Developing a Pan-European Technical Standard for a Comprehensive High-quality Lung Cancer CT Screening Program. An ERS Technical Standard

Appendices

Appendix A: Search strategy

SCOPE:

narrative review on pre-defined key steps in LDCT lung cancer screening programmes

a. Capacity and infrastructure requirements
    i. capacity (personnel and equipment)
    ii. infrastructural
b. Clinical governance, roles and responsibilities
    i. clinical governance
c. Invitation methods
    i. invitation methods
d. Participant pathway
    i. pathway
e. Risk assessment for entry into screening programmes
f. Low Dose Computed Tomography Acquisition and Reading
    i. parameters for image acquisition?
    ii. reading of CT imaging?
g. CT interval and surveillance
h. Non-attendance and Exiting the Programme
    i. non-attendance?
    ii. exiting the programme?
i. Communication of results
    i. participants?
    ii. information given on participants?
j. Data management
    i. requirements for data management?

LIMITS:

Systematic Reviews

Cohorts of 50+ cases

Guidelines

Statements

RCTs

Government and Society documents

European languages

SEARCH STRATEGIES:

1. RCTs in LDCT lung cancer screening - DETeCCTS_update_2020 library : large equation with focus on document type, time limit from 2020 (update of previous systematic review by Thierry Berghmans and Valérie Durieux) = 20 new documents (plus previous systematic review(s) accessible for us)

2. Real life publication in LDCT lung cancer screening - DETeCCTS_focus_RL library : large equation with focus on real life, time limit from 2010 = 1340 documents (no time limit: 1663 documents)

3. Risk assessment: DETeCCTS_RA library : equation for risk assessment, time limit from 2015 = 570 documents

1. Information on RCTs in lung cancer screening

(exp mass screening/ or exp early diagnosis/ or screening.tw or early diagnos*.tw) and (lung neoplasms/ or bronchial neoplasms/ or carcinoma, bronchogenic/ or carcinoma, non-small-cell lung/ or small cell lung carcinoma/ or pancoast syndrome/ or lung neoplasm*.tw or lung cancer*.tw or lung carcinoma*.tw or lung tumour*.tw or lung tumor*.tw or pulmonary neoplasm*.tw or pulmonary cancer*.tw or pulmonary carcinoma*.tw or pulmonary tumour*.tw or pulmonary tumor*.tw or bronchial neoplasm*.tw or bronchial cancer*.tw or bronchial carcinoma*.tw or bronchial tumour*.tw or bronchial tumor*.tw or bronchogenic neoplasm*.tw or bronchogenic cancer*.tw or bronchogenic carcinoma*.tw or bronchogenic tumour*.tw or bronchogenic tumor*.tw or pancoast* syndrome*.tw or pancoast* tumor*.tw or pancoast* tumour*.tw) and (exp Tomography, X-Ray/ or Tomography Scanners, X-Ray Computed/ or CT*.tw or Scan*.tw or Tomograph*.tw or Tomodensitometr*.tw) and (smokers/ or exp smoking/ or tobacco/ or exp "Tobacco Use"/ or exp tobacco products/ or smoker*.tw or tobacco smok*.tw or tobacco consumption.tw or cigaret*.tw or high risk*.tw)

AND (comparative study.ti or controlled clinical trial.ti or randomized controlled trial.ti OR rct.ti OR phase iii.ti or clinical trial, phase iii.pt or comparative study.pt or controlled clinical trial.pt or randomized controlled trial.pt)

From 2020 = 20 (25/11/2021)

2. Information on real life publications in lung cancer screening

(exp mass screening/ or exp early diagnosis/ or screening.tw or early diagnos*.tw) and (lung neoplasms/ or bronchial neoplasms/ or carcinoma, bronchogenic/ or carcinoma, non-small-cell lung/ or small cell lung carcinoma/ or pancoast syndrome/ or lung neoplasm*.tw or lung cancer*.tw or lung carcinoma*.tw or lung tumour*.tw or lung tumor*.tw or pulmonary neoplasm*.tw or

pulmonary cancer*.tw or pulmonary carcinoma*.tw or pulmonary tumour*.tw or pulmonary tumor*.tw or bronchial neoplasm*.tw or bronchial cancer*.tw or bronchial carcinoma*.tw or bronchial tumour*.tw or bronchial tumor*.tw or bronchogenic neoplasm*.tw or bronchogenic cancer*.tw or bronchogenic carcinoma*.tw or bronchogenic tumour*.tw or bronchogenic tumor*.tw or pancoast* syndrome*.tw or pancoast* tumor*.tw or pancoast* tumour*.tw) and (exp Tomography, X-Ray/ or Tomography Scanners, X-Ray Computed/ or CT*.tw or Scan*.tw or Tomograph*.tw or Tomodensitometr*.tw) and (smokers/ or exp smoking/ or tobacco/ or exp "Tobacco Use"/ or exp tobacco products/ or smoker*.tw or tobacco smok*.tw or tobacco consumption.tw or cigaret*.tw or high risk*.tw)

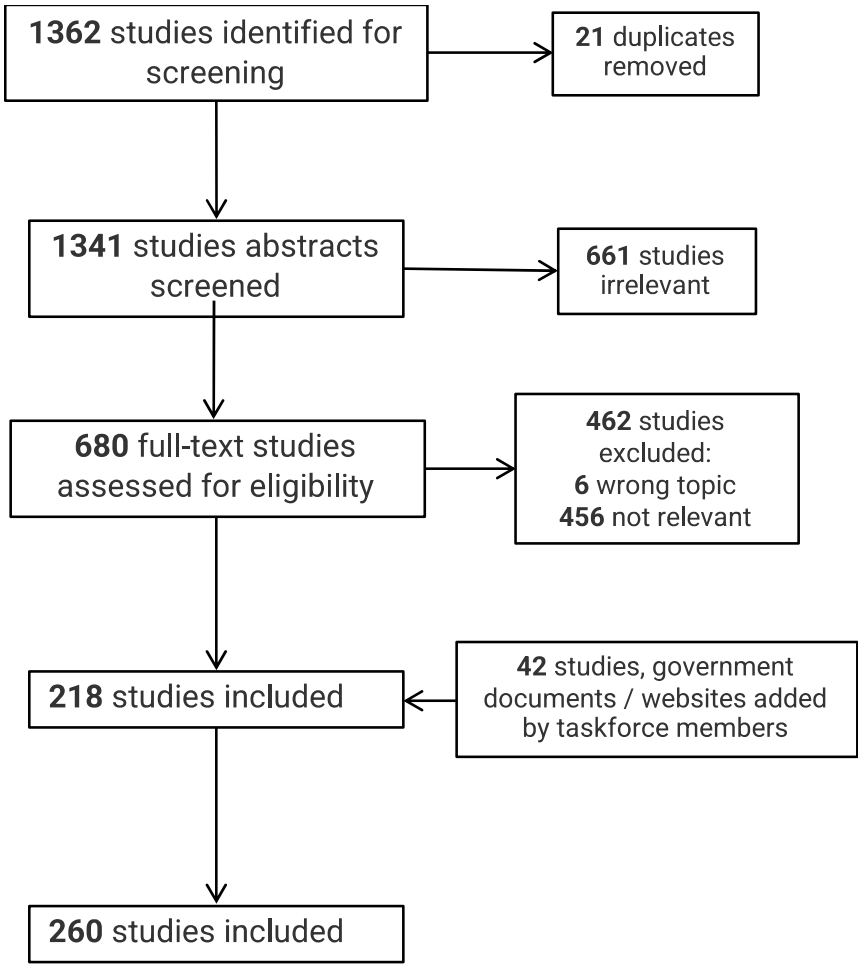
From 2010 = 1340 (25/11/2021)

3. Information on risk assessment

(lung neoplasms/ or bronchial neoplasms/ or carcinoma, bronchogenic/ or carcinoma, non-small-cell lung/ or small cell lung carcinoma/ or pancoast syndrome/ or lung neoplasm*.tw or lung cancer*.tw or lung carcinoma*.tw or lung tumour*.tw or lung tumor*.tw or pulmonary neoplasm*.tw or pulmonary cancer*.tw or pulmonary carcinoma*.tw or pulmonary tumour*.tw or pulmonary tumor*.tw or bronchial neoplasm*.tw or bronchial cancer*.tw or bronchial carcinoma*.tw or bronchial tumour*.tw or bronchial tumor*.tw or bronchogenic neoplasm*.tw or bronchogenic cancer*.tw or bronchogenic carcinoma*.tw or bronchogenic tumour*.tw or bronchogenic tumor*.tw or pancoast* syndrome*.tw or pancoast* tumor*.tw or pancoast* tumour*.tw) and (smokers/ or exp smoking/ or tobacco/ or exp "Tobacco Use"/ or exp tobacco products/ or smoker*.tw or tobacco smok*.tw or tobacco consumption.tw or cigaret*.tw or high risk*.tw) and (risk model*.tw or Risk Assessment/ or Risk assessment*.tw or Risk prediction model.tw or Assessment tool.tw or Prediction score.tw or Bach.tw or Liverpool Lung Project.tw or LLP.tw or Spitz.tw or Two-stage clonal expansion.tw or TSCE.tw or Model for African Americans.tw or Lung cancer in Korean men.tw or Hoggart.tw)

From 2015 = 570 (25/11/2021)

Appendix B: Flow diagram of article screening results



Appendix C:

Topics identified by TF members as essential components of a Lung Cancer Screening program

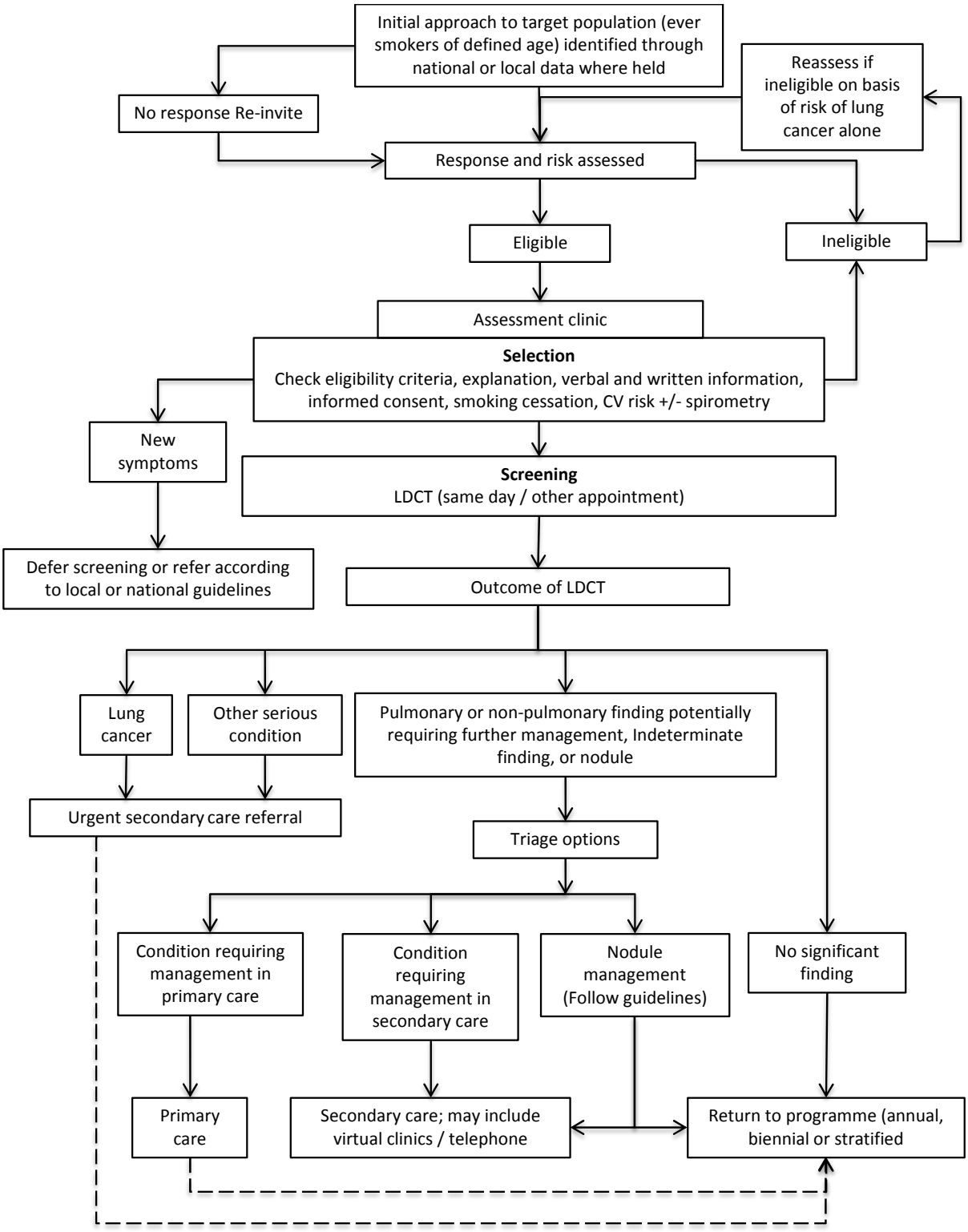
Topic	Questions
Capacity and infrastructure requirements	What are the requirements in terms of capacity (personnel and equipment) in order to deliver a CT screening program for lung cancer? What are the infrastructural considerations that may influence the delivery of a CT screening program for lung cancer? What are additional services within a CT screening program for lung cancer?
Clinical governance, roles and responsibilities	What clinical governance standards apply to CT screening? Which roles form part of clinical governance of programs?
Participant Pathway	What are the components that are included in the participant pathway? What components are regarded as crucial?
Invitation methods	What invitation methods have been used successfully in screening for cancer? Which invitation methods are the most effective?
Risk assessment for entry into screening programs	What methods are used to assess the risk of lung cancer in potential participants? Which risk assessment methods may be applied to select eligible participants?
Smoking cessation	What is the optimum strategy for integration of smoking cessation into LCS programs?
Non-attendance and Exiting the Program	What methods have been applied to address non-attendance? Which methods are most effective What are the options for exiting the program?
LDCT Acquisition, Reading and Reporting	What are the accepted parameters for image acquisition? What are the standards for reading of imaging? What are the standards applied to interpretation and reporting?
CT interval and surveillance	What intervals have been applied between scans? What are the implications of different intervals? What circumstances may influence the choice of interval?

Communication of results	What methods are used to communicate results to participants? What impacts do the methods used, and content of, the information given on participants?
Data management	What are the requirements for data management? What data are collected? How are data analysed? How are data managed and what are the options?

Appendix D: Core roles and responsibilities in the governance of a LCS program.

Title of role	**Function**	**National / local / both**
National Screening Advisory Body	Evaluates the effectiveness and cost effectiveness and makes national recommendations	National
National Cancer Board / Team	Translates recommendations for screening, national cancer plans into a national LCS program	National
National LCS Steering Committee or Collaborative Group	Develops protocol, advises on all aspects of the program including outcome and quality assurance data	National / Local
Local LCS Steering Committee	Direct oversight of the local program ensuring adherence to protocol (whether national or local)	National / local
Director / Lead of local programme	Takes overall responsibility for local delivery of LCS including adherence to the agreed protocol and quality assurance standards	National / local
Lead Radiologist(s)	Responsible for adherence of radiology team to defined standards	National / local
Lead Clinician(s)	Responsible for adherence of the clinical team managing indeterminate, incidental and positive findings from LDCT	National / local
Lead Assessor(s)	Responsible for ensuring the correct selection and recruitment process	National / local

Appendix E: An example lung cancer screening participant pathway



Appendix F: Additional desirable features of semi-automated volumetry

1. Facility to measure nodule volume on nodules not identified by CAD.
2. Facility adjust segmentation in a semi-automated fashion when necessary.
3. Facility to accept or reject CAD identified nodules.
4. Ability to track nodules consistently.
5. Ability to measure and record diameter where segmentation has failed.
6. Provision of percentage volume change and volume doubling time calculations compared to all previous scans.
7. Ability to detect, segment and measure subsolid nodules.

Appendix G: Minimum required dataset items

Centers for Medicare & Medicaid Services[257]		**NHS England Targeted Lung Healthcheck Program[10]**	
Data Type	**Minimum Required Data Elements**	**Data Type**	**Required Data Elements**
Facility	Identifier	Demographic data	Participant ID, LSOA, sex, age, GP Practice code, CCG code, marital status, ethnicity, main language
Radiologist(reading)	National Provider Identifier (NPI)	Co-morbidities	COPD, IHD, Cancer (date of previous cancer diagnosis), other medical diagnoses
Patient	Identifier	Lung Health Check (LHC)	Dates of letters/ telephone contact ID of person contacting participant LHC date LHC assessor ID Symptoms WHO/ECOG Performance Status Height, weight, BMI LDCT consent & ID of person taking consent
Ordering Practitioner	National Provider Identifier (NPI)	Smoking history	Smoking Type, Age started smoking, Date stopped smoking, Total quit period (years), Average number smoked daily, Number of years smoked, Estimated Pack Years,

CT scanner	Manufacturer, Model.	Risk assessment	All LLP v2 variables All PLCOm2021 variables
Indication	Lung cancer LDCT screening absence of signs or symptoms of lung cancer	Exclusion criteria	Unable to lie flat, Weight >200Kg, Previous thoracic CT <12 months ago, does not have capacity to consent to LDCT, Not physically fit, Participant declined
System	Lung nodule identification, classification and reporting system	Smoking cessation	Smoking Cessation Offered, Consent to be referred for smoking cessation. Outcomes of smoking cessation, including quit data at 3 months
Smoking history	Current status (current, former, never). If former smoker, years since quitting. Pack-years as reported by the ordering practitioner. For current smokers, smoking cessation interventions available.	Screening	Date Scanner ID Radiation dose Reader 1 ID/ reader 2 ID CAD used Nodule data/ risk assessment Incidental findings Screening outcome/ recommendation Onward referrals/ reason for these
Effective radiation dose	CT Dose Index (CTDIvol).	Diagnostics	Diagnostic/ staging tests

			Outcome TNM stage if lung cancer Treatment if lung cancer
Screening	Screen date Initial screen or subsequent screen	Outcomes	Death within 30 days of any procedure Date of death Cause of death
LDCT: low-dose computed tomography; LSOA: Lower Super Output Area; GP: General Practitioner; CCG: Clinical commissioning group; COPD: chronic obstructive pulmonary disease; IHD: ischaemic heart disease; WHO/ECOG: World Health Organisation/ Eastern Cooperative Oncology Group; BMI: body mass index; LLP: Liverpool Lung Project; PLCO: Prostate, Lung, Colorectal and Ovarian cancer; CAD: computer-aided detection; TNM: tumour, node, metastasis			