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Introduction

The case for lung cancer screening

**Early detection, with screening at its core, is key to reducing mortality from lung cancer.** Lung cancer currently causes more deaths than any other cancer worldwide.1 Low-dose computed tomography (LDCT) has been proven to be an effective and safe tool to screen for lung cancer,2-4 with the potential to reduce mortality by up to one quarter among high-risk individuals (*Box 1*).5

**As the implementation of targeted LDCT screening gains pace, it is essential to optimise these programmes to ensure that they have an impact on population health.** The evidence supporting LDCT has motivated several countries to establish large-scale screening programmes or to plan to do so. Setting up a lung cancer screening programme is complex, but important lessons can be learnt from existing programmes on how to optimise design and implementation.6

Box 1. The case for investment in LDCT screening for lung cancer

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| **Lung cancer is the most common cause of cancer deaths around the world**  In 2020, more than 2.2 million people around the world were diagnosed with lung cancer, which accounts for one fifth of all cancer deaths worldwide.1 Lung cancer also incurs the greatest economic burden of all cancers.7-9  **Lung cancer offers significant potential for early detection**  More than 40% of lung cancer diagnoses occur at stage IV, the most advanced stage of the disease.10 The average five-year survival rate for lung cancer is 68–92% if diagnosed early (stage I), but less than 10% if diagnosed at stage IV.10 11  **Targeted LDCT screening is an effective and safe screening tool**  LDCT screening can reduce mortality from lung cancer by up to one quarter in high-risk individuals.2-5 It can deliver a significant stage shift to earlier diagnosis among people who currently smoke or used to smoke.6 12 When optimised, LDCT screening does not lead to a high proportion of false-positive results or subsequent unnecessary procedures or treatments.12-14  **A strong case for implementation**  LDCT screening meets all recognised criteria for implementation (the Wilson & Jungner criteria).15 16 Lung cancer screening is widely reported to be cost-effective,17-19 and could potentially be more efficient than other cancer screening programmes, with fewer people requiring a screening test to prevent one death.20 |

Ensuring system readiness for implementation

**A systems approach helps determine how best to implement a screening programme within each health system.** This involves assessing local infrastructure, technical and workforce capacity, governance, data flows and existing care pathways. Screening programmes must also be designed to target and engage those at the greatest risk of lung cancer while embedding actions to address inequitable health outcomes.

**Not all health systems will be fully ‘ready’ for lung cancer screening implementation, but that should not delay planning.** Some countries will have certain components in place and others still in development. Other countries will have regions that are more ready than others, calling for a stepwise roll-out over time. In all scenarios, adopting a systems approach to assessing readiness (*Box 2*) can help ensure that implementation is both feasible and geared for success.

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| Box 2. What is health system readiness for lung cancer screening?  System readiness refers to the ability of a health system to rapidly and sustainably adapt policies, processes and infrastructure to support the integration of new components of care.21 Understanding readiness requires a systems approach that considers the roles and collective interplay of all pillars of a health system to effectively integrate a new intervention or programme.22-24 |

A framework to support the implementation of LDCT lung cancer screening

The Lung Cancer Policy Network has developed an implementation framework to support those involved in the planning of lung cancer screening programmes around the world.

We hope that by applying the framework, researchers and decision-makers will get a clearer sense of what gaps they may need to address to ensure the successful implementation of a screening programme. This can help them plan and resource accordingly.

The framework was developed based on a review of existing literature, extensive expert interviews and insights from Network members. It was refined based on application to five countries where implementation has already taken place: Canada, Poland, South Korea, the UK and the US. The full methodology can be viewed [here](https://www.lungcancerpolicynetwork.com/app/uploads/A-framework-to-support-implementation-of-LDCT-lung-cancer-screening-research-methodology.pdf).

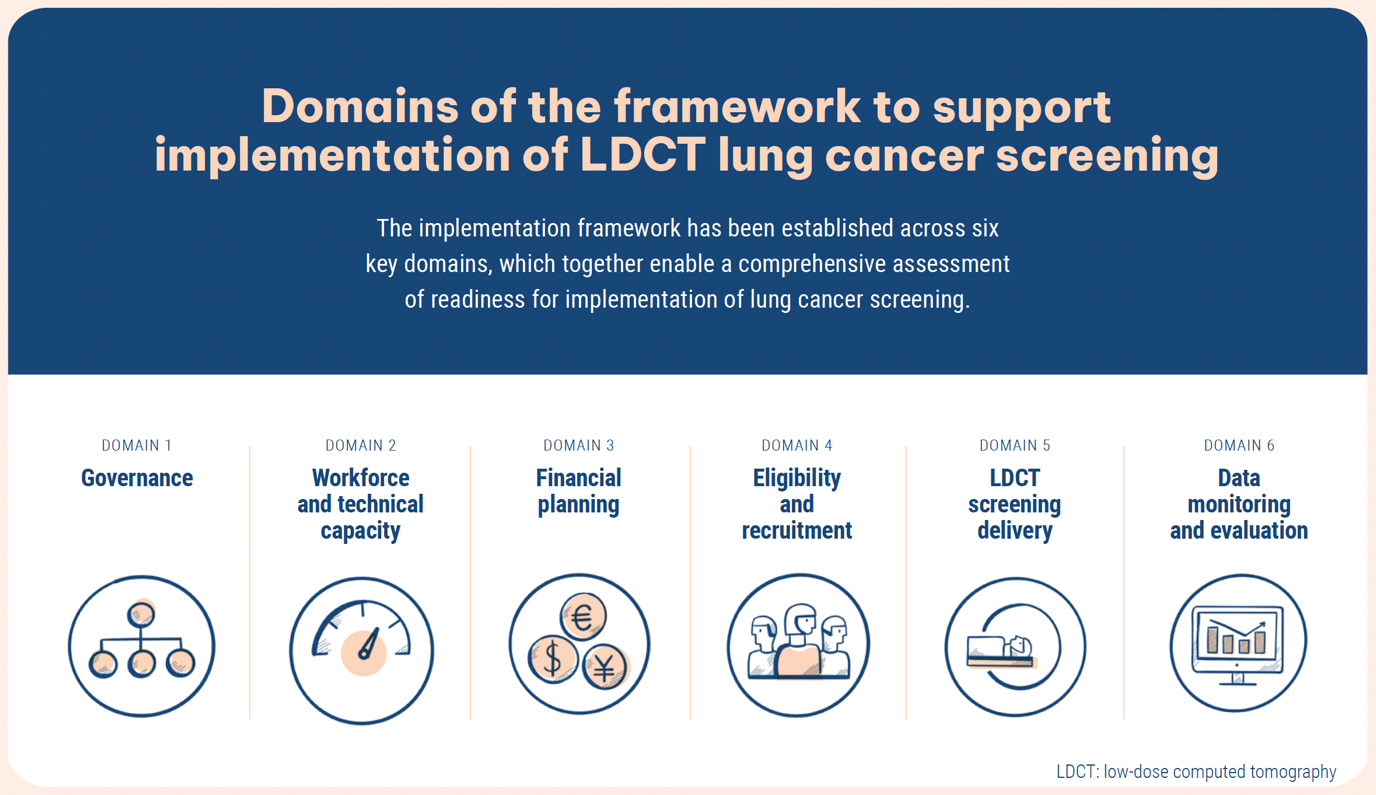
Applying the framework

The framework can be used to assess health system readiness for screening implementation either at the national level or within a specific region.

It is organised into six domains(*Figure 1*), each consisting of a series of metrics[[1]](#footnote-2). These help assess whether key requirements for screening are in place and identify measures required to address any identified gaps.

Resources accompanying the framework are signposted on the cover page of each domain. This information may help those involved in designing a screening programme think through different approaches to optimising implementation.

Figure 1. Domains of the implementation framework



**Implementation** **toolkit**

An [implementation toolkit](https://www.lungcancerpolicynetwork.com/implementation-toolkit/) has been developed to support the application of the framework. The toolkit contains the supporting materials for each domain as well as templates to help structure the information relevant to some metrics.

Glossary

The terminology used within the framework may need to be adapted to each country as appropriate. For technical terms that have not been provided as footnotes, please refer to the [glossary](https://www.lungcancerpolicynetwork.com/glossary-category/a/) on the Lung Cancer Policy Network’s website.

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Domain 1. Governance

What does this cover?

A governance framework should identify who is responsible for: setting screening policies, guidelines and standards; programme delivery; monitoring for quality assurance; and evaluation of the programme’s performance and its impact on health outcomes.

In this domain, metrics are designed to assess:

* what existing strategies, policies and guidelines are in place to implement LDCT screening
* who is responsible for the planning, leadership, local delivery and evaluation of an LDCT screening programme
* how engaged different stakeholders are in supporting the implementation of a screening programme for lung cancer, and where opportunities for further engagement may be focused.

Why is this important?

Good governance enables consistency across all centres participating in a screening programme.25 To ensure a screening programme achieves its desired impact on population health and is cost-effective, it is essential to establish a framework for leadership and clear accountability mechanisms at the national or regional level. In addition, to deliver consistent and high-quality screening for lung cancer, it is important to consult all stakeholders who may be directly or indirectly affected by the introduction of screening throughout the programme design and implementation phases.

Resources available for this domain

* [Examples](https://www.lungcancerpolicynetwork.com/app/uploads/Stakeholder-groups-that-may-be-involved-in-screening.pdf) of stakeholder groups that may be involved in an LDCT screening programme

[**Further reading and resources**](https://www.lungcancerpolicynetwork.com/implementation-resources/) **specific to this domain are available in the implementation toolkit.**

1.1 Governing policy context

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| Is there a national cancer control plan and, if applicable, regional cancer plans or other relevant strategies?  If yes, does the national cancer control plan, or another relevant plan/strategy, include early detection as a stated priority?  Are lung cancer and lung cancer screening, specifically, included?  Is there an anti-tobacco (tobacco control) plan?  Is there a formal government commitment to implement and fund an organised[[2]](#footnote-3) 16 lung cancer screening programme?  If so, what is the estimated timeframe for implementation (i.e. is it a short-term priority likely to be achieved within 2 years)?  Have national guidelines for lung cancer screening been published? |

1.2 Stakeholder engagement

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| Which stakeholders are currently engaged?  Which stakeholders are actively involved in raising awareness of LDCT screening for lung cancer?  Have any relevant professional societies and/or patient organisations issued a joint or individual position statement on lung cancer screening?  Is the lung cancer patient community engaged? If so, are groups who experience inequities in lung cancer incidence/mortality included?  Are there any groups that still need to be targeted?  Could further engagement help reach any groups opposed to the implementation of LDCT lung cancer screening?  What is the best approach to engaging groups that experience inequitable health outcomes in lung cancer? (*See also* Targeted approaches to ensure equity) |

1.3 Programme governance and coordination

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| Would lung cancer screening be implemented nationwide or in a phased approach (i.e. by a select few sites or regions with a gradual roll-out)?  Which stakeholders will be involved in the programme governance, and how will this work at the national, regional and local level? (*See* *toolkit resources*)  Who will be responsible for:  the overarching leadership, coordination and evaluation of a programme?  setting and reviewing screening guidelines and standards? (*Specify if these are different bodies*) |

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| **Additional considerations**   * Are there any other organised cancer screening programmes in place?   If yes, what lessons learnt relating to governance and programme set-up should be considered when implementing lung cancer screening?  Would all organised cancer screening programmes be jointly coordinated or evaluated by a central body? |

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Domain 2. Workforce and technical capacity

What does this cover?

Each country will need to assess its workforce capacity and the technical or infrastructural requirements to operationalise lung cancer screening within its health system.

In this domain, metrics are designed to assess:

* which existing workforce within the health system could support the implementation of a lung cancer screening programme
* the wider workforce requirements, such as diagnostic and treatment services, that would be needed
* what technical infrastructure exists and whether there is a need to plan for any additional capacity for the delivery of screening
* what the ideal model of screening implementation should be, given the existing capacity.

Why is it important?

A screening programme follows a pathway that includes identification, invitation, screening and referral for diagnosis and treatment. Therefore, when setting up a screening programme, it is necessary to ensure capacity to implement all these components effectively. This involves assessing whether there is sufficient equipment and staff to enable integration into broader care pathways at all levels, anticipating the impact of screening on this capacity (e.g. an increase in referrals for treatment or surgery) and addressing any gaps accordingly.

Resources available for this domain

* [Template](https://www.lungcancerpolicynetwork.com/app/uploads/Template-initial-assessment-workforce-capacity.docx) for an initial assessment of workforce capacity for lung cancer screening
* [Summary](https://www.lungcancerpolicynetwork.com/app/uploads/Additional-considerations-for-planning-capacity-for-screening.pdf) of additional considerations for planning technical and workforce capacity for lung cancer screening

[**Further reading and resources**](https://www.lungcancerpolicynetwork.com/implementation-resources) **specific to this domain are available in the implementation toolkit.**

2.1 Technical infrastructure for screening

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| Which structure(s) of organised screening is most feasible (e.g. centralised, decentralised, hybrid) based on the existing capacity and organisation of the health system?  Would this structure be uniform across all centres participating in the programme, or would it vary?  Will the chosen model(s) ensure consistent access/outreach across the country?  Is there sufficient CT scanner capacity to implement an organised LDCT screening programme? It may be helpful to consider:  How many CT scanners are available per 10,000 people with cancer26 or per 100,000 population? (*See* *toolkit resources*)  What proportion will be available and meet the requirements for use in an organised LDCT screening programme? (*See* *also* Quality assurance and safety)  What is their geographical distribution, and where might there be deficits in access (rural, urban, community or hospital-based settings etc.)?  Would the existing CT scanners be available for scans outside of office hours (e.g. at weekends)?  What other technical requirements should be considered (e.g. mobile CT equipment, specialised hubs for LDCT screening diagnosis)? |

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| **Additional considerations**  Would the use of CT scanners or other equipment for lung cancer screening have an impact on other services that require their use (e.g. by exacerbating current backlogs)? |

2.2 Workforce capacity to deliver screening

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| What workforce capacity within the health system is needed to deliver the screening programme? (*See* *toolkit resources*)  Would successful implementation require an increase in the workforce?  If yes, how could the forecast increase in demand be met?  Do any reported staff shortages or capacity limitations affect the healthcare professionals required for screening?  If yes, for which professions?  What existing health system capacity could be task-shifted to support implementation of lung cancer screening?  What recommendations have been proposed to address limitations in workforce capacity (e.g. task-shifting, creation of new roles)? |

2.3 Wider workforce requirements across the lung cancer pathway

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| Is there an established lung cancer care pathway?[[3]](#footnote-4) 27  Are there sufficient numbers of key personnel (surgeons, radiation oncologists, radiographers, nurses, primary care physicians) to ensure proper follow-up and treatment of participants in the screening programme as it is scaled up?  What additional workforce requirements may be needed?  Are there any technical innovations or areas of research that could support an initial increase in demand for lung cancer care (e.g. telehealth, the use of AI in computer-aided detection)?  Are any of these already in place? |

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| **Additional considerations**   * Consider which other areas of the health system may already be understaffed or would be most affected if there were an increase in early stage cancers. For example:   surgery  non-surgical treatments (e.g. radiotherapy)  specific deficits in staff (e.g. palliative care, psychologists, dentists, nutritionists, specialist nurses)  specific deficits in training  the burden of cancer more broadly and any backlogs (e.g. due to COVID-19).   * Have relationships been established between the broader healthcare settings required to support the roll-out of lung cancer screening (e.g. data sharing between diagnostic units or regional hospitals)? |

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Domain 3. Financial planning

What does this cover?

It is important to accurately anticipate the costs of implementing a screening programme and determine how to finance it.

In this domain, metrics are designed to assess:

* anticipated budget requirements for implementing an organised screening programme
* how a screening programme may be financed, including potential sources of funding
* whether any economic evaluations have been undertaken or are planned.

Why is it important?

As screening programmes are complex and span several areas of health services, it is essential to ensure all aspects of a programme are appropriately resourced and budgeted for. When planning how to finance a screening programme, any existing gaps or deficits across the broader care pathway need to be identified and addressed, including existing barriers to participation, for example, in terms of out-of-pocket costs.[[4]](#footnote-5) This is to ensure people who experience barriers to accessing health services are not prevented from participating and that where lung cancer is detected, every person has timely access to diagnostic or treatment services.28 With this in mind, a comprehensive budget and a forecasting exercise are needed to ensure all aspects of the screening programme are sufficiently resourced as the programme scales up.

Resources available for this domain

* [Summary](https://www.lungcancerpolicynetwork.com/app/uploads/Potential-costs-to-consider-for-screening-programmes.pdf) of example programme costs to be considered for implementation

[**Further reading and resources**](https://www.lungcancerpolicynetwork.com/implementation-resources) **specific to this domain are available in the implementation toolkit.**

3.1 Budget requirements

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| Has a comprehensive budget been developed for the screening programme?  What costs need to be considered for each component of the programme (e.g. recruitment, administration)? (*See* *toolkit resources*)  What are the biggest risks/uncertainties in terms of budget?  How are potential risks being monitored and planned for?  Have economic evaluations been conducted?  Has a budget impact analysis[[5]](#footnote-6) 29 been conducted for the screening programme? If yes, how is this built into programme planning?  Has a cost-effectiveness analysis[[6]](#footnote-7) 30 been conducted? If yes, what data were used for the base case (e.g. clinical trial evidence, data from a local pilot)? |

3.2 Programme financing

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| * How will an organised screening programme be financed?   What sources have been (or could be) secured to fund the programme?  Who will cover different components (organisation and coordination, reimbursement of screening etc.)?  Will the programme be funded for a set term or in a stepwise approach?  What will be the requirements for the term to be renewed or the programme to be expanded to other regions/areas?   * What aspects of lung cancer screening are covered for participants?   Is screening free for participants?  Is there a set reimbursement code or equivalent for LDCT screening?  Are there any out-of-pocket costs related to screening or other aspects of the lung cancer care pathway that may affect the uptake of a screening programme (e.g. diagnosis, treatment)?  Will any travel grants or other financial resources be provided to ensure financial barriers do not affect participation? (*See also* Engaging the target population) |

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Domain 4. Eligibility and recruitment

What does this cover?

When implementing a screening programme, it is essential to define eligibility criteria, the recruitment process, and targeted approaches that can be taken to secure attendance from groups who may be at the highest risk of lung cancer.

In this domain, metrics are designed to assess:

* how to define the population eligible for lung cancer screening, including: assessing the epidemiology and risk factors for lung cancer in the population; the proposed eligibility criteria; and methods to identify the target population
* the informational needs of the target population to make an informed decision about participating in screening
* whether the programme is culturally sensitive for all groups at high risk of lung cancer
* the process for recruitment, including the different ways to access screening and the engagement of healthcare professionals in referring the target population.

Why is it important?

A screening programme for lung cancer will be most impactful if recruitment is targeted towards people at the highest risk of lung cancer. However, many people in this group experience socioeconomic disadvantage, and may have fewer opportunities to engage in screening and experience additional challenges.31 32 This can exacerbate health inequalities they may already be facing across the lung cancer care pathway.20 Appropriate eligibility criteria and effective, equity-oriented approaches to recruitment and engagement of these groups are essential to secure their attendance.

Resources available for this domain

* [Templates](https://www.lungcancerpolicynetwork.com/app/uploads/Templates-for-understanding-populations-at-highest-risk-of-lung-cancer.docx) for understanding which populations might be at highest risk of lung cancer
* [Infographic](https://www.lungcancerpolicynetwork.com/app/uploads/Selected-risk-prediction-models-used-in-lung-cancer-screening.pdf) of selected risk prediction models used in lung cancer screening
* [Summary](https://www.lungcancerpolicynetwork.com/app/uploads/Potential-barriers-to-and-solutions-for-engaging-participants.pdf) of potential barriers to and solutions for engaging participants in screening

**[Further reading and resources](https://www.lungcancerpolicynetwork.com/implementation-resources) specific to this domain are available in the implementation toolkit.**

4.1 Defining the eligible population

4.1.1 Prevalence of lung cancer and risk profile of the population

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| What are the most recently reported incidence and mortality rates of lung cancer, by age and sex? (*See* *toolkit resources*)  Are there any trends by age or sex that could inform the identification of populations at high risk of lung cancer?  If so, are the data reliable and up to date?  If any lung cancer staging data are available, what proportion of people are diagnosed in the early stages (stage I–II) vs. the late stages (stage III–IV) of the disease? (*See* *toolkit resources*)  What is the population-level smoking prevalence by age and sex? (*See* *toolkit resources*)  What are the lung cancer incidence and mortality rates for people who currently smoke or used to smoke heavily and for those who have ever smoked?**[[7]](#footnote-8)** 28 33 34  Apart from people with a history of smoking, are any other populations considered at particularly high risk of lung cancer?  What are the incidence and mortality rates of lung cancer in people who have never smoked?  Have other risk factors – such as occupation, geographical area, comorbidities (e.g. COPD), socioeconomic position etc. – been considered?  (*See also* Proposed eligibility criteria for individuals)  Overall, how many people may be eligible at the national/regional level? |

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| **Additional considerations**  Are there any local epidemiological studies demonstrating that certain groups are at higher risk of lung cancer (e.g. minority groups)? If so, how do these vary at the local level? |

4.1.2 Proposed eligibility criteria for individuals

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| Are there national recommendations for lung cancer screening?  What are the proposed eligibility criteria for LDCT screening? (*See* *toolkit resources*)  What evidence was used to inform the selected eligibility criteria (e.g. clinical trials, implementation research, guidelines)?  Have the criteria been modelled and validated in this country/region prior to implementation?  Are there reliable and high-quality sources of data for determining an individual’s smoking history? (*See also* Domain 6. Data monitoring and evaluation)  If yes, how will they be used to identify people eligible for screening?  Are other data available that can be used to identify any potential risk factors for lung cancer in individuals (e.g. occupational exposure, sociodemographic data)?  If yes, how will they be used to identify people eligible for screening? (*See also* Tools to identify the target population)  Are the eligibility criteria expected to change as the programme is expanded or reaches a certain phase of implementation? |

4.1.3 Tools to identify the target population

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| Are any tools (e.g. risk prediction models/calculators) being considered to identify and assess people at risk of lung cancer?(*See* *toolkit resources*)  If yes:  What is the basis for their potential selection?  Have they been evaluated within this population?  What is the minimum threshold of risk defined for participation in a screening programme?  Are any existing biomarker tests being evaluated for their ability to refine the selection of participants based on individual risk (e.g. in clinical trials or implementation research)?  If yes:  Would these be included in the screening programme? |

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| **Additional considerations**  How might future adjustments to the eligibility criteria (e.g. changes in risk thresholds, inclusion of other risk factors) affect the cost-effectiveness of an organised screening programme? (*See also* Domain 3. Financial planning) |

4.2 Engaging the target population

4.2.1 Information to engage participants

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| What information about both lung cancer and the screening programme is included in communication materials to participants? (*See* *toolkit resources*)  Have materials been developed in collaboration with patient advocates and populations at high risk of lung cancer?   * Have any groups been omitted?   What specific needs of the target population need to be considered when designing information on screening? It may be beneficial to think of this by group (*See* *toolkit resources)*  Has an assessment of health literacy needs been undertaken?  Will different methods be needed for different population groups?  How will the format and contents meet the needs of target participants?  What methods will be used to support shared decision-making?  Is a specific protocol in place for shared decision-making?  Are lung cancer-specific decision aids available? (*See* *toolkit resources*) |

4.2.2 Securing attendance from participants

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| What will the process be for reaching out to and recruiting individuals to participate in the screening programme?  Is there (or will there be) a central coordination centre responsible for issuing invitations to participants?  Will the programme track and send reminders to participants who do not attend their appointment for a baseline scan?  Will self-referral for screening be possible?  What format and delivery of materials will be used to recruit participants for screening (e.g. mass media campaign, letters)? |

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| **Additional considerations**  Is it possible to apply lessons learnt from other cancer screening programmes to optimise the design and delivery of information about lung cancer screening? |

4.2.3 Targeted approaches to recruitment to ensure equity

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| Which groups may be more likely to experience greater barriers to participating in screening? (*See also* Defining the eligible population)  Has qualitative research been undertaken to identify and examine barriers to attendance for different groups at high-risk of lung cancer?  What is known about these barriers and the ways they affect participation by different groups?  What targeted approaches are being considered to secure access to screening for these groups? (*See* *toolkit resources*)  Can additional measures be adopted to secure attendance (e.g. mobile CT screening, telehealth)?  Who else could be involved in screening to maximise attendance and reach (e.g. community leaders, patient navigators)? |

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| **Additional considerations**  What interventions or approaches are already in place to engage underserved groups from other cancer screening programmes?   * Were they developed in close consultation with this population? If so, were the process and the resulting materials evaluated to ensure they were effective? * Can these be leveraged or replicated for lung cancer screening? |

4.3 Engaging healthcare professionals in recruitment

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| Will family physicians (general practitioners) be involved in recruitment for screening?  Will financial incentives be provided to family physicians to engage participants?  Will any other primary care professionals (e.g. pharmacists, dentists) or healthcare specialists (e.g. pulmonologists) be involved in recruitment? (*See also* Stakeholder engagement)  Who will be responsible for conducting an eligibility assessment for potential participants in a screening programme?  What resources are available to support healthcare professionals in assessing the eligibility of individuals for screening in clinical practice (e.g. online tools, training)? (*See also* Workforce capacity to deliver screening) |

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| **Additional considerations**  Have any local studies/consultations assessed the most effective ways of engaging primary care physicians in lung cancer screening? What are some of the lessons learnt? |

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Domain 5. LDCT screening delivery

What does this cover?

The format and delivery of a screening programme must be clearly established, including the frequency of scans offered to participants, the technical specifications for LDCT screening, the methods and requirements for quality assurance, and other elements of the screening protocol. There are also important considerations regarding the integration of a screening programme into existing models of lung cancer care, with appropriate protocols for monitoring and referral.

In this domain, metrics are designed to assess:

* what protocols and parameters will be used when establishing the technical requirements for the delivery of LDCT screening
* how to manage other conditions incidentally detected during LDCT screening for lung cancer, including the referral process
* the quality control of LDCT screening, including processes for assuring that screening is high quality and safe for all participants in the programme
* how smoking cessation might be integrated into the screening pathway
* how the processes for diagnostic workup and participant follow-up might work.

Why is it important?

Every step of a screening programme should be guided by evidence-based standards and built into a common protocol to ensure consistency across participating centres. The success of screening depends on having appropriate monitoring and care escalation processes for participants with signs of lung cancer. Any existing gaps within lung cancer care pathways need to be addressed to achieve the best possible health outcomes for people diagnosed with lung cancer.

Resources available for this domain

* [Infographic](https://www.lungcancerpolicynetwork.com/app/uploads/Example-pathway-for-managing-results-from-LDCT-screening.pdf) of an example pathway for managing results from LDCT screening
* [Summary](https://www.lungcancerpolicynetwork.com/app/uploads/Approaches-to-evaluation-of-lung-nodules.pdf) of different approaches to the evaluation of lung nodules

[**Further reading and resources**](https://www.lungcancerpolicynetwork.com/implementation-resources) **specific to this domain are available in the implementation toolkit.**

5.1 Screening protocols

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| Can an existing protocol (e.g. one used in clinical trials or another country/region) be directly applied to a screening programme for this target population?  If yes, has this been reviewed to identify any areas that would benefit from adaptation to local conditions?  If a screening protocol is to be developed specifically for the screening programme, have the following key components been fully considered? (*See toolkit resources*)  Eligibility and recruitment (*See* Domain 4. Eligibility and recruitment)  Radiation dose and whether it complies with national and international regulations and definitions of low-dose CT (*See also* Quality assurance and safety)  Screening interval (e.g. annual, biennial)  Follow-up interval if lung nodules are detected  Whether the assessment and management of lung nodules will be based on volumetric analysis (e.g. using European trial data) or adopt a diameter-based approach (e.g. US guidelines). (*See* *toolkit resources*)  Is there a protocol for managing incidental findings when screening for lung cancer?  Will individuals incidentally diagnosed with lung cancer outside of the screening programme (i.e. incidental pulmonary nodules[[8]](#footnote-9) 35) automatically enter a care pathway for lung cancer?  Are any rapid referral pathways[[9]](#footnote-10) 36 in place? |

5.2 Quality assurance and safety

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| * Is there an external quality assurance process for healthcare professionals involved in screening?   Is there an accreditation[[10]](#footnote-11) 37 body that sets out standards and provides accreditation to radiologists involved in screening?  Is there a minimum amount of thoracic CT experience that radiologists require? (*See also* Workforce capacity to deliver screening)  Has an internal process been established to ensure the quality of the LDCT screening programme meets regulatory and safety requirements?  Is a process in place to monitor and manage any risk to individual participants in terms of radiation dose from LDCT screening?  What tools are in place to ensure consistently high standards in terms of the equipment used (e.g. phantoms[[11]](#footnote-12) 38)?  Will a computer-aided detection[[12]](#footnote-13) 39 software package be used to support the interpretation of scans and clinical decision-making? |

5.3 Integration with smoking cessation

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| What smoking cessation services are already routinely available to people who currently smoke (i.e. outside of a lung cancer screening programme)?  What specific interventions are included (e.g. pharmacotherapy)?  How would an organised lung cancer screening programme work alongside existing smoking cessation services?  Which existing services could be incorporated into a screening programme?  Which healthcare professionals will deliver smoking cessation interventions during screening? (*See also* Domain 2. Workforce and technical capacity)  Will smoking cessation be offered to all participants who currently smoke (e.g. opt-out approach) or only those who seek support (opt-in approach)? |

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| **Additional considerations**  Are there any insights into barriers to smoking cessation interventions that should be considered ahead of their integration into lung cancer screening? |

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5.4 Follow-up and diagnosis

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| How will participants with suspected lung cancer exit the screening programme when the results indicate the need for diagnostic work-up? (*See* *toolkit resources*)  Will a process be established to maintain communication with referring or family physicians while a participant is undergoing diagnostic work-up? (*See also* Programme governance and coordination)  Is there a coordinator or patient navigator to support the participant and communicate results between primary care professionals and specialists? (*See also* Engaging the target population)  If results from screening indicate a need for diagnostic work-up, will participants transition into a clear care pathway for lung cancer?  If yes:  Is the care pathway included in national guidelines for lung cancer care?  Will these guidelines cover the entire care pathway, i.e. from the time when lung cancer might first be suspected to after treatment?  How will participants be discharged from the screening programme when they no longer meet the eligibility criteria? |



Domain 6. Data monitoring and evaluation

What does this cover?

Preparing to introduce organised screening involves establishing what data are required to monitor and evaluate the programme for quality improvement. Coordinators of screening programmes will also need to determine how all relevant data on participants and their outcomes will be governed and standardised between each site that offers screening.

In this domain, metrics are designed to assess:

* what types of data and levels of access will be needed to support the set-up of an organised screening programme, including sharing agreements with existing data management systems within the country or region.
* how these data will be standardised and shared between screening centres and external providers, including how the overall data management system will fulfil these needs
* the planning required to monitor the screening programme, including potential benchmarks against which the programme can be evaluated for its impact on population health.

Why is it important?

Screening programmes are complex, requiring comprehensive and well-organised health information systems to encompass all aspects of the lung cancer care pathway – from identification and recruitment for screening all the way to outcomes from people diagnosed with lung cancer. Robust data collection is key to being able to evaluate the success of the programme, assess for any risks (e.g. false positive results[[13]](#footnote-14) 40I), and determine its true impact in the population (e.g. through links with cancer registries).

Resources available for this domain

* [Summary](https://www.lungcancerpolicynetwork.com/app/uploads/Types-of-data-and-requirements-for-setting-up-screening-programme.pdf) of types of data and potential requirements for setting up a screening programme

[**Further reading and resources**](https://www.lungcancerpolicynetwork.com/implementation-resources) **specific to this domain are available in the implementation toolkit.**

6.1 Data management systems and access

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| What existing data would be required to enable the identification and recruitment of participants for the screening programme? (*See* *toolkit resources*)  What barriers and facilitators affect access to these data?  Is there a population-based cancer registry?[[14]](#footnote-15) 37  If yes:  Are there comprehensive data specific to lung cancer?  Are the cancer registration data sufficient in terms of quality and quantity?  What data from the screening programme will be stored?  How will data (including participation and smoking cessation rates, participant outcomes etc.) be collected and stored between different centres in a screening programme?  Is there any existing data management infrastructure available, such as a cancer screening registry,[[15]](#footnote-16) 37 or will a centralised database be set up? (*See* *toolkit resources*)  Will linkage of data[[16]](#footnote-17) 37 from the screening programme to a cancer registry be required? If so, which data must be collected for reporting purposes? |

6.2 Programme monitoring and evaluation

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| How will the screening programme be monitored for quality assurance?  Which data must be collected?  How often will data be reviewed?  What are the perceived challenges in evaluating the programme, and how will each be addressed?  Is there an audit or feedback process in place for individual providers of screening (e.g. for accreditation)? (*See also* Quality assurance and safety)  If yes, how often will data be reported to an oversight body?  Are there (or will there be) any national/regional indicators for the monitoring and evaluation of organised screening programmes?  How will programme stakeholders respond to feedback from the oversight body?  Will an academic institution be involved in the programme for research? (*See also* Domain 1. Governance)  If yes, will the institution focus on addressing a particular research theme (e.g. smoking cessation, barriers to screening)? |

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1. A metric is a precise question to help break down and measure each theme within the framework. Metrics are largely designed to stimulate quantitative or qualitative data collection. [↑](#footnote-ref-2)
2. Organised screening is when a clearly defined group of people is invited to attend screening following a common protocol. All participants are offered the same services, information and support, and outcomes may be monitored by a centralised third party to ensure they are of a high standard. In comparison, opportunistic screening happens when someone either requests a screening test or is offered one by a healthcare professional during a routine check-up. It is not systematically offered to all people who might be eligible for screening in a given population. [↑](#footnote-ref-3)
3. The lung cancer care pathwayrefers to a structured approach to the diagnosis, treatment and management of lung cancer. It involves a coordinated effort by a multidisciplinary team of healthcare professionals to provide evidence-based care to people with lung cancer. The care pathway typically includes steps such as initial evaluation and diagnosis, staging of the cancer, treatment and follow-up care. [↑](#footnote-ref-4)
4. Out-of-pocket costs are those that an individual pays for medical expenses that are not covered by a health insurance plan, i.e. deductibles, co-payments and costs for non-covered healthcare services. [↑](#footnote-ref-5)
5. Budget impact analysis evaluates whether a high-value intervention is affordable over time. [↑](#footnote-ref-6)
6. Cost-effectiveness analysis evaluates whether an intervention provides value relative to an existing intervention. [↑](#footnote-ref-7)
7. People who smoke or used to smoke heavily: although specific definitions vary, this is often measured using pack-years (the number of packs of cigarettes smoked per day multiplied by the number of years a person has smoked). For those who no longer smoke, the same measure is used but within a set minimum number of years since a person stopped smoking.

   People who have ever smoked: those who do not currently smoke and may not have smoked recently but who have previously smoked at least 100 cigarettes in their lifetime.

   People who have never smoked: do not currently smoke or have smoked fewer than 100 cigarettes during their lifetime. [↑](#footnote-ref-8)
8. Incidental pulmonary nodules: masses in the lung detected by chance during other screening programmes or diagnostic tests. [↑](#footnote-ref-9)
9. Rapid referral pathways: an intervention to ensure that people receive timely and appropriate follow-up if their LDCT scan detects signs of lung cancer. [↑](#footnote-ref-10)
10. Accreditation: a series of initiatives to ensure screening is offered under a common set of standards at each site, e.g. peer review and evaluation of workforce qualifications, equipment performance, laboratory, pathology, endoscopy, radiology quality control and quality assurance programmes. [↑](#footnote-ref-11)
11. Phantoms: a type of medical equipment that simulates a patient’s thorax to calibrate CT equipment and perform quality control testing of screening. [↑](#footnote-ref-12)
12. Computer-aided detection (CADe): this class of computer systems is used to support healthcare professionals in evaluating medical images of an individual undergoing screening. CADe systems can locate and interpret potential nodules to indicate whether they may be cancerous. If the system concludes that a scan may be positive for lung cancer, the person will be referred for a follow-up. [↑](#footnote-ref-13)
13. False positive results: a scenario where someone initially tests positive during lung cancer screening, but subsequent diagnostic procedures reveal that they do not have the disease. This error can result from a test failing to distinguish between cancerous and benign features on a scan. [↑](#footnote-ref-14)
14. Population-based cancer registries systematically collect information from multiple sources in a geographically defined population to monitor and assess the epidemiology of cancer in the community and how it changes over time. [↑](#footnote-ref-15)
15. A cancer screening registry is a digital or paper-based information system that collects and stores participant data for programme monitoring, evaluation and reporting. [↑](#footnote-ref-16)
16. Linking data involves use of matching criteria (e.g. a unique identifier) to create a relationship between records stored in separate databases. [↑](#footnote-ref-17)