








OPEN ACCESS

# Telephone risk-based eligibility assessment for low-dose CT lung cancer screening

Jennifer L Dickson ,<sup>1</sup> Helen Hall ,<sup>1</sup> Carolyn Horst,<sup>1</sup> Sophie Tisi,<sup>1</sup> Priyam Verghese,<sup>1</sup> Anne-Marie Mullin,<sup>2</sup> Jonathan Teague,<sup>2</sup> Laura Farrelly,<sup>2</sup> Vicky Bowyer,<sup>3</sup> Kylie Gyertson,<sup>3</sup> Fanta Bojang,<sup>3</sup> Claire Levermore,<sup>3</sup> Tania Anastasiadis,<sup>4</sup> Karen Sennett,<sup>5</sup> John McCabe,<sup>1</sup> Anand Devaraj,<sup>6,7</sup> Arjun Nair,<sup>3</sup> Neal Navani,<sup>1,3</sup> Matthew EJ Callister ,<sup>8</sup> Allan Hackshaw,<sup>2</sup> SUMMIT Consortium, Samantha L Quaife ,<sup>9</sup> Sam M Janes ,<sup>1,3</sup>

For numbered affiliations see end of article.

## Correspondence to

Dr Sam M Janes, Lungs for Living Research Centre, UCL Respiratory, University College London, London, UK; s.janes@ucl.ac.uk

SLQ and SMJ are joint senior authors.

Received 22 December 2021  
Accepted 9 June 2022

## ABSTRACT

Eligibility for lung cancer screening (LCS) requires assessment of lung cancer risk, based on smoking history alongside demographic and medical factors. Reliance on individual face-to-face eligibility assessment risks inefficiency and costliness. The SUMMIT Study introduced a telephone-based lung cancer risk assessment to guide invitation to face-to-face LCS eligibility assessment, which significantly increased the proportion of face-to-face attendees eligible for LCS. However, levels of agreement between phone screener and in-person responses were lower in younger individuals and minority ethnic groups. Telephone-based risk assessment is an efficient way to optimise selection for LCS appointments but requires further iteration to ensure an equitable approach.

## INTRODUCTION

Lung cancer screening (LCS) using low-dose CT (LDCT) reduces lung cancer mortality in high-risk populations.<sup>1,2</sup> Eligibility is determined by lung cancer risk calculations, comprising smoking history, demographic and medical factors. No comprehensive population-based system exists from which LCS eligibility can be determined, therefore necessitating individual risk assessment of all potentially eligible individuals. Up to 88% of adults approached based on age alone were ultimately ineligible for LCS.<sup>2,3</sup> More targeted strategies including primary-care recorded smoking status or telephone screening of exclusion criteria (eg, current cancer treatment) still find 25%–50% of individuals ineligible at in-person assessment,<sup>4,5</sup> resulting in unnecessary appointments and potential distress.<sup>6</sup>

To reduce this inefficiency, the SUMMIT study introduced a telephone-based eligibility assessment ('phone screener') between the invitation and appointment to estimate individual lung cancer risk, in a similar approach to the Yorkshire Lung Screening Trial.<sup>7</sup> This manuscript reports the feasibility and accuracy of the phone screener in the first 12 months of recruitment.

## METHODS

The SUMMIT study is a prospective observational cohort study aiming to assess the implementation of LDCT for LCS in a high-risk population and to validate a multicancer early detection blood test. Study eligibility was assessed via a three-step process:

primary care invitation, phone screener and face-to-face 'Lung Health Check' (LHC) (table 1). Potentially eligible individuals were invited by post from across north central and east London, with those meeting either US Preventive Services Task Force (USPSTF) 2014 criteria<sup>8</sup> or prostate, lung, colorectal, ovarian (PLCO)<sub>m2012</sub> 6-year lung cancer risk<sup>9</sup>  $\geq 1.3\%$  invited to undergo LCS as part of the study.

The initial phone screener (V.1) verified age and smoking status only; however, due to a high proportion of LHC attendees being ineligible for LCS, questions were expanded (V.2, conducted by National Health Service (NHS) band four staff), enabling estimation of USPSTF and PLCO<sub>m2012</sub> criteria (table 1). Eligible individuals were offered an LHC appointment at which NHS band five staff (blinded to phone screener responses) asked questions and measured height and weight to accurately assess USPSTF and PLCO<sub>m2012</sub> criteria (taken as the 'gold standard').

## Analysis

The accuracy of phone screener-based estimation of eligibility was quantified by the proportion of responders subsequently eligible for LCS at LHC appointment. Levels of agreement for individual participant responses during phone screener and LHC (for specific questions and overall eligibility status) were compared with Cohen's Kappa (K) and interpreted as per Landis and Koch,<sup>10</sup> for all LHC attendees and within age and ethnicity groups.

## RESULTS

### Effectiveness of telephone-based eligibility estimation on efficient utilisation of LHC appointments

Between March 2019 and April 2020, 30759 individuals responded to the LHC invitation. The first 3.6% (n=1111) completed phone screener V.1, the remaining 96.4% (n=29648) completed V.2 (figure 1). Significantly fewer individuals were eligible for an LHC using V.2 compared with V.1, (56.1% vs 86.9%,  $p < 0.001$ ). This resulted in an increased proportion of LHC attendees being LCS eligible (60.3% V.1 vs 82.6% V.2,  $p < 0.001$ ).



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

**To cite:** Dickson JL, Hall H, Horst C, *et al.* *Thorax* Epub ahead of print: [please include Day Month Year]. doi:10.1136/thoraxjnl-2021-218634

**Table 1** Three step eligibility assessment for the SUMMIT Study and comparison of data collected at phone screener versus Lung Health Check to calculate lung cancer risk

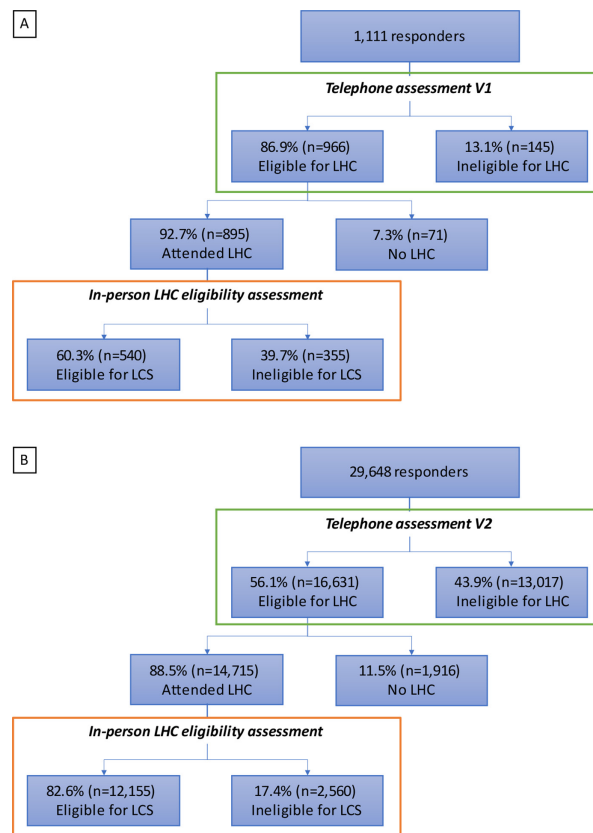
Primary care invitation	Phone-screener risk assessment	Face-to-face 'lung health check' eligibility assessment
Age 55–77 years Current smoker within past 20 years	Version 1: Verification of age and smoking status (smoker within last 20 years and more than 100 cigarettes in lifetime)	Calculation of: USPSTF 2014 criteria (30 pack-years of smoking and if a former smoker, have quit in the past 15 years)
<b>Exclusion criteria:</b> Dementia register Housebound Palliative care register or metastatic cancer Refused research	Version 2: Estimate of USPSTF 2014 criteria (30 pack-years of smoking and if a former smoker, have quit in the past 15 years) and/or PLCO <sub>m2012</sub> 6-year lung cancer risk $\geq 1.3\%$	and/or PLCO <sub>m2012</sub> 6-year lung cancer risk $\geq 1.3\%$
Phone screener (V2) estimate lung cancer risk	LHC assessment of lung cancer risk	
Categorical variables	Categorical variables	
Smoked >100 cigarettes in lifetime	Smoked >100 cigarettes in lifetime	
Age (from GP extraction)	Age (from GP extraction)	
Smoking status (current vs former)	Smoking status (current vs former)	
Ethnicity (PLCO groups)	Ethnicity (PLCO groups)	
Highest level of education	Highest level of education	
History of COPD	History of COPD	
Personal history of cancer	Personal history of cancer	
Family history of lung cancer	Family history of lung cancer	
Continuous variables	Continuous variables	
Smoking duration	Smoking duration	
Smoking consumption (amount)	Smoking consumption (amount)	
	Periods of smoking abstinence	
Self-reported height and weight (BMI estimate)	Measurement of height and weight (BMI calculated)	
BMI, body mass index; COPD, chronic obstructive pulmonary disease; GP, general practitioner; LHC, lung health check; PLCO, prostate lung colorectal ovarian; USPSTF, united states preventive services task force.		

**Agreement between telephone screening and LHC assessments**

For the 14 714 individuals who completed phone screener V.2 and attended an LHC, the level of agreement between eligibility assessments conducted by phone screener versus LHC was fair ( $K=0.441$ ) for USPSTF criteria and moderate ( $K=0.346$ ) for PLCO<sub>m2012</sub> criteria (table 2). Level of agreement between phone screener and LHC responses was substantial or 'almost perfect' for all categorical variables except educational status ( $K=0.347$ ) (table 2). Statistically significant differences in mean pack-year history and body mass index were observed (table 2), but their magnitudes were unlikely to be clinically significant. The level of agreement for eligibility assessments was lowest in individuals from an Asian ethnic group and those aged 55–59 years and highest in the white ethnic group and those aged over 75 years (table 2).

**DISCUSSION**

We present the first reported data demonstrating the impact of a telephone-based lung cancer risk assessment tool on optimising



**Figure 1** Comparison between version 1 (A) and version 2 (B) of the phone screener in refining the population eligible for LHC. LCS, lung cancer screening; LHC, lung health check.

selection for LCS appointments. Introduction of the multifactor phone screener significantly increased the proportion of ineligible individuals identified, resulting in fewer face-to-face LHC appointments. Phone screener and LHC responses showed high levels of agreement for most eligibility questions. However, lower levels of agreement were seen for educational status in all individuals, and for overall eligibility criteria in younger and minority ethnic groups. Lower levels of agreement for USPSTF criteria (vs PLCO<sub>m2012</sub>) are likely explained by the greater influence of smoking consumption on this score. Ambiguous responses regarding smoking consumption during the phone screener were interpreted to maximise lung cancer risk estimates, allowing opportunity for face-to-face eligibility assessment for individuals with borderline eligibility criteria, which may account for some of this variation. With approximately 4–6 weeks between phone screener and LHC, responses may legitimately change between these timepoints. We are unable to assess the impact of potential data entry errors, but a minority of individuals were excluded due to implausible values, highlighting the need for real-time data validation. Finally, periods of smoking abstinence were included in pack-year calculations at the LHC (reported by 62.7%) but not during the phone screener.

Blinding LHC staff to telephone screener responses allowed LHC responses to be evaluated independently. However, comparisons could only be drawn for those who both responded to the LHC invitation and were eligible during the phone screener, who may differ to non-responders and those who were found to be ineligible at phone screener. From this non-randomised study, it is not possible to ascertain if those considered ineligible by telephone screening were truly

**Table 2** Agreement between the phone screener questions and LHC assessments of (A) individual questions/eligibility criteria for all responders and (B) eligibility criteria across age/ethnicity subgroups

(A) All responders (n=14 714)		Agreement between phone screener V2 and LHC	
<b>Categorical</b>		<b>Level of agreement between phone screener and LHC (% , Kappa*)</b>	
≥100 cigarettes in lifetime		99.9% (K=NA)	
Current vs former smoker		94.4% (K=0.891, p<0.001)	
Ethnic group †		95.8% (K=0.849, p<0.001)	
Highest level of education achieved		53.4% (K=0.347, p<0.001)	
Personal history of COPD		87.5% (K=0.692, p<0.001)	
Personal cancer history		95.8% (K=0.816, p<0.001)	
Family history lung cancer		91.1% (K=0.693, p<0.001)	
USPSTF criteria		76.6% (K=0.441, p<0.001)	
PLCO <sub>m2012</sub> eligibility		82.2% (K=0.346, p<0.001)	
<b>Continuous</b>		<b>Mean difference (95% CI) between phone screener and LHC responses</b>	
BMI‡		-1.16 kg/m <sup>2</sup> (-1.21 to -1.11)	
Pack-year history§		2.87 pack-years (2.58 to 3.16)	
(B) Agreement between phone screener V2 and LHC eligibility criteria across different age/ethnicity groups			
	n	USPSTF criteria	PLCO <sub>m2012</sub> eligibility
<b>Age (from GP data extraction)</b>			
55–59 years	3643	71.0%	72.1%
60–64 years	3727	76.3%	79.8%
65–69 years	3541	79.6%	86.3%
70–74 years	2718	79.5%	90.8%
75 years +	1041	81.2%	91.2%
Missing	44		
<b>Ethnicity</b>			
Asian	1343	69.2%	69.9%
Black	796	68.8%	75.9%
Mixed	356	73.3%	77.5%
Other	629	70.7%	76.6%
White	11 590	78.5%	84.6%

\*Level of agreement according to K values defined<sup>10</sup> as 'slight' (0–0.2), 'fair' (0.21–0.4), 'moderate' (0.41–0.6), 'substantial' (0.61–0.8) or 'almost perfect' (0.81–1).  
†Summarised as three-category variable (Asian, black or white). n=2,013 (13.7%) declined to answer during the phone screener. Responses were mandated at the LHC.  
‡n=114 excluded due to implausible values (weight <30 kg or >200 kg; height <135 cm or 200 cm).  
§n=103 excluded due to implausible values (>80 cigarettes per day or >280 grams of tobacco per week; smoking start age >smoking cessation age; smoking start or cessation age >current age; period of smoking abstinence >total smoking duration).  
.BMI, body mass index; COPD, chronic obstructive pulmonary disease; LHC, lung health check; PLCO, prostate lung colorectal ovary; USPSTF, united states preventive services task force.

ineligible for LCS, and therefore the impact on the sensitivity of risk assessment, but this should be a small proportion.

Further research should investigate validated multilingual translations, cultural variations with acceptability and inclusion of diverse educational categories to ensure equitability and accuracy. Additionally, efficiency gains resulting from the phone screener are likely to impact cost-effectiveness, which requires further evaluation alongside wider patient satisfaction and any potential added benefits of LHC attendance for ineligible individuals including cardiovascular risk assessment, spirometry and smoking cessation.

Existing studies demonstrate targeted invitations followed by in-person LCS eligibility assessment lead to inefficient resource utilisation. The data presented here support

telephone-based risk assessment as an efficient way to optimise selection for LCS appointments.

#### Author affiliations

<sup>1</sup>Lungs for Living Research Centre, UCL Respiratory, University College London, London, UK

<sup>2</sup>Cancer Research UK and UCL Cancer Trials Centre, University College London, London, UK

<sup>3</sup>University College London Hospitals NHS Foundation Trust, London, UK

<sup>4</sup>Tower Hamlets Clinical Commissioning Group, London, UK

<sup>5</sup>Killick Street Health Centre, London, UK

<sup>6</sup>Department of Radiology, Royal Brompton Hospital, London, UK

<sup>7</sup>National Heart and Lung Institute, Imperial College London, London, UK

<sup>8</sup>Department of Respiratory Medicine, Leeds Teaching Hospitals, Leeds, Yorkshire, UK

<sup>9</sup>Centre for Prevention, Detection and Diagnosis, Wolfson Institute of Population Health, Barts and The London School of Medicine and Dentistry, Queen Mary

University of London, London, UK

**Twitter** Arjun Nair @LUNGRADIOLOGIST, Samantha L Quaife @QuaifeS and Sam M Janes @lungsforslving

**Acknowledgements** We would like to thank all of the participants who gave up their time to help with this research study. We are also incredibly grateful to all of those who are so dedicated to delivering the SUMMIT Study, which includes all staff at the participating academic, primary care and secondary care sites. Specifically, we thank the Lung Health Check contact centre team who oversaw delivery of the telephone screener (Julian McKee, Mark Clark). We are also hugely grateful to the Yorkshire Lung Screening Trial team (Irene Simmonds, Suzanne Rogerson) for their support and advice in introducing the telephone screener. We would also like to thank all those at GRAIL LLC. who have supported the SUMMIT Study, and particularly those who worked on programming the primary care data search and extraction, the Lung Health Check invitation mailings and the telephone screening questions (Thomas Rooney, Henry Armbrugg-Jennings, Eduardo Sosa, Jack Galilee, Marcus Foster).

**Collaborators** SUMMIT Consortium: Sam M Janes (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Jennifer L Dickson (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Carolyn Horst (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Sophie Tisi (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Helen Hall (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Priyam Verghese (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Andrew Creamer (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Thomas Callender (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Ruth Predecki (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Amyn Bhamani (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Mamta Ruparel (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Allan Hackshaw (CRUK & UCL Cancer Trials Centre, University College London, London), Laura Farrelly (CRUK & UCL Cancer Trials Centre, University College London, London), Jon Teague (CRUK & UCL Cancer Trials Centre, University College London, London), Anne-Marie Mullin (CRUK & UCL Cancer Trials Centre, University College London, London), Kitty Chan (CRUK & UCL Cancer Trials Centre, University College London, London), Rachael Sarpong (CRUK & UCL Cancer Trials Centre, University College London, London), Malavika Suresh (CRUK & UCL Cancer Trials Centre, University College London, London), Samantha L Quaife (Centre for Prevention, Detection and Diagnosis, Wolfson Institute of Population Health, Barts and The London School of Medicine and Dentistry, Queen Mary University of London, London), Arjun Nair (University College London Hospitals NHS Foundation Trust, London), Anand Devaraj (Royal Brompton and Harefield NHS Foundation Trust, London; National Heart and Lung Institute, Imperial College, London), Kylie Gyertson (University College London Hospitals NHS Foundation Trust, London), Vicky Bowyer (University College London Hospitals NHS Foundation Trust, London), Ethaar El-Emir (University College London Hospitals NHS Foundation Trust, London), Judy Airebamen (University College London Hospitals NHS Foundation Trust, London), Alice Cotton (University College London Hospitals NHS Foundation Trust, London), Kaylene Phua (University College London Hospitals NHS Foundation Trust, London), Elodie Murali (University College London Hospitals NHS Foundation Trust, London), Simranjit Mehta (University College London Hospitals NHS Foundation Trust, London), Janine Zylstra (University College London Hospitals NHS Foundation Trust, London), Karen Parry-Billings (University College London Hospitals NHS Foundation Trust, London), Columbus Ife (University College London Hospitals NHS Foundation Trust, London), April Neville (University College London Hospitals NHS Foundation Trust, London), Paul Robinson (University College London Hospitals NHS Foundation Trust, London), Laura Green (University College London Hospitals NHS Foundation Trust, London), Zahra Hanif (University College London Hospitals NHS Foundation Trust, London), Helen Kiconco (University College London Hospitals NHS Foundation Trust, London), Ricardo McEwen (University College London Hospitals NHS Foundation Trust, London), Dominique Arancon (University College London Hospitals NHS Foundation Trust, London), Nicholas Beech (University College London Hospitals NHS Foundation Trust, London), Derya Owayolu (University College London Hospitals NHS Foundation Trust, London), Christine Hosein (University College London Hospitals NHS Foundation Trust, London), Sylvia Patricia Enes (University College London Hospitals NHS Foundation Trust, London), Qin April Neville (University College London Hospitals NHS Foundation Trust, London), Jane Rowlands (University College London Hospitals NHS Foundation Trust, London), Aashna Samson (University College London Hospitals NHS Foundation Trust, London), Urja Patel (University College London Hospitals NHS Foundation Trust, London), Fahmida Hoque (University College London Hospitals NHS Foundation Trust, London), Hina Pervez (University College London Hospitals NHS Foundation Trust, London), Sofia Nnorom (University College London Hospitals NHS Foundation Trust, London), Moksud Miah (University College London Hospitals NHS Foundation Trust, London), Julian McKee (University College

London Hospitals NHS Foundation Trust, London), Mark Clark (University College London Hospitals NHS Foundation Trust, London), Jeannie Eng (University College London Hospitals NHS Foundation Trust, London), Fanta Bojang (University College London Hospitals NHS Foundation Trust, London), Claire Levermore (University College London Hospitals NHS Foundation Trust, London), Anant Patel (Royal Free London NHS Foundation Trust, London), Sara Lock (Whittington Health NHS Trust, London), Rajesh Banka (Barking, Havering and Redbridge University Hospitals NHS Trust, Essex), Angshu Bhowmik (Homerton University Hospital Foundation Trust, London), Ugo Ekeowa (The Princess Alexandra Hospital NHS Trust, Essex), Zaheer Manger (North Middlesex University Hospital NHS Trust, London), William M Ricketts (Barts Health NHS Trust, London), Neal Navani (North Bristol NHS Trust, Bristol), Terry O'Shaughnessy (Barts Health NHS Trust, London), Charlotte Cash (Royal Free London NHS Foundation Trust, London), Magali Taylor (University College London Hospitals NHS Foundation Trust, London), Samanjit Hare (Royal Free London NHS Foundation Trust, London), Tunku Aziz (Barts Health NHS Trust, London), Stephen Ellis (Barts Health NHS Trust, London), Anthony Edey (North Bristol NHS Trust, Bristol), Graham Robinson (Royal United Hospitals Bath NHS Foundation Trust, Bath), Alberto Villanueva (Surrey and Sussex Healthcare NHS Trust, Surrey), Hasti Robbie (King's College Hospital NHS Foundation Trust, London), Elena Stefan (The Princess Alexandra Hospital NHS Trust, London), Charlie Sayer (University Hospitals Sussex NHS Foundation Trust, Sussex), Nick Scream (Royal Papworth Hospital NHS Foundation Trust, Cambridge), Navinah Nundall (University College London Hospitals NHS Foundation Trust, London), Lyndsey Gallagher (University College London Hospitals NHS Foundation Trust, London), Andrew Crossingham (University College London Hospitals NHS Foundation Trust, London), Thea Buchan (University College London Hospitals NHS Foundation Trust, London), Tanita Limani (University College London Hospitals NHS Foundation Trust, London), Kate Gowers (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Kate Davies (Lungs For Living Research Centre, UCL Respiratory, University College London, London), John McCabe (Lungs For Living Research Centre, UCL Respiratory, University College London, London), Joseph Jacob (Lungs For Living Research Centre, UCL Respiratory, University College London, London; Centre for Medical Image Computing (CMIC), London), Karen Sennett (Killick Street Health Centre, London), Tania Anastasiadis (Tower Hamlets Clinical Commissioning Group, London), Andrew Perugia (Noclor Research Support, London), James Rusius (Noclor Research Support, London).

**Contributors** SMJ and SLQ are joint senior authors. The concept of using telephone screening questions was developed by the study management team for the SUMMIT Study, led by SMJ and with advice provided by MEJC. JLD and HH prepared the manuscript for review and completed the data analysis. All authors contributed to the development and finalisation of the manuscript.

**Funding** The SUMMIT study is funded by GRAIL LLC. through a research grant awarded to SMJ as Principal Investigator. SMJ was a Wellcome Trust Senior Fellow in Clinical Science (WT107963AIA). SMJ is supported by CRUK programme grant (EDDCPGM/100002), the Rosettes Trust, the Roy Castle Lung Cancer Foundation, the Garfield Weston Trust and UCLH Charitable Foundation. NN is supported by an MRC Clinical Academic Research Partnership (MR/T02481X/1). This work was partly undertaken at UCLH/UCL who received a proportion of funding from the Department of Health's NIHR Biomedical Research Centre's funding scheme (SMJ, AN, NN). SLQ is supported by a Cancer Research UK (CRUK) Population Research Fellowship (C50664/A24460) and Barts Charity (MRC&U0036).

**Competing interests** JLD, CH, ST, HH, PV, JM, AH and SMJ are investigators for the SUMMIT Study within which the present study cohort is embedded. SUMMIT is sponsored and conducted by University College London and funded by GRAIL LLC. through a research grant awarded to SMJ as principal investigator. SLQ collaborates on the SUMMIT study and has received honorarium from Elsevier for writing a book chapter. AN is a member of the advisory board for Aidence BV. AH has received an honorarium for an advisory board meeting for GRAIL, a consultation fee for Evidera Inc for a GRAIL initiated project, and previously owned shares in Illumina. SMJ has received honoraria from Astra Zeneca, BARD1 Bioscience and Jansen for being an Advisory Board Expert and travel to a US conference. SMJ received grant funding from Owlstone for a separate research study and has a family member who is an employee of Astra Zeneca. SMJ has received travel funding for a conference from Takeda and an honorarium for planning and speaking at educational meetings from Astra Zeneca. All authors perceive that these disclosures pose no academic conflict for this study and declare no other relationships or activities that could appear to have influenced the submitted work.

**Patient consent for publication** Not applicable.

**Ethics approval** Approval received from London City and East Research Ethics Committee (REC) and HRA approval for conduct in the UK (reference: 17/LO/2004). Specific approval was granted by the NHS Health Research Authority via recommendation from the NHS Confidentiality Advisory Group (reference: 18CAG0054) to extract and hold data on individuals prior to consent. Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

#### ORCID iDs

Jennifer L Dickson <http://orcid.org/0000-0002-9333-8320>

Helen Hall <http://orcid.org/0000-0001-7305-8367>

Matthew EJ Callister <http://orcid.org/0000-0001-8157-0803>

Samantha L Quaife <http://orcid.org/0000-0002-4918-6382>

Sam M Janes <http://orcid.org/0000-0002-6634-5939>

#### REFERENCES

- 1 Aberle DR, Adams AM, Berg CD. Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med* 2011;365:395–409.
- 2 de Koning HJ, van der Aalst CM, de Jong PA, *et al*. Reduced lung-cancer mortality with volume CT screening in a randomized trial. *N Engl J Med* 2020;382:503–13.
- 3 Field JK, Duffy SW, Baldwin DR, *et al*. UK lung cancer RCT pilot screening trial: baseline findings from the screening arm provide evidence for the potential implementation of lung cancer screening. *Thorax* 2016;71:161–70.
- 4 Crosbie PA, Balata H, Evison M, *et al*. Implementing lung cancer screening: baseline results from a community-based 'Lung Health Check' pilot in deprived areas of Manchester. *Thorax* 2018;74:405–9.
- 5 Bartlett EC, Kemp SV, Ridge CA, *et al*. Baseline Results of the West London lung cancer screening pilot study - Impact of mobile scanners and dual risk model utilisation. *Lung Cancer* 2020;148:12–19.
- 6 Kummer S, Waller J, Ruparel M, *et al*. Psychological outcomes of low-dose CT lung cancer screening in a multisite demonstration screening pilot: the lung screen uptake trial (LSUT). *Thorax* 2020;75:1065–73.
- 7 Crosbie PA, Gabe R, Simmonds I, *et al*. Yorkshire lung screening trial (YLST): protocol for a randomised controlled trial to evaluate invitation to community-based low-dose CT screening for lung cancer versus usual care in a targeted population at risk. *BMJ Open* 2020;10:e037075.
- 8 Moyer VA, U.S. Preventive Services Task Force. Screening for lung cancer: U.S. preventive services Task force recommendation statement. *Ann Intern Med* 2014;160:330–8.
- 9 Tammemägi MC, Church TR, Hocking WG, *et al*. Evaluation of the lung cancer risks at which to screen ever- and never-smokers: screening rules applied to the PLCO and NLST cohorts. *PLoS Med* 2014;11:e1001764.
- 10 Landis JR, Koch GG. The measurement of observer agreement for categorical data. *International Biometric Society* 1977;33:159–74 <http://www.jstor.com/stable/2529310>