Targeted Screening for Lung Cancer with Low Radiation Dose Computed Tomography

Quality Assurance Standards prepared for the Targeted Lung Health Checks Programme
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NHS England gateway reference: 001088
Introduction

1.1. The national Targeted Lung Health Checks programme offers people aged 55 to 74 who have ever smoked the opportunity to have a lung health check, and for those at risk of lung cancer, a referral to lung cancer screening. The programme contributes to the overall Long Term Plan early diagnosis of cancer ambition that by 2028 the proportion of cancers diagnosed at stage one and two will rise to three quarters of cancer patients.

1.2. This document sets out 15 quality standards for the programme that together form the quality assurance framework for skills and training, information and communication, and clinical delivery. The quality standards assurance framework sets the standards for nurse and radiologist experience and training, hardware, software, data management, communications, radiology acquisition and reporting, and follow on clinical management in secondary care.

1.3. Each standard relates to a specific part of the targeted lung health check pathway and cross references to the published NHS England Standard Protocol. Each standard sets out the objective, definition and metric, and the local and national assurance and audit process to demonstrate that each standard is being met.

1.4. The standard protocol outlines the four clinical roles each project has 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 to implement and monitor the 15 quality standards.

1.5. Each project will establish local standard operating procedures to ensure the quality standards are continually met and clinical risks are mitigated. The Clinical Director of Programme will report against these standards on a quarterly basis to NHS England and NHS Improvement through the Targeted Lung Health Checks Delivery Group.
Standard 1: Lung cancer screening nurses

Cross reference to Targeted Lung Health Checks Standard Protocol  Section 2.3.2

1a. Description
This standard sets out the training and experience requirements for nurses conducting lung health checks and managing the lung cancer screening programme.

1b. Objective
To ensure that the project has the trained and skilled workforce with the capacity to deliver the programme. To ensure nurses delivering the targeted lung health checks programme are qualified and competent. To ensure the service is safe and effective.

1c. Definition
Minimum qualifications for nurses:
- Registered with the Nursing and Midwifery Council; and
- For those performing spirometry to ARTP guidelines, on the national spirometry register (relevant for all healthcare practitioners performing spirometry).

Minimum training course requirements:
- Communicating with high-risk individuals about lung cancer screening;
- Consent training; and
- IR(ME)R for Referrers.

1d. Metric
- 100% of nurses conducting lung health checks meet the minimum qualifications and minimum training course requirements.
- 100% of those conducting spirometry are on the national spirometry register.

1e. Local audit
The Clinical Director of Programme will ensure nurses providing direct care meet the minimum training standard and for practitioners performing spirometry. They will maintain a local minimum training and experience record for nurses and other healthcare practitioners.

1f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.

Training courses
Training courses are available to demonstrate competence to perform lung health checks, spirometry and to meet the IR(ME)R regulations for referral to CT. Further course information and booking details are available on the Roy Castle Lung Cancer Foundation website.

<table>
<thead>
<tr>
<th>ARTP</th>
<th>NCSCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Spirometry Register</td>
<td>Communicating with high-risk individuals about lung cancer screening</td>
</tr>
</tbody>
</table>

| IR(ME)R for Referrers Course | Local Consent Training Course |
Standard 2: Lung cancer screening radiologists

Cross reference to Targeted Lung Health Checks Standard Protocol Section 4.6.1

2a. Description
This standard sets out the training and experience requirements for radiologists who report low dose CT lung cancer screening scans for the Targeted Lung Health Checks programme.

2b. Objective
To ensure that the project has the trained and skilled workforce with the capacity to deliver the programme. To ensure consultant radiologists reporting low dose CT lung cancer screening are qualified and competent. To ensure the service is safe and effective.

2c. Definition
Minimum qualifications for consultant radiologists:
- Registered with the General Medical Council (GMC); and
- Fellow of the Royal College of Radiologists (RCR).

Minimum training course requirements:
- British Society of Thoracic Imaging (BSTI) Lung Nodule Workshop.

Minimum experience:
- Reporting a minimum of 500 thoracic CTs per annum in their routine clinical practice, a significant proportion of the CTs are where there is a suspicion of lung cancer; and
- Regular attendance at a thoracic MDT meeting (includes virtual attendance) as part of their routine clinical work.

2d. Metric
- 100% of consultant radiologists reporting thoracic low dose CT scans for the Targeted Lung Health Checks programme meet the minimum requirements.

2e. Local audit
The Responsible Radiologist will ensure reporting radiologists always meets the minimum standard. They will maintain a local minimum training and experience record for radiologists reporting low dose CT scans for the programme.

2f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.

Training course - Lung Nodule Workshop
BSTI provides training events for radiologists to gain specific competency and experience in reading low dose CT lung cancer screening scans. Further details are available on the Roy Castle Lung Cancer Foundation website.

Covers BTS nodule management guidelines, hands on familiarisation of volumetry software, minimising false positives and false negatives, and importance of morphology and size assessment.
Standard 3: Radiology hardware

Cross reference to Targeted Lung Health Checks Standard Protocol Section 4.1.1 and 4.3.1

3a. Description
This standard sets out the hardware requirements for CT scanners used to deliver the Targeted Lung Health Checks programme.

3b. Objective
To ensure CT scanning equipment is safe and effective. To ensure harm from radiation is minimised by using as low a dose of radiation as possible. To ensure image quality will allow radiologists to detect lung cancers.

3c. Definition
Minimum standard:
- A sixteen channel multi-detector CT, fixed site or mobile, and calibrated according to the manufacturer’s specifications, capable of delivering low radiation dose protocols; and
- Each effective radiation dose is below 2 mSv CT dose index (CTDIvol).

3d. Metric
- Medical Physics’ confirmation that the scanner meets the minimum standard.
- 100% of radiation doses are below 2 mSv.

3e. Local audit
The Responsible Radiologist will ensure the low dose CT scanner always meets the minimum standard.

3f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 4: Radiology software

Cross reference to Targeted Lung Health Checks Standard Protocol Section 4.1.6 and 4.4

4a. Description
This standard sets out the software requirements for reporting low dose CT scans.

4b. Objective
To ensure the reporting radiology environment and process is efficient, using software that assists in producing rapid and accurate reports. To ensure auto-population of participant demographic data, scan parameter data, Brock scores and dates of scans into reporting proforma, to prevent human error and reduce reporting time.

4c. Definition
Analysis and reporting software including voice recognition reporting software is compatible with data acquisition requirements. Volumetric software used for assessment of pulmonary nodules remains constant to allow accurate comparison of volumes. If software upgrades or changes are made the new software will remeasure the old and follow up nodules unless data is available to demonstrate consistency between models.

Minimum standard:
- Computer-aided detection;
- Nodule volumetry software that automatically detects nodules and measures volume; and
- Ability to retrieve and compare any previous CT imaging.

Desirable standard:
- Facilitates double reads.

4d. Metric
- 100% of image reconstruction is standardised and used for any subsequent follow-up examinations where possible with emphasis on ensuring that slice thickness, reconstruction increment, reconstruction algorithm is identical.
- 100% of slice thickness are ≤ 1.25mm\(^1\).

4e. Local audit
The Responsible Radiologist will ensure the reporting software always meets the minimum standard.

4f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.

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\(^1\) An example of reconstruction parameters used in low-dose screening CT for Moderate spatial frequency/soft tissue are: reconstruction slice thickness 1mm; reconstruction increment 0.7mm; reconstruction FOV of the entire lung parenchyma.
Standard 5: Patient Administration System software

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3

5a. Description
This standard sets out the software requirements for the patient administration system that projects will use to call and re-call participants invited to the Targeted Lung Health Checks programme.

5b. Objective
To ensure participants invited and all subsequent appointments are managed through an auditable patient administration system. To prevent harm to participants caused by failure to recall or to follow up on findings.

5c. Definition
Patient administration software will support participant administration that is reliable and delivers a consistent process which facilitates re-call, governance, audit and evaluation.

Minimum standard:
• Software will record data acquired from GP record, the lung health check, CT scanner (including exposure, factors, radiation dose, type of scanner) and radiology reports;
• Software will track participants including recall, and change of participant contact details; and
• The software will allow the extraction of the minimum dataset.

Desirable standard:
• Automatic appointment scheduling.
• A single database for all participant data and imaging data.
• Automatic queries for data completeness and quality assurance.
• Web-based entry system with appropriate security.
• Single record linking primary care data and hospital electronic records with data from PACS.

5d. Metric
• Patient Administration System and software meets the minimum standard.

5e. Local audit
The Responsible Assessor will ensure the patient administration systems use to deliver the lung health checks programme meets the minimum standard.

5f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 6: Data management

Cross reference to Targeted Lung Health Checks Standard Protocol Section 9

6a. Description
Standard sets out what data sharing agreements are in place to control and manage participant data for the purpose of programme delivery.

6b. Objective
To ensure data sharing agreements are in place to direct how participant data is recorded, handled and used to deliver the Targeted Lung Health Checks programme. To ensure the confidentiality of participant data and adhere to local clinical and information governance.

6c. Definition
Projects will ensure the relevant Data Sharing Agreements are agreed, detailing how data is collected and used to deliver the project.

6d. Metric
- Data Sharing Agreements are in place.
- Standard operating procedures are in place to guide data management.

6e. Local audit
The Clinical Director of Programme will ensure that data management always meets the minimum standard.

6f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 7: Lung health checks programme pathway

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3 to 8

7a. Description
This standard sets out what will happen in the lung health checks pathway from the identification of eligible participants, the lung health check, lung cancer risk assessment, smoking cessation and low dose CT scanning through to follow up.

7b. Objective
To ensure the clinical teams adhere to and ensure accuracy across the lung health checks programme pathway. To ensure all participants receive the same level of interventions and care, and opportunities for face to face conversations about lifestyle changes and especially smoking cessation, are maximised.

7c. Definition
The lung health checks programme pathway is as follows:

Key:
A = suspected lung cancer on any LDCT or ≥300mm³ or ≥8mm max. diam. and Brock risk ≥10%.
B = indeterminate result:
B₁ ≥80 to <300mm³ or ≥8mm to <8mm diameter, or
B₁ ≥300mm³ or ≥8mm max. diameter and Brock risk <10%.
B₂ 5 to <8mm diameter.
C = no significant finding or nodule <80mm³ or <5mm maximum diameter.
LDCT = low radiation dose CT
New nodules on interval LDCT see protocol section 5.1.2

7d. Metric
- 100% of participants follow the lung health checks programme pathway.

7e. Local audit
The Responsible Assessor will ensure participants follow the lung health checks programme pathway and always meets the minimum standard.
7f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 8: Participant communications

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3.1, 3.4 and 8

8a. Description
This standard sets out what information participants will receive from the point of invitation, results and onward referral, to the point of discharge.

8b. Objective
To ensure that the project accurately identifies the population eligible for targeted screening. To ensure participants are provided with information to allow them to make an informed decision to maximise uptake in the eligible population. To ensure communication relating to invitation approach, results, referrals and discharge is consistent across the programme to maximise informed choice at each step of the pathway.

8c. Definition
The issuing of the standard letters\(^1\) and the participant booklet is detailed overleaf

8d. Metric
- 100% of participants will receive the standard letters and the standard booklet at the correct point in the pathway.
- 100% of participants who attend the lung health check or have a CT scan will receive an outcome letter within 4 weeks of an appointment or scan.

8e. Local audit
The Responsible Assessor will ensure that communication methods always meet the standard.

8f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Cancer Health Checks Delivery Group.

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\(^1\) The standard letters and participant booklet are available on request from england.cancerpolicy@nhs.net
**Standard 9: General Practice communications**

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3.1, 3.4 and 8

9a. Description
This standard sets out what information a participant’s GP will receive.

9b. Objective
To ensure that GPs have all the information on whether a participant attended for a lung health check, the outcome of this and subsequent follow up. To ensure the effective management of incidental findings that are agreed locally and set out in project clinical pathways.

9c. Definition
Letters to a participants’ GP must include details of results from the lung health check appointment (lung health check assessment, risk assessment, spirometry assessment and smoking cessation or any other lifestyle advice), low dose CT scan proforma and the plan of care. The issuing of the standard letters to GPs is detailed below:

2 The standard template is available on request from england.cancerpolicy@nhs.net

9d. Metric
- 100% of GP letters includes the minimum standard information.
- 100% of GP letters are sent within 4 weeks of the participant attending an appointment or scan.
9e. **Local audit**
The Responsible Assessor will ensure that the minimum standard is always met.

9f. **National Audit**
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 10: Smoking cessation

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3.2.2 and 3.4

10a. Description
This standard sets out the expectations for offering smoking cessation interventions as part of the Targeted Lung Health Checks programme.

10b. Objective
To ensure the opportunities for educating, counselling and supporting participants to quit smoking are maximised. To ensure lung health check nurses offer referral to local smoking cessation services to participants that are current smokers.

10c. Definition
The uptake of smoking cessation courses and quit rates.

10d. Metric
- 100% of current smokers that attend a lung health check are offered a smoking cessation intervention.

10e. Local audit
The Responsible Assessor will ensure that smoking cessation interventions are offered to all current smokers who attend a lung health check.

10f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 11: Participant experience

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3 to 8

11a. Description
This standard sets out how the projects will gather insights into participant experiences.

11b. Objective
To ensure the recording of participant experience and feedback is a catalyst to make improvements and to inform the evaluation of the Targeted Lung Health Checks programme. To ensure those invited for a lung health check are asked to provide feedback to amend approaches to maximise uptake in the eligible population.

11c. Definition
The Clinical Director of Programme will ensure that the participant experience survey, designed by Ipsos MORI as part of the evaluation of the Targeted Lung Health Checks programme, is distributed to those invited to a lung health check.

11d. Metric
The participant experience survey will measure participants experiences, awareness and understanding of the Targeted Lung Health Checks programme.

11e. Local audit
The Clinical Director of Programme will ensure that the project distribute the participant experience surveys as agreed by the Targeted Lung Health Checks Delivery Group.

11f. National Audit
The Clinical Director of Programme will confirm quarterly to the Targeted Lung Health Checks Delivery Group that the project is on track in its distribution of participant experience surveys.
Standard 12: Low dose CT referral

Cross reference to Targeted Lung Health Checks Standard Protocol Section 3.3.3

12a. Description
This standard sets out how participants with a positive lung cancer risk score are identified and referred for a low dose CT scan.

12b. Objective
To ensure that clinical practitioners are competent to correctly use the risk assessment tools. To ensure only participants that are at risk of lung cancer are referred for a low dose CT scan. To ensure that the CT scan is acquired at the earliest opportunity following the lung health check appointment. To ensure follow up CT scans are acquired as detailed in the participants clinical record.

12c. Definition
A participant will proceed to lung cancer screening if they meet the minimum threshold of either the Liverpool Lung Project or the Prostate Lung Colorectal and Ovarian risk prediction tool. Each tool assesses risk as follows:
- Liverpool Lung Project (LLPv2) ≥2.5% risk of lung cancer over 5 years; or
- Prostate Lung Colorectal and Ovarian or (PLCO_{m2012}) ≥1.51% risk of lung cancer over 6 years.

A participant who scores positive using either risk prediction model and does not meet any of the exclusion criteria will receive a low dose CT scan within four weeks of their lung health check.

Participants who require a follow up interval low dose CT scan will receive this within a two-week window of their target follow up scan date.

12d. Metrics
- 100% of those referred for a low dose CT scans have a risk prediction score of LLPv2 ≥2.5% over 5 years or PLCO_{m2012} ≥1.51% risk of lung cancer over 6 years.
- Percentage of participants’ who have the CT scan on the same day as their lung health check.
- For those who do not have same day CT, the length of time from lung health check to CT scan in days, and a record of reasons for not achieving a same day scan.
- Audit follow up interval scans that are not completed within the two-week window of the target interval follow up scan date.

12e. Local audit
The Responsible Radiologist will ensure that the referral for lung cancer screening always meets the minimum standard. The Responsible Assessor will audit all participants that have an interval follow-up scan outside the two-week window and agree an action plan to reduce the number of scans acquired off plan.

12f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 13: Low dose CT reporting

Cross reference to Targeted Lung Health Checks Standard Protocol Section 4.6

13a. Description
This standard sets out how low dose CT scans are reported.

13b. Objective
To ensure reporting of low dose CT scans are consistent and standardised. To ensure radiologists clinically report, using the incidental findings guidance for each participant.

13c. Definition
Radiologists will use the low dose CT reporting proforma in Annex 1. Radiologists will report incidental findings using the guidance in Annex 2.

The overall target for referral is <15%. The referral rate is a combination of referrals for suspected lung cancer via fast track clinic, including nodules requiring work-up other than additional LDCT (e.g. PET-CT), target <7% [1-3]; and referral for significant incidental findings (<8%) [1, 4].

13d. Metric

- 100% of CT reports for the Targeted Lung Health Check programme contain the information detailed in the CT reporting proforma.
- 100% of radiologists use the incidental finding management protocol to inform interpretation of low dose CT scans.
- Overall project referral rates are <15%.

13e. Local audit
The Responsible Radiologist will ensure that reporting proforma and management of incidental findings process is followed, and that the overall referral rates are <15%.

13f. National Audit
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group.
Standard 14: Quality assurance of low dose CT scans

Cross reference to Targeted Lung Health Checks Standard Protocol Sections 4.3 and 4.6.2

14a. Description
This standard sets out the quality assurance of the acquisition and reporting of low dose CT scans.

14b. Objective
To ensure participants receive low dose CT scans of diagnostic quality with no excessive radiation. To ensure radiologists are supported by peers to improve the quality of reporting low dose CT scans.

14c. Definition
Acquisition of low dose CT scans: Standard 3 defines the acquisition requirements that radiographers must adhere to.

Double reporting: the first 25 CT scans reported by each radiologist in a lung health check programme are double read. Double reading is performed by radiologists within the same lung health check programme. Where there are discrepancies between reporting decisions, the Responsible Radiologist should discuss with the Clinical Director of Programme to agree the mechanism for arbitration.

Quarterly and annual reviews: the Responsible Radiologist will review reporting performance on a quarterly and annual basis. They will work with the Clinical Director of Programme to support radiologists who are outliers.

14d. Metric
- 100% of scans are of diagnostic quality:
  - audit and review the non-diagnostic CT quality rate;
  - audit and review the mean, standard deviation, median, interquartile and range of radiation dose; and
  - audit and review reasons for all radiation doses greater than 2 mSv.
- 100% of reporting radiologists have quarterly and annual reviews:
  - Quarterly review: audit the mean, standard deviation, median, interquartile and range of the following metrics for each radiologist:
    - numbers reported;
    - recall rates to secondary care for nodules;
    - recall rates to secondary care for incidental findings;
    - number of referrals considered inappropriate by the MDT (for direct feedback);
    - number of additional investigations generated for incidental findings per participant;
    - number of PET-CTs performed;
    - benign biopsies;
    - benign resections;
    - interval cancers rates;
    - sensitivity; and
    - specificity.
  - Annual review: in addition to the quarterly metrics, includes a review of the:
    - training and experience standards (Standard 2);
    - the number of screening scans reported per Programmed Activity;
    - incidental finding rate divided into non-significant incidental findings and significant incidental findings; and
- lung nodule detection rate, the number and percentage of:
  - nodules referred for investigation in secondary care;
  - indeterminate nodules requiring additional LDCT surveillance at a rate of 11-20% [1-3]; and
  - nodules requiring no action (false positives).
- 100% of outliers, as defined from a quarterly or annual review will have evidence of agreed actions (including a period of double reporting) with the Responsible Radiologists.

**14e. Local audit**
The Responsible Radiologist will ensure that the quality assurance of the acquisition and reporting low dose CT is followed, and quarterly and annual reviews of the reporting radiologists are completed. The Responsible Radiologist and Responsible Clinician will compile an annual report on the mean, standard deviation, median, interquartile and range of the aggregate quarterly metrics at a project level.

**14f. National Audit**
The Clinical Director of Programme will report quarterly against this standard to the Targeted Lung Health Checks Delivery Group and submit an annual report on the acquisition and reporting of low dose CT scans at a project level.
Standard 15: External quality assurance of radiologists

Reporting radiologists will undertake an annual external quality assurance programme to read low dose CT scans. This will involve radiologists reviewing a set number of CT scans with the results used to benchmark reporting of radiologists with peers. The programme will establish a feedback loop to measure the ongoing quality of radiologists reporting practices.

Objective
To ensure reporting of low dose CT scans is evaluated to flag outliers who have high rates of recalls and high rates of interval cancers being detected. To ensure radiologists that are outliers receive training and ongoing support overseen by the Responsible Radiologist and Clinical Director of Programme.

Next Steps
NHS England and NHS Improvement will publish more detail on the programme and the details of the standard in the spring of 2020.
References


Annex 1: Low dose CT Reporting Proforma

This reporting template captures all findings in a structured format and provides an example of how this may look. Radiology departments will use this annex to create a structured automated report template in the radiology reporting system currently or hosted as an electronic form. Commercially available lung cancer screening reporting software will report nodule and other findings in a PDF format and a Digital Imaging and Communications in Medicine (DICOM) capture object. Radiologists will need to report incidental findings not included in the reports from the commercial software on transfer to the Picture Archiving and Communications System (PACS) or on export in XML format.

In setting up the programme the Responsible Radiologist, the Clinical Director of Programme, local PACS and Information Technology teams, will agree which format is used to capture, store and communicate the report.

<table>
<thead>
<tr>
<th>FIELD DESCRIPTION</th>
<th>VARIABLE INPUT OPTIONS</th>
<th>TYPE OF INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiologist Name</td>
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<td></td>
</tr>
<tr>
<td>GMC Number</td>
<td>Autopopulated</td>
<td></td>
</tr>
<tr>
<td>Site of LDCT</td>
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<td>Autopopulated</td>
</tr>
<tr>
<td>Type of scan</td>
<td>Baseline/ 3 month/ 12 month/ 24 month</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Date of Scan</td>
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</tr>
<tr>
<td>Date of Report</td>
<td>Autopopulated from Reporting Solution</td>
<td>Autopopulated</td>
</tr>
<tr>
<td>Was CAD(^4) available?</td>
<td>Yes/ No - software failed to process study/ No - other (specify)</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Scan quality</td>
<td>Adequate/Inadequate due to breathing artefact/Inadequate coverage</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Participant Name</td>
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<tr>
<td>History of Extra-Thoracic cancer(^5)</td>
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<tr>
<td>Family history of lung cancer(^5)</td>
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</tr>
</tbody>
</table>

\(^3\) Type of inputs: “dropdown” denotes a field where variables could be inputted as a dropdown menu for the reporting radiologist to choose the correct option, where the reporting tool allows for such a function.
\(^4\) computer-aided detection
\(^5\) Include ‘History of extrathoracic cancer’ and ‘Family history of cancer’ into the referral for low dose CT, as this information is required by the reporting radiologist. This could be done by, for example, ensuring this information is visible in the electronic or paper request form used to request the CT, or providing access to the lung health check questionnaire answers provided by the participant.
<table>
<thead>
<tr>
<th>Field</th>
<th>Component</th>
<th>Type</th>
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<tbody>
<tr>
<td>Nodule1_sliceNo</td>
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<tr>
<td>Nodule1_Volumetry reliable?</td>
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<tr>
<td>Nodule1_Nodule size (mm³)</td>
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<tr>
<td>Nodule1_maximum diameter (mm)</td>
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<td>Nodule1_Nodule type</td>
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<td>Nodule1_Spiculated</td>
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<tr>
<td>Nodule1_change assessment</td>
<td>Growth (Volume change from baseline &gt;25% if volume reliable=Yes, OR diameter change&gt;2mm if volume reliable=No)/ stable/shrinking/resolved/ NEW</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule1_VDT (days)</td>
<td>Volume doubling time from baseline</td>
<td>Free text</td>
</tr>
</tbody>
</table>

**Use same reporting fields for Nodule 2, 3 and 4 (if applicable)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Component</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodule2_sliceNo</td>
<td>Slice from series used for volumetry</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule2_Volumetry reliable?</td>
<td>Yes/No</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_Nodule size (mm³)</td>
<td>Nodule volume</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule2_Nodule maximum diameter (mm)</td>
<td>Nodule longest diameter</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule2_Nodule type</td>
<td>pure ground-glass/part-solid/solid/ IPLN/inflammatory</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_Lobe</td>
<td>RUL/RML/RLL/LUL/LLL</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_Position</td>
<td>intraparenchymal/subpleural/endobronchial</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_Spiculated</td>
<td>No/Yes</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_suspicious features</td>
<td>none/bubble-like appearance/ air bronchogram/ pleural indentation/ pleural retraction/ cyst with irregular wall</td>
<td>Dropdown (select multiple)</td>
</tr>
<tr>
<td>Nodule2_Brock score</td>
<td>Brock score</td>
<td>Autopopulated</td>
</tr>
<tr>
<td>Nodule2_change assessment</td>
<td>Growth (Volume change from baseline &gt;25% if volume reliable=Yes, OR diameter change&gt;2mm if volume reliable=No)/ stable/shrinking/resolved/NEW</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule2_VDT (days)</td>
<td>Volume doubling time from baseline</td>
<td>Free text</td>
</tr>
</tbody>
</table>

**Nodule3**

<table>
<thead>
<tr>
<th>Field</th>
<th>Component</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodule3_sliceNo</td>
<td>Slice from series used for volumetry</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule3_Volumetry reliable?</td>
<td>Yes/No</td>
<td>Dropdown</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Nodule3_Nodule size (mm³)</td>
<td>Nodule volume</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule3_Nodule maximum diameter (mm)</td>
<td>Nodule longest diameter</td>
<td>Free text</td>
</tr>
<tr>
<td>Nodule3_Nodule type</td>
<td>pure ground-glass/ part-solid/ solid/ IPLN/inflammatory</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule3_Lobe</td>
<td>RUL/RML/RLL/LUL/LLL</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule3_Position</td>
<td>intraparenchymal/subpleural/endobronchial</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule3_Spiculated</td>
<td>No/Yes</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule3_suspicious features</td>
<td>none/bubble-like appearance/ air bronchogram/ pleural indentation/ pleural retraction/ cyst with irregular wall</td>
<td>Dropdown (select multiple)</td>
</tr>
<tr>
<td>Nodule3_Brock score⁶</td>
<td>Brock score</td>
<td>Autopopulated</td>
</tr>
<tr>
<td>Nodule3_change assessment</td>
<td>Growth (Volume change from baseline &gt;25% if volume reliable=Yes, OR diameter change&gt;2mm if volume reliable=No)/stable/ shrinking/ resolved/NEW</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Nodule3_VDT (days)</td>
<td>Volume doubling time from baseline</td>
<td>Free text</td>
</tr>
</tbody>
</table>

| Nodule4 | Slice from series used for volumetry | Free text |
| Nodule4_Volumetry reliable? | Yes/No | Dropdown |
| Nodule4_Nodule size (mm³) | Nodule volume | Free text |
| Nodule4_Nodule maximum diameter (mm) | Nodule longest diameter | Free text |
| Nodule4_Nodule type | pure ground-glass/part-solid/solid/ IPLN/inflammatory | Dropdown |
| Nodule4_Lobe | RUL/RML/RLL/LUL/LLL | Dropdown |
| Nodule4_Position | intraparenchymal/subpleural/endobronchial | Dropdown |
| Nodule4_Spiculated | No/Yes | Dropdown |
| Nodule4_suspicious features | none/ bubble-like appearance/ air bronchogram/ pleural indentation/ pleural retraction/ cyst with irregular wall | Dropdown (select multiple) |
| Nodule4_Brock score⁶ | Brock score | Autopopulated |
| Nodule4_change assessment | Growth (Volume change from baseline >25% if volume reliable=Yes, OR diameter change>2mm if volume reliable=No)/stable/ shrinking/ resolved/NEW | Dropdown |
| Nodule4_VDT (days) | Volume doubling time from baseline | Free text |

<p>| Total number of nodules detected | 0/ 1/ 2/ 3/ 4/ other - free text for maximum number | Dropdown |
| Emphysema extent⁶ | None/mild (&lt;25%)/ moderate (25-50%)/ severe (&gt;50%) | Dropdown |
| Emphysema predominant type⁶ | None/centrilobular/ paraseptal/ panacinar | Dropdown |
| Highest Brock score | Highest Brock score from four reported nodules | Autopopulated |</p>
<table>
<thead>
<tr>
<th>Are there incidental pulmonary findings?</th>
<th>No/ Yes</th>
<th>Dropdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchiectasis</td>
<td>None/ Mild (airways 1.5- 2X size of artery)/ moderate (airways 2-3X size artery/ severe (&gt;3X size of artery AND &gt;1segment)</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Respiratory-Bronchiolitis</td>
<td>Absent/Present</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Interstitial lung abnormalities (ILA)</td>
<td>None or ILA other than reticulation/ &lt;5% reticulation of total lung volume/ 5-10% reticulation of total lung volume/ &gt;10% of total lung volume</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Infective consolidation</td>
<td>No/ Yes</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Active Tuberculosis</td>
<td>No/ Yes</td>
<td>Dropdown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are there incidental intrathoracic findings?</th>
<th>No/ Yes</th>
<th>Dropdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediastinal mass present?</td>
<td>Absent/Present</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Mediastinal mass_description</td>
<td>Report position, density and size (use this to describe large lymph nodes that require referral as well)</td>
<td>Free text</td>
</tr>
<tr>
<td>Coronary calcification&lt;sup&gt;a&lt;/sup&gt;</td>
<td>None/ Mild/ Moderate/ Severe</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Aortic valve calcification</td>
<td>None/ Moderate/ Severe</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Thoracic Aortic aneurysm</td>
<td>None/ &lt;4cm/ 4.0cm-5.5cm/ &gt;5.5cm</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Pleural effusion/thickening or mass</td>
<td>Absent/ Unilateral right/ Unilateral left/bilateral</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Pleural effusion or thickening_description</td>
<td>Describe findings (use this to describe unusual lesions e.g. schwannoma)</td>
<td>Free text</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are there incidental extrathoracic findings?</th>
<th>No/Yes</th>
<th>Dropdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspicious Breast lesion</td>
<td>Describe size, position and suspicious feature(s)</td>
<td>Free text</td>
</tr>
<tr>
<td>Suspicious thyroid lesion</td>
<td>Describe size, position and suspicious feature(s)</td>
<td>Free text</td>
</tr>
<tr>
<td>Liver or splenic lesion</td>
<td>benign/indeterminate and potentially malignant (ill-defined margin, heterogeneous density, mural thickening or nodularity, thick septa)</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Liver or splenic lesion_description</td>
<td>Describe size, position and suspicious feature(s)</td>
<td>Free text</td>
</tr>
<tr>
<td>Renal lesion</td>
<td>benign (too small to characterise or homogeneous)/ benign (homogeneous -10 to 20HU: thin or imperceptible wall, no mural nodule, septa or calcification)/benign (homogeneous &gt;=70HU : thin or imperceptible wall, no mural nodule, septa or calcification)/benign (solitary, contains ROI &lt;-10HU AND no calcification AND &lt;4cm)/indeterminate and potentially malignant (homogeneous 21-69HU : thin or imperceptible wall, no mural nodule, septa or calcification)/ indeterminate and potentially malignant (heterogeneous, thick or irregular wall, mural nodule, septa or calcification); indeterminate and potentially malignant (solitary, contains ROI &lt;-10HU AND calcification); indeterminate and potentially malignant (multiple, contains ROI &lt;-10HU AND calcification); indeterminate and potentially malignant (solitary AND no calcification AND</td>
<td>Dropdown</td>
</tr>
</tbody>
</table>

<sup>a</sup> Coronary calcification is a new option added to the table.
<table>
<thead>
<tr>
<th>Renal lesion description</th>
<th>Describe size, position and suspicious feature(s)</th>
<th>Free text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenal lesion</td>
<td>Benign (&lt;10HU and &lt;1cm); indeterminate</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Adrenal lesion description</td>
<td>Describe size, position and suspicious feature(s)</td>
<td>Free text</td>
</tr>
<tr>
<td>Abdominal aortic aneurysm</td>
<td>None/ 3-5cm/ &gt;5cm</td>
<td>Dropdown</td>
</tr>
<tr>
<td>Bones</td>
<td>None/ osteoporotic fracture &lt;=50%/ osteoporotic fracture &gt;50%/ malignant lytic or sclerotic features</td>
<td>Dropdown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Is there any other urgent finding?</th>
<th>No/Yes</th>
<th>Dropdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urgent finding description</td>
<td>Description of urgent finding</td>
<td>Free text</td>
</tr>
<tr>
<td>Follow up recommendation_nodules</td>
<td>Urgent referral to lung cancer MDT^7 Refer to Screening Review Meeting-specify reason Interval LDCT at 3 months Interval LDCT at 12 months Interval LDCT at 24 months</td>
<td>Dropdown (multiple selections not allowed) Free text for specifying reason</td>
</tr>
<tr>
<td>Follow-up recommendation_other</td>
<td>Urgent referral to other cancer MDT- specify which Urgent referral to other non-cancer team-specify which Refer to Chest Clinic Refer to Tuberculosis service GP action required Specify MDT or GP action for incidental finding requiring action, as per NHSE protocol (see Annex 2)</td>
<td>Dropdown (select multiple) Free text for specifying reason</td>
</tr>
</tbody>
</table>

^7 MDT = multidisciplinary team
## Annex 2: Incidental findings management protocol


The table below provides guidance on the management of common incidental findings on low dose CT scans in the context of screening for lung cancer. It should be read in conjunction with the NHS England Standard Protocol and the sections 6, 9, 12 and 13 of the American College of Radiology white paper.

A summary of protocols in use in pilots and research studies in England and a justification for the following recommendations is available on request by emailing england.cancerpolicy@nhs.net

### Table: Finding Reporting Recommendation

<table>
<thead>
<tr>
<th>Finding</th>
<th>Reporting Recommendation</th>
<th>Action required</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emphysema</td>
<td>Classify as:</td>
<td></td>
<td>It should not be used to diagnose COPD.</td>
</tr>
<tr>
<td></td>
<td>• Mild (&lt;25%);</td>
<td>Smoking cessation. Consider referral to local community respiratory team for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Moderate (25-50%); or</td>
<td>moderate and severe. Enter onto COPD register if diagnosis confirmed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Severe (&gt;50%).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronchiectasis</td>
<td>Classify as:</td>
<td>Mild/borderline bronchiectasis: no action or communication required.</td>
<td>Information on symptoms should be available from the lung health check. Do not recommend for non-specific clinical correlation. Option, for review at screening review meeting. CT results with moderate and severe disease communicate result to the participant and GP.</td>
</tr>
<tr>
<td></td>
<td>• Mild (airways are 1.5-2 times the size of artery);</td>
<td>Moderate or severe bronchiectasis either:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Moderate (2-3 times the size); or</td>
<td>• refer to chest clinic if chronic cough or recurrent LRTI has been documented at the health check; or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Severe (greater than three times the size of corresponding artery [7])</td>
<td>• notify participant and GP regarding standard bronchiectasis/ infection prophylaxis management and give the option of referral.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For bronchiectasis to be categorised as severe, it must also be present in more than one segment of the lung.</td>
<td>Consider referral to local community respiratory team.</td>
<td></td>
</tr>
<tr>
<td>Bronchial wall thickening</td>
<td>Do not report.</td>
<td>None.</td>
<td></td>
</tr>
<tr>
<td>RBILD</td>
<td>Report.</td>
<td>Smoking cessation.</td>
<td></td>
</tr>
<tr>
<td>Interstitial Lung Abnormalities (ILAs)</td>
<td>Report all ILD and recommend:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If &gt;10% reticulation based on visual estimation, for respiratory referral; or</td>
<td>• &lt;5% ILA does not require action or communication.</td>
<td>Option should be available for review at the screening review meeting. Only communicate significant CT results to the participant and the GP.</td>
</tr>
<tr>
<td></td>
<td>• If 5-10%, recommend correlation with</td>
<td>• Consider referral if &gt;10% or &gt;5% with restrictive spirometry for further</td>
<td></td>
</tr>
<tr>
<td>Finding</td>
<td>Reporting Recommendation</td>
<td>Action required</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Consolidation</td>
<td>Categorise as consolidation/likely inflammatory requiring 3 months repeat CT or consolidation/possibly malignant requiring MDT referral.</td>
<td>Refer MDT if cancer is possible. Repeat 3 months CT if looks inflammatory. Assess for clinical infection and prescribe antibiotics as required.</td>
<td>Minor areas of consolidation, unlikely to be of clinical significance should either not be reported or reported as above.</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Indicate if likely to be TB; indicate differential diagnosis</td>
<td>Refer to Tuberculosis service if finding suspicious for Tuberculosis.</td>
<td>ACP</td>
</tr>
<tr>
<td>Mediastinal mass</td>
<td>Report size of mediastinal mass, position and whether cystic; recommend review by Lung Cancer MDT or Screening Review MDT.</td>
<td>See notes for further management.</td>
<td>Options include continued surveillance at next screening round CT or further investigation including PET/CT/MRI, based on size and morphology. Cystic lesions do not require further investigation [9].</td>
</tr>
<tr>
<td>Coronary calcification</td>
<td>Report as mild / moderate / severe based on visual estimation of most affected artery [10].</td>
<td>Cardiovascular risk assessment to be completed and primary prevention recommended where not already in place.</td>
<td>Projects will agree locally whether to add in cardiovascular risk assessment as an additional clinical intervention into the lung health check appointment. Cardiovascular risk assessment may have been performed in primary care for participants meeting LHC eligibility criteria, so CT-detected coronary artery calcification may not add to this.</td>
</tr>
<tr>
<td>Aortic valve disease</td>
<td>Report if moderate or severe calcification involving 2 or 3 cusps. Isolated specks of calcification do not require reporting.</td>
<td>Primary care to refer for echocardiogram if moderate or severe non-localised aortic valve calcification, and not known to have aortic valve disease [11].</td>
<td></td>
</tr>
<tr>
<td>Aortic aneurysms</td>
<td>Thoracic: • &lt;4cm, no action. • 4.0cm-5.5cm, for GP to refer. • &gt;5.5cm, for urgent referral.</td>
<td>Thoracic: • &lt;4cm, no action. • 4.0cm-5.5cm, referral. • &gt;5.5cm, urgent referral.</td>
<td>This does not require discussion at the screening review meeting.</td>
</tr>
<tr>
<td></td>
<td>Abdominal: • 3-5cm, to refer. • &gt;5cm, for urgent referral.</td>
<td>Abdominal: • 3-5cm, referral. • &gt;5cm, urgent referral.</td>
<td>ACP</td>
</tr>
<tr>
<td>Finding</td>
<td>Reporting Recommendation</td>
<td>Action required</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Breast nodules</td>
<td>Specify site and size.</td>
<td>Breast MDT referral if not previously known or no information.</td>
<td>Images and information available will inform the radiological assessment. Incompletely imaged lesions or lesions too small to characterize should not by itself prompt further investigation.</td>
</tr>
<tr>
<td>Liver lesions</td>
<td>Further guidance on evaluation of liver lesions on unenhanced CT is provided in ACR white paper [12]. Classification options have been built into the reporting template (Annex 1). Lesions are classified into malignant, indeterminate and benign or incompletely imaged/ unable to evaluate.</td>
<td>See notes and reporting recommendations. Clinical teams to agree local pathways: • malignant lesions refer to the appropriate cancer pathway; • indeterminate lesions refer to the screening review meeting; and • all other lesions require no action.</td>
<td>Assessment should be made on images and information available. Incompletely imaged kidneys or lesions too small to characterize should not prompt further investigation by itself.</td>
</tr>
<tr>
<td>Renal lesions</td>
<td>Further guidance on evaluation of renal lesion density is provided in ACR white paper [13]. Classification options have been built into the reporting template (Annex 1). Lesions are classified into malignant, indeterminate and benign or incompletely imaged/ unable to evaluate.</td>
<td>See notes and reporting recommendations. Clinical teams to agree local pathways: • malignant lesions refer to the appropriate cancer pathway; • indeterminate lesions refer to the screening review meeting; and • all other lesions require no action.</td>
<td></td>
</tr>
<tr>
<td>Bone abnormalities</td>
<td>GP to refer for bone density evaluation for &gt;50% osteoporotic fractures.</td>
<td>Recommended to participant and GP bone risk assessment and protection.</td>
<td></td>
</tr>
<tr>
<td>Thyroid abnormalities</td>
<td>Report only if any local lymphadenopathy and/or punctate calcification.</td>
<td>Refer to thyroid MDT.</td>
<td></td>
</tr>
<tr>
<td>Adrenal lesions</td>
<td>Report size and attenuation. • if &lt;1cm, do not recommend referral; or • for other lesions, recommend review at screening review meeting.</td>
<td>• &lt;1cm or &lt;10HU⁸, no action. • 1-4cm and &gt;10HU⁸, no action but participant to return for 12 months scan. • &gt;4cm for endocrine referral.</td>
<td></td>
</tr>
<tr>
<td>Pleural effusions/thickening</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Report size and laterally if malignant features seen, refer to lung cancer service. This includes schwannomas.</td>
<td>Discuss at screening review meeting or for lung cancer referral.</td>
<td></td>
</tr>
</tbody>
</table>

Authors: Prof. David Baldwin  
Dr. Claire Bloomfield

Consultant Respiratory Physician, Nottingham University Hospital  
Chief Operating Officer for Medical Imaging, University of Oxford

---

⁸ Radiologists to measure adrenal lesions as they would in clinical practice - that is, using the mean HU from the ROI measured on average multiplanar reconstructions of 3-5mm thickness (radiologist to manipulate the thickness in current software packages).
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Dr. Alexis Webb  Cancer Research UK

Reviewed by CT Screening Advisory Sub-group of the Lung Cancer Clinical Expert Group.

References:
