) to avoid unnecessary worry.

  "We get queries all the time from members of the public, 'Why can't I have a lung health check?' It's because they're in an area that's not covered, or their practice hasn't been invited yet. There's going to be an element of that when it becomes a national screening programme as well, because not everybody's going to receive an invite at the same time." [Cancer Alliance Lead]

Primary care

Key findings for rollout:

- Primary care engagement, at the level of PCN and GP practice, has been broadly successful. However, there have been pockets of low engagement or resistance. This has typically been the

result of concern about the level of incidental findings that would need to be managed by primary care and which would not be covered through additional funding through the programme.

"We've had, sort of, pockets of difficulties in general practice… because obviously of the AI, the detail on scans is quite incredible and so it picks up the minute details… and I think that, kind of, coming in tandem with all of the GP pressures that there are since Covid, that has proved to be a little bit of a push back…from some practices. [Project Lead]

- Frequently, these conditions cannot be treated or do not require treatment, but nonetheless cause patient worry and require action by GP practices.

"One particular CCG area that we've moved into recently, we've had… response from just under 50% of the GP practices. The rest are refusing to actually provide the information, which, you know, that just puts a stop to it. We can't do it unless we get the patient lists to contact." [Clinical Director]

Considerations for those charged with leading rollout:

- One way to help address this would be for the programme to provide further clarification about the most appropriate management of certain incidental findings that are frequently identified, causing work for GP practices, whilst making negligible difference to the participant.

"One of the difficulties has always been, from the national team, they've not actually… been very clear in terms of the incidental findings with regards to both emphysema and coronary artery calcification… There has been a big push back because of that potential workload… We still don't have a clear answer in terms of how to go forward." [Clinical Director]

9.5 Transitioning Phase 1 and 2 projects into "business as usual"

The pilot programme used a Standard Protocol which was closely tied to evidence from the preceding clinical trials, and which has been updated at several junctures throughout programme delivery. However, there are some ongoing questions and challenges which pertain specifically to transitioning existing services into 'business as usual' (BAU) activity; this penultimate section of the report considers these points and how the Phase 1 and 2 projects might adapt to a steady state.

9.5.1 Service commissioning

Where contracts need to be renewed or renegotiated, existing projects are concerned about competing for procurement with new projects just setting up. From the perspective of sustaining existing projects, services will predominantly be focused on surveillance CT scanning once their initial surge of eligible individuals has been invited for an LHC. Effective procurement practices must ensure that projects now operating on a BAU basis are not deprioritised by third party providers in favour of new areas that are expecting a surge in their LHC and scanning needs.

"There will come a tipping point where [providers] say 'I don't think we've got enough capacity'" [Cancer Alliance stakeholder]

9.5.2 CT scanner purchase

Within the context of extending commissioned services or considering new procurement options, some projects are considering purchasing a CT scanner(s) to enable local sustainability. However, there are

concerns about how to ensure the most efficient usage possible, to make that capital investment worth it. There are also some concerns about whether there will be sufficient in-house expertise to effectively manage a scanner in-house after having commissioned it externally. Cross-programme knowledge sharing about in-house scanner management could help.

> **"When the contract for Cobalt was awarded, it was based on an option to purchase at the end. But, I don't know whether radiology have given any thought to that option, or whether because of all of the associated costs, they've kind of ruled that out."** [Project Lead]

> **"That'll be our next big priority, how do we make it more sustainable long-term so we're not just renting off another company."** [Clinical Director]

9.5.3 Staffing TLHC services

As BAU services will be undertaking fewer LHCs, there are uncertainties about how to efficiently staff the nursing roles to ensure capacity is available when required. There are also concerns about ensuring nursing staff remain engaged in the role, which some stakeholders acknowledged can be quite repetitive.

> **"The nurses that you have as part of your team are very highly skilled. Doing the lung health checks day in, day out, I think they feel like they're probably losing their clinical skills and it's a bit boring… we're starting to see people moving on to other roles."** [Cancer Alliance Lead]

> **"So, if you're saying 55-year-olds that's [ageing-in], you could just literally do one blitz for a month and get through that entire population within literally one month, but then what will the nurse do for the rest of the 11 months?"** [Clinical Director]

Another key area of concern for staffing is radiology. As existing projects move to a steady state and require sustaining, the pressures on radiology will remain higher than many other parts of the service due to the high levels of surveillance scanning.

> **"If a radiologist disappears then I'm really struggling, so for me that's my biggest worry in terms of sustainability. You know, it takes 20 years to train one of these and they're not training enough, just at a time when they need more because of this project."** [Clinical Director]

9.5.4 Ageing-in and re-invitation

Projects did not express major concerns about managing the process of inviting those ageing-into the programme locally, or re-inviting those who declined their initial invite. Predominantly, stakeholders felt that there needed to be a period of planning and modelling what impact this would have on demand for LHCs and CT scanning. Few projects appear to have made substantial progress with planning at this stage, though they recognise that this will need to be a priority moving forwards.

> **"We need to be evolving, we need to be doing what other screening programmes are and keep doing that rotation of re-inviting our population… So, by coming up with that strategy and developing that plan, will mean then each year we'll know what resources we require to deliver that and that's where it becomes sustainable."** [Project Lead]

Considerations for modelling re-invitation include the likely uptake (given the lack of precedent from which to build assumptions) and details such as when to re-check individuals deemed low risk at their initial LHC.

> **"People not turning up. If you don't engage around one, I think the probability is you're not to engage, full stop, isn't it? There's very little pick up from that group when you try and get them again."** [Clinical Director]

> **"Because if you have [a LHC] at 55, if then you're not at high risk, add 10 years… we do need to think about… re-checking people."** [Project Lead]

9.5.5 Long-term management of scans

Some Phase 1 and 2 projects have begun delivering 48-month surveillance scans, in line with the Standard Protocol. The expectation is that all participants will be offered a surveillance scan every two years until they age out of the programme. Most of the challenges raised by projects revolve around sourcing the required CT scanning and reporting capacity, alongside the logistics of managing CT scanning locations. This is because established projects will need to be simultaneously conducting initial CT scans for ageing-in populations and reinvited populations, as well as interval scans at different timepoints for various populations. Some stakeholders worried about how to ensure the ongoing benefits of a community-based scanning approach once participants are coming from across large geographical localities and may need to travel a long way to attend a scan. It will be important for the programme going forward to consider these challenges and seek to avoid this, whilst preserving the accessible scanning approach.

> **"It's the, kind of, logistics of as you get through your initial cohort, it's logistically difficult to then fill a CT van with 3 month, 12 month, 24-. So, you stick something in one place and you say, right, these are your initial cohorts... But I think as the programme develops, it's going to become logistically nightmarish to actually run it efficiently and effectively whilst utilising scanning opportunity."** [Project Lead]

Ultimately, rich learning will continue to emerge from Phase 1 and 2 projects for the foreseeable future, with staff in these projects continuing to encounter new challenges as early adopters looking to move to BAU ways of working. This underlines the importance of ongoing knowledge sharing in enabling effective programme expansion.

9.6 Further research and evaluation

This evaluation has prompted ideas for several future areas of research and evaluation:

- **Evaluating LHC engagement strategies**: As outlined in Chapter 4, projects have deployed a wide range of strategies to try and drive programme engagement and improve LHC uptake, particularly amongst groups that are less likely to attend (for example, those living in more deprived areas). However, whilst project stakeholders have suggested some strategies have been effective, the relative efficacy of different strategies has not been tested in a robust way and cannot be verified in the available data. This leaves an evidence gap around best practice. Further analysis of the effectiveness of different outreach and engagement interventions is recommended, particularly in relation to groups living in areas of higher deprivation, and for other ethnic groups (and sub-groups within this broad category, if sample size allows).

- **Longer-term impact and economic evaluation**: As identified in Chapter 5, it has not been possible – within the timeframes of the evaluation – to detect an impact of the TLHC programme on lung cancer mortality. However, there is reason to expect that an impact may be observed in the longer-term, given the observed impact of the programme on stage at diagnosis, and findings from the various precursor trial sites. It would therefore be beneficial to assess the impact on primary programme outcomes at a future point agreed with clinical oversight. This would also then strengthen the economic evaluation, providing further detail about the benefits associated

with the programme. Any methodology would need to account for the wider programme roll-out in the meantime, in terms of establishing a counterfactual.

    - Longer-term impact evaluation could also explore the impacts associated with the programme once wider roll-out has been delivered, particularly noting the anticipated lower levels of lung cancer risk in subsequent cohorts.

- **Improved data access and research into smoking cessation embedded alongside a targeted lung screening programme:** Access to data on smoking cessation services referrals, uptake and outcomes has been poor through this evaluation. This has been due to difficulties TLHC projects have experienced in accessing relevant data from third party smoking cessation services. This would be a valuable area for further research, to see whether engaging individuals – often with "entrenched" smoking behaviours – as part of a targeted screening programme brings benefits above-and-beyond other smoking cessation offers. This learning will be important for the transition into a national screening service, to better inform the standardisation of this part of the protocol and decisions about funding smoking cessation services. Given the barriers to data collection, examining this in case study areas (potentially those that are more engaged) may be the best first step for building this knowledge base.

- **Revisiting some Phase 1 and 2 projects to learn how they have moved into a steady state of BAU delivery:** Further mixed-methods evaluation could be undertaken to explore whether any of the anticipated risks have emerged, whether there have been unexpected challenges, and how to most effectively embed the service to deliver long-term sustainability.

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