Respirology

WILEY

Official Journal of the Asian Pacific Society of Respirology
Respirology
APSR

INVITED REVIEW OPEN ACCESS

Invited Review Series: Lung Cancer Screening—Preparedness, Toolkit for Nodule Service, Economic Implications, Lessons From International Counterparts

Lessons Learned From International Lung Cancer Screening Trials; People at Risk Deserve Screening for Early Detection

Emily Stone[1] | Henry Marshall[2] | Pan-Chyr Yang[3] | Kwun M. Fong[2]

[1]Department of Thoracic Medicine and Lung Transplantation, St Vincent's Hospital Sydney; and Melbourne School of Population and Global Health, University of Melbourne, Victoria, Australia; and School of Clinical Medicine UNSW Sydney, Sydney, NSW, Australia | [2]Prince Charles Hospital, Chermside, QLD, Australia; and The University of Queensland Thoracic Research Centre, The Prince Charles Hospital, Brisbane, QLD, Australia | [3]Department of Internal Medicine, National Taiwan University College of Medicine; and Institute of Biomedical Sciences, Academia Sinica; and Genomics Research Centre, Academia Sinica, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan

Correspondence: Emily Stone (emily.stone@unsw.edu.au) | Kwun M. Fong (kwun.fong@health.qld.gov.au)

Received: 21 July 2024 | **Revised:** 7 June 2025 | **Accepted:** 21 July 2025

Series Editors: Tracy Leong and Fraser Brims

Funding: This work was supported by National Health and Medical Research Council, Medical Research Future Fund, and Common Good.

Keywords: CT | lung cancer | screening

ABSTRACT

In the modern era, the role of lung cancer screening by low dose computed tomography (CT) is now broadly accepted, with many jurisdictions offering or intending to offer population-based screening based on high quality randomised controlled trial (RCT) evidence. Optimal implementation will be crucial to ensure sufficiently high participation rates in efficient quality assured lung cancer screening programmes (LCSPs) to achieve the gains predicted by modelling and health technology assessments. Performed well, LCSPs can be anticipated to complement the reduction in lung cancer burden already realised from the introduction of molecularly targeted agents and immune checkpoint inhibitors for advanced stage lung cancer. In this review, we will describe the recent clinical developments from published trials to highlight contemporaneous lung cancer screening (LCS) issues and discuss potential enablers and barriers to the effective implementation of LCSP commonly encountered across the world, particularly from the viewpoint of the Asia Pacific region and peoples.

1 | Introduction

While there have been important therapeutic advances for advanced lung cancer, lung cancer remains the world's leading cause of cancer-related death, accounting for almost 2.5 million new cases worldwide, or 1 in 8 cancers, and 1.8 million deaths in 2022 [1]. Smoking cessation and primary prevention remain critical, with survival improvements anticipated in time. In parallel, LCS is arguably the most useful tool to reduce lung cancer mortality given the landmark positive RCTs: U.S. National Lung Screening Trial (NLST) [2], Dutch–Belgian lung cancer screening trial [3] (Nederlands–Leuvens Longkanker Screenings Onderzoek [NELSON]), and Multicentric Italian Lung Detection (MILD) [4]. A Cochrane meta-analysis found that LCS reduced lung cancer mortality by 20% and overall mortality by 5% [5]. Effective recruitment to LCS, embedded smoking cessation, and provision of subsequent care have recently been proposed as some of the key priorities for any LCS program [6].

To identify potential enablers and barriers to scalable and sustainable LCS that have been trialled, we report a narrative review of relevant worldwide clinical studies, supplemented by data from pearling of reference lists and personal databases of relevant publications.

2 | Methodology

For expediency, we undertook a literature search of the NLM Pubmed database with 3 clinically restricted pre-set filters: (i) *(ldct lung cancer screening) AND (Prognosis/Narrow[filter])*, (ii) *(ldct lung cancer screening) AND (Diagnosis/Narrow[filter]) and* (iii) *(ldct lung cancer screening) AND (Therapy/Narrow[filter])* to understand the impact of LCS on clinically relevant domains of diagnosis, therapy, and prognosis. We identified 348 journal publications; English language articles were selected for review, collation, and narrative synthesis reflecting domains of diagnosis (including participation), therapy, and prognosis. In addition, a separate search of review articles provided additional background for the Discussion with the following search strategy: *(lung cancer) AND (screening) AND (implementation) OR English language journal publications addressing domains of diagnosis, therapy and implementation*.

3 | Status of Selected International Clinical Trials

A landmark American College of Radiology's Lung Cancer Screening Registry (LCSR) analysis of 1,159,092 persons who had LCS from 3625 facilities found that 90.8% met the USPSTF eligibility criteria [7, 8]. Compared with adults from the 2015 National Health Survey (NHIS) who met the criteria ($n = 1257$), screening recipients in the LCSR were older, more likely to be female, and more likely to currently smoke. Only 22.3% had a repeated annual LDCT. At 24 months of follow-up, 34.3% were adherent; beyond 24 months, 40.3% were adherent [7]. On baseline screening, 17% showed positive screening results with an overall cancer detection rate of 0.56%, higher with advancing Lung-RADS categories as expected. The cancer stage distribution was similar to that observed in the National Lung Cancer Screening Trial, with 53.5% of patients receiving a diagnosis of stage I cancer and 14.3% with stage IV cancer. A stage shift toward early-stage lung cancer was noted [8].

4 | European Trials

The feasibility of an RCT for LDCT scanning was demonstrated in the United States in the Lung Screening Study (LSS), a pivotal pilot project of the ongoing Prostate, Lung, Colorectal, and Ovarian (PLCO) cancer screening trial that demonstrated the feasibility of an RCT of LDCT scanning in the United States [9, 10]. In Europe, DANTE enrolled males, aged 60 to 75 years, people who smoked 20 or more pack-years, randomised to screening with LDCT or control and found LC in 4.7% of the CT arm and 2.8% of control subjects ($p = 0.016$) and noted mortality from non-lung cancer causes [11, 12]. The German Lung Cancer Screening Intervention (LUSI) is a randomised trial, comparing five annual rounds of LDCT screening (screening arm; $n = 2029$ participants) with a control arm ($n = 2023$) followed by annual postal questionnaire inquiries, with a hazard ratio for lung cancer mortality of 0.74 (95% CI: 0.46–1.19; $p = 0.21$) and a statistically significant reduction in lung cancer mortality among women (HR = 0.31 [95% CI: 0.10–0.96], $p = 0.04$) [13]. Extended NLST follow-up (median follow-up 11.3 years for incidence and 12.3 years for mortality) confirmed a number needed to screen (NNS) of 303, similar to the original analysis [14]. The multicentre pilot UK Lung Cancer Screening study recruited 4055 participants from 247,354 potential participants, with 2028 in the CT arm and 2027 in the control arm. Overall, 42 participants (2.1%) were diagnosed with lung cancer, 85.7% of the screen-detected cancers identified as stage 1 or 2, and 83.3% underwent surgical resection as their primary treatment [15]. HUNCHEST, the first pilot nationwide low-dose LCS programme in Hungary, identified a positive predictive value of 31.6% [16]. The Multicentric Italian Lung Detection study (MILD) prospectively randomised 4099 participants to screening ($n = 2376$) or to a control arm ($n = 1723$) [17]. The screening arm was further randomised to annual ($n = 1190$) or biennial ($n = 1186$) LDCT for a median period of 6 years. At 10 years, the MILD study reported a 39% reduced risk of LC mortality at 10 years [hazard ratio (HR) 0.61; 95% confidence interval (CI) 0.39–0.95], and a 20% reduction of overall mortality (HR 0.80; 95% CI 0.62–1.03). LDCT benefit improved beyond the 5th year of screening, with a 58% reduction in LC mortality (HR 0.42; 95% CI 0.22–0.79) and a 32% reduction in overall mortality (HR 0.68; 95% CI 0.49–0.94) [4, 17–18], adding to the body of evidence from the internationally pivotal NLST and NELSON trials. MILD data also suggested that a strategy of biennial screening may save about one third of CT scans with similar performance indicators as compared to annual screening [19] (Table 1).

5 | Asian Trials

A similarly large sample size was reported in a Chinese multicentre, prospective cohort study of 1,016,740 enrolled participants who were invited for one-off LDCT for LCS [20] Of these, 3581 were diagnosed with lung cancer after a median follow-up of 3.6 years, with reductions in lung cancer mortality and all-cause mortality in participants who underwent LDCT[20]. The Cancer Screening Program in Urban China (CanSPUC) Henan studied 282,254 participants, finding 589 lung cancers, from which they developed and internally validated the Henan Lung Cancer risk prediction model [21]. In the subsequent CanSPUC cohort study, with inverse probability weighting (IPW) adjustment for potential imbalances, lung cancer mortality decreased (31.0% lower) (HR0.69 [95% CI 0.49–0.97]) as well as all-cause mortality (23.0% lower) (HR0.77 [95% CI 0.68–0.87]) in the screened group with a single LDCT [22]. A West China Hospital cohort study combined USPSTF guidelines with Chinese expert consensus guidelines to select 15,996 participants who presented for yearly health examinations for LCS [23]. Importantly, the Chinese consensus guidelines included people with passive smoking histories. The study showed that the rate of missed diagnosis was as high as 90.8% applying just USPSTF guidelines to this population. In the Gejiu, Yunnan screening centre of the Lung Cancer Screening Program in Rural China (LungSPRC), 2006 participants completed baseline screening, with positive rates of baseline and annual screening at 9.7% and 9.0%, while the lung cancer detection rate was 0.4% and 0.6% [24]. Another community-based trial of

TABLE 1 | Selected international trials.

	Study	Country	Screening program	Comparator	Sample size	Age range (years)	Screening rounds	Intervals
European	DANTE [11]	Italy	LDCT	No screening	2811	60–74	5	Annual
	LUSI [14]	Germany	LDCT	No screening	4052	50–69	5	Annual
	UKLCS [15]	UK	LDCT	No screening	4055	50–75	1	NA
	HUNCHEST [16]	Hungary	LDCT	None	1890	50–79	3	Annual
	MILD [17]	Italy	LDCT	No screening	4099	≥49	10	Annual v. biennial
Asian	Li et al. [20][a]	China	LDCT	None	79,581	40–74	1	NA
	Guo et al. [21][a]	China	LDCT	None	282,254	40–74	1	NA
	Yu et al. [22][a]	China	LDCT	None	58,136	40–74	1	NA
	Ji et al. [23]	China	LDCT	None	15,996	Any (mean 50.31 ± 14.76)	11	Annual
	Wei et al. [24]	China	LDCT	None	2006	40–74*, 50–74**	5	Annual
	K-LUCAS [25]	Korea	LDCT	None	5692	55–74	2	Annual
	Kim et al. [26][b]	Korea	LDCT	None	52,615	≥18 (mean 49.5 ± 11.3)	Mean 2.1 ± 1.9	NS

Note: Selected international lung cancer screening trials investigating screening with low dose computed tomography (LDCT) of the chest.
Abbreviations: NA = not applicable; NS = not specified.
[a]Studies conducted under the framework of the China Urban Cancer Screening Program (CanSPUC).
[b]Retrospective cohort study.
*With occupational exposure.
**Without occupational exposure.

3512 participants (98.9%) who underwent LDCT screening, and 3145 participants (99.3%) who received a control questionnaire reported lung cancer detection in 1.5 versus 0.3% respectively [27]. The Korean Lung Cancer Screening Project (K-LUCAS) considered 71,829 participants aged 50 years or older in the national health screening program, finding 5975 (8.3%) eligible for lung cancer screening with 17.8% refusals, otherwise showing feasibility [25]. Another South Korean analysis of 52,615 adults who had previously had LCS reported that non-screen-detected cancers tended to be centrally located and that most non-screen-detected central cancers (89.1%) had a negative result on prior LDCT screening [26] (Table 1).

6 | LCS in Different Settings and Targeted Populations

6.1 | Occupational Settings

A number of studies have evaluated LCS, including smoking cessation rates, in a range of occupational or sociodemographic settings. Participation in an LDCT screening study was associated with reduced LC mortality in an Occupational Health surveillance cohort study of 2433 asbestos-exposed men [28]. LDCT as a part of regular health examinations in 8392 hospital employees in different regions of China detected pathologically confirmed lung cancer in 2.1%; more in females than males (2.5% vs. 1.3%) [29]. A study of New York rescue/recovery workers exposed to the September 11, 2001, attacks who underwent LCS based on smoking history and age reported 50 screen-detected cancers but observed 13 missed lung cancers, detected through registry and medical records, thought mainly attributable to smoking less and quitting longer than guideline/model eligibility criteria [30]. A US Veterans Health Administration (VHA) study reported that 1-year quit rates for Veterans receiving LCS are similar to those reported in LDCT clinical trials and cohort studies (i.e., 10%–17%) but only 1% received the recommended combination of pharmacotherapy and counselling, and the most effective pharmacotherapies (combination nicotine replacement therapy (NRT) or varenicline) were infrequently used [31]. Another study of LCS in a small military population study reported predictors of non-adherence versus adherence to be younger age ($p = 0.008$), female sex ($p = 0.005$), and enlisted officer rank ($p = 0.03$). Lack of perceived contact for follow-up was expressed as the primary reason for non-compliance [32] (Table 2). Further studies on occupational exposures are addressed in the discussion section.

6.2 | Sociodemographic Settings

Analysis of LCS in a majority-rural health care system revealed 2.1% LC diagnosis rate and no significant differences observed between rural and non-rural patients in lung cancer diagnosis rate or early-stage lung cancer survival [33]. A Korean LCS study of older adults (70–80 years) found the LC detection rate in the late 70s group similar to the early 70s group (3.4% vs. 2.7%, $p = 0.485$), and reported that 80.6% with screening-detected LC received appropriate 'tumour reduction treatment' [34]. An early prospective community cohort reported on feasibility challenges in the deployment of CT screening, calling for a structured and integrated setting [35]. In a US metropolitan community (Kentucky) study, of 6433 patients evaluated for LCS during an office visit with their primary care provider 4170 (64.8%) underwent LDCT with 20.9% having nodules > 4 mm [36]. In the same study, 2653 LCS participants currently smoked, with a 42% quit rate for those enrolled in group tobacco cessation classes, particularly relevant for a state with high cigarette smoking and lung cancer deaths. On the other hand, pulmonologist-led LCS in a cohort of 791 outpatients with stable respiratory diseases reported screening positivity in 14.0% and 5.6% in the first and second screening rounds, respectively (positive predictive value: 11.0% and 26.6%, respectively) albeit with a 19% loss to follow-up [37] (Table 2).

Notably, despite being acknowledged as priority populations (e.g., by Cancer Australia), there are very few data on screening Indigenous populations from international cohorts.

6.3 | LCS for People Who Have Never Smoked or Are Light Smokers

Lung cancer in people who have never smoked accounts for at least one-third of lung cancer worldwide, more prevalent in East Asia in women. Lung cancer is the leading cause of cancer mortality in women in many East Asian countries such as Korea, Taiwan, and Hong Kong [38, 39] (Table 3).

6.4 | Taiwan

In Taiwan, more than 60% of lung cancer patients do not have a smoking history, especially in women, with 94% of lung cancer in women occurring in those who have never smoked [46, 47]. A prospective study of 1102 subjects with a lung cancer family history (LCFH) in Taiwan showed that LCFH is a risk factor for lung cancer, with a 10-year cumulated lung cancer detection rate of 4.5% [40]. The Taiwan Lung Cancer Screening in Never-Smoker Trial (TALENT) (Author disclosure PCY PI) is a nationwide, multicentre, prospective cohort study that detected LCs in eligible individuals who had negative chest radiography, were aged 55–75 years, had never smoked or had smoked fewer than 10 pack-years and stopped smoking for more than 15 years (self-report), and had one of the following risk factors: a family history of lung cancer; passive smoke exposure; a history of pulmonary tuberculosis or chronic obstructive pulmonary disorders; a cooking index of 110 or higher; or cooking without using ventilation. Lung cancer was diagnosed in 318 (2.6%) of 12,011 participants (257 [2.1%] participants had invasive lung cancer and 61 [0.5%] had adenocarcinomas in situ) with the prevalence higher among participants with a family history of lung cancer. The majority were adenocarcinoma, and 77.4% had stage I disease. The issue of potential overdiagnosis was discussed, especially for adenocarcinoma in situ [41]; we explore the concept of overdiagnosis further in our discussion. Based on these results, Taiwan initiated a National Lung Cancer Early Detection Program on July 1, 2022, with biennial LDCT screenings for those with a heavy smoking history (30 pack-years) and those without (never or light smoking history) with LCFH aged 45–74 years for females and aged 50–74 years for males. From a total of 78,000 participants in this program until December 31, 2023,

TABLE 2 | Lung cancer screening in different settings and targeted populations.

	Study	Target group	Country	Screening program	Comparator	Sample size	Age range (years)	Screening rounds	Intervals
Occupational risks	Barbone et al. [28]	Asbestos exposure	Italy	LDCT	No screening	2433	Median 58–60	2	Annual
	Zhang et al. [29]	Hospital employees	China	LDCT	None	15,686	NS	6	Annual
	Cleven et al. [30]	9/11 rescue and recovery workers	USA	LDCT	None	3953	≥ 50	2	NS
	Heffner et al. [31][a]	Military veterans	USA	LDCT	None	47,609	50–79	NS*	NA
	Seastedt et al. [32][a]	Defence health beneficiaries	USA	LDCT	None	242	55–80	NS	NS
Sociodemographic settings	Hinojos et al. [33][a]	Majority-rural LCS	USA	LDCT	None	1805	Median (IQR) 63 (59–68)	NS	Annual
	Kang et al. [34][a]	Older at-risk participants	Korea	LDCT	None	1281	70–80 at initial LDCT	NS	1–2 yearly
	Lam et al. [35]	Community setting	USA	LDCT	None	154	≥ 50	1*	NA
	Shields et al. [36]	Primary-care led	USA	LDCT	None	4170	55–80	1*	NA
	Svartman et al. [37][a]	Pulmonologist-led	Brazil	LDCT	None	791	55–80	2	NS

Note: Selected studies investigating lung cancer screening by low dose computed tomography (LDCT) chest in targeted occupational and sociodemographic settings.
Abbreviations: LCS = lung cancer screening; NS = not specified.
[a]Retrospective study.
*Baseline screening scan only included in study.

TABLE 3 | Selected trials in never or light-smoking individuals.

Study	Target group	Country	Screening program	Comparator	Sample size	Age range (years)	Screening rounds	Intervals
Wang et al. [40]	Family history	Taiwan	LDCT	None	1102	≥ 55*	3	Annual
TALENT [41]	Minimal or no smoking + one other risk factor**	Taiwan	LDCT	None	12,011	55–75	6	Annually then biennially
Chen et al. [42]	Light and non-smoking***	Taiwan	LDCT	None	43,853#	45–74 female 50–74 male	NS	NS
Kang et al. [43]a	Never smoking	Korea	LDCT	None	12,176#	40–75	1##	NS
Kim et al. [44]a	Female never smoking	Korea	LDCT	None	4365	40–79	1##	NS
Wang et al. [45]b	Non smoking###	China	LDCT	None	91,455	40–74	1	NA

Note: Selected trials investigating lung cancer screening with low dose computed tomography (LDCT) of the chest in participants with minimal or no smoking history.
Abbreviation: NS = not specified.
*If age ≤ 54 then older than the family proband.
**Additional risk factors = family history, passive smoke exposure, pulmonary tuberculosis, chronic obstructive pulmonary disease, high cooking index, cooking without ventilation.
***Cohorts within larger study of Taiwan National Lung Cancer Early Detection Program that includes heavy, light, and non-smoking individuals.
#Sample is sub-group of full study cohort.
[a]Retrospective study.
[b]Conducted under the framework of the China Urban Cancer Screening Program (CanSPUC).
##Baseline screening scan only included in study.
###Cohort with larger study that includes individuals with a smoking history.

lung cancer was confirmed in 956 subjects by surgery or biopsy, with 85.0% at stage 0–1. The lung cancer detection rate was 1.2%. Subjects with LCFH exhibited a higher detection rate (overall: 1.6%, no smoking: 1.7%, and light smoking: 0.9%) compared with heavy smoking history (0.7%) and those with both risk factors (1.1%) [42].

6.5 | Korea

Another risk prediction model has been developed integrating age, gender, smoking pack-years, family history of lung cancer, personal cancer history, BMI, lung function test, CEA, bilirubin, AFP, and CRP with differential performance for never smokers, light smokers, and heavy smokers [48]. In a Korean never-smoker population of 12,176 (63.6% women), 10.0% were found to have lung nodules, with a LC diagnosis rate of 0.45% (92.7% stage I) compared to 0.86% for ever-smokers [43]. A Korean study of 4365 female never smokers aged 40–79 years reported that after a median follow-up of 9.69 years, 0.5% had lung cancer, reflecting a low risk of lung cancer development in female never smokers in Korea [44].

6.6 | Zhejiang, China

A prospective cohort LCS study of smokers and non-smokers in Zhejiang, China enrolled participants aged 40–74 years, and those with a high model risk score were recommended to undergo LCS. At baseline, 62.56% (18,818/30,079) of smokers and 6% (5483/91,455) of non-smokers were identified as high risk ($p < 0.001$), of whom 41.9% (7885/18,818) and 66.31% (3636/5483) underwent LCS. After a median follow-up of 5.1 years, 1100 lung cancer cases and 456 all-cause death cases (116 lung cancer death cases) were found. Compared with participants who were not screened, LCS in smokers significantly increased lung cancer incidence (hazard ratio [HR] 1.39, 95% CI 1.09–1.76; $p = 0.007$) but reduced lung cancer mortality (HR 0.52, 95% CI 0.28–0.96; $p = 0.04$) and all-cause mortality (HR 0.47, 95% CI 0.32–0.69; $p < 0.001$). Among non-smokers, no significant results were found for lung cancer incidence ($p = 0.06$), all-cause mortality ($p = 0.89$), and lung cancer mortality ($p = 0.17$) [45].

7 | Selection for LCS: Risk-Based Screening

7.1 | Europe

ESTHER, a population-based prospective cohort study in Germany that quantified the performance of 11 different LC risk models in screening-age adults, suggested that LC risk models have the potential to identify people at highest risk of LC, and select for LCS [49].

7.2 | Asia Pacific

The International Lung Screen Trial (author disclosures ES, HM, KF PIs) reported that the Prostate Lung Colorectal and Ovarian Cancer Screening Trial PLCOm2012 risk model was more efficient than the USPSTF2013 criteria for selecting

individuals for LCS and could be used for identifying high-risk individuals [50, 51]. Noting people with previous malignancy have an increased risk of lung cancer yet are often underrepresented in clinical trials, a small single-institutional study reported that individuals with a cancer history were significantly less likely to have abnormal screening results than those without a cancer history [52]. Conversely, a different study in patients with prior malignancy found the rate of screen-detected second primary lung cancer and of having invasive diagnostic procedures is higher than in a general screened population [53]. In a real-world retrospective study at a US non-profit healthcare system, modification of LCS eligibility confirmation processes led to increased participant rates [54]. An ongoing study evaluating invitation methods for Indigenous New Zealand Māori people for LCS in a pragmatic cluster randomised controlled trial (RCT) will be highly relevant and informative [55]. A two-arm, blinded, between-subjects RCT of a targeted, low-burden, and stepped invitation strategy versus hospital-based Lung Health Check appointments offering LDCT screening demonstrated an uptake rate of 52.6%, without a difference between intervention (52.3%) and control (52.9%) groups in unadjusted (odds ratio [OR], 0.98; 95% confidence interval [CI], 0.82–1.16) or adjusted (OR, 0.98; 95% CI, 0.82–1.17) analyses [56]. Preliminary results from a study of 279 (51%) female and 267 (49%) males suggested equal gender participation in LCS [57].

7.3 | Nodule Management

An analysis of the Alberta Lung Cancer Screening Study comparing Pan-Canadian Early Detection of Lung Cancer Nodule Risk Classification (NRC) categories and ACR Lung Screening Reporting and Data System (Lung-RADS) found that NRC and Lung-RADS both performed well with a trend to higher sensitivity for the NRC. Early recall rates remained less than 10% with both classification systems, lower than NLST[58]. The ITALUNG study of two biomarkers, loss of heterozygosity and microsatellite instability, raised the possibility that multimodal screening including this panel may improve LCS efficiency at baseline [58, 59]. ITALUNG noted high and stable LCS compliance but a low detection rate and specificity, and some surgical procedures were undertaken for benign lesions [58, 60]. A retrospective cohort study in the U.S. of 9266 screened patients found that 15.9% had a baseline LDCT scan showing abnormalities, of whom 9.5% were diagnosed with lung cancer within 12 months. Absolute rates of downstream imaging and invasive procedures in screened patients were 31.9% and 2.8%, respectively, with invasive procedure complication rates higher than in NLST (30.6% vs. 17.7% for any complication; 20.6% vs. 9.4% for major complications) [61].

7.4 | LCS Barriers/Enablers

A mixed methods analysis of data from the UKLS trial identified practical and emotional barriers to participation [62]. In addition, there is an informative and recent review of patient barriers and facilitators which reports some key themes [63]. The UKLS participants also reported that cancer distress was higher for the intervention arm participants who received positive screening results than in controls ($p \leq 0.001$), but this did not persist at subsequent follow-up ($p = 0.04$), with no clinically significant long-term psychosocial impact on high-risk participants [64].

In the Pan-Canadian Early Detection of Lung Cancer Study, there were no clinically significant differences in HRQoL outcomes between baseline and following survey time points, although a minority of participants (number-needed-to-harm = 7 after baseline screening and 18 at 1 year) demonstrated clinically significant increased anxiety levels [65].

The SUMMIT Study found that providing written information to LCS participants helped prepare participants for LDCT results and appeared to be a helpful adjunct to a written communication [66]. In addition, they found a high rate of satisfaction 82.8% ($n = 1573$) with receiving their results by letter, with 2.9% ($n = 55$) reporting dissatisfaction. 86.3% ($n = 1640$) stated a letter was their preferred communication method and 77.3% ($n = 1469$) reported that their letter contained the right amount of information.

In a US pre- and post-intervention study, clinician-facing EHR prompts and an EHR-integrated everyday shared decision-making tool appeared promising for improving LCS in the primary care setting [67]. A retrospective cohort study of LCS in a US rural healthcare setting found low compliance with repeat annual screening and recommendations for workup, speculated to be exacerbated by prevailing healthcare and socioeconomic issues [68].

A prospective multi-centre population-based cohort study from China found an overall uptake rate of 33.0%, which was negatively correlated with the incidence of advanced-stage lung cancer, male sex, current smoking, depressive symptoms, structural delays in initiating LDCT scans, lack of media-assisted publicity, and navigation assistance [69]. A study from the PROSPR-Lung Consortium showed a gap in the lung screening care pathway where 40% of those referred for LCS did not complete an LDCT within 90 days, noting insurance status and lower neighbourhood socioeconomic status negatively impacting screening uptake [70]. An innovative comparison of LCS and a guideline concordant lung nodule programme (LNP) in the Mississippi Delta showed that the cumulative lung cancer diagnosis hazard of screening-age persons enrolled in the LNP was higher than that in an LCS cohort and may be an alternative pathway to early detection to help address disparities [71, 72]. In an analysis of the NLST by race, black individuals experienced higher all-cause mortality than white individuals (HR, 1.35; 95% CI 1.22–1.49); however, black individuals screened with LDCT had a reduction in all-cause mortality [73]. A Hawaiian cohort study of 1030 eligible LCS participants found racial and ethnic disparities in LCS completion rates highlighting the need to better understand factors associated with different racial and ethnic groups [74].

7.5 | Mobile CT

The placement of a mobile CT unit in a New York City high-traffic area offering free screening found that mobile screening participants were significantly more likely to be younger, be uninsured, and have lower smoking intensity and were less likely

to meet 2013 USPSTF guidelines (but would meet their 2021 guidelines) and self-identify as White race and Hispanic ethnicity than a hospital-based screening cohort [75].

7.6 | Artificial Intelligence (AI)—Nearly Here for LCS?

The Lung Screen Uptake Trial (LSUT) observational cohort study studied radiographer readings of LDCT and found that computer-assisted detection CAD-supported radiographers were less sensitive than radiologists at identifying clinically significant pulmonary nodules, but had a low false-positive rate and good sensitivity for detection of confirmed cancers [76].

Pilot work on an AI convolutional neural network (CNN) prototype indicates its potential use for identification of risk factors for cardiopulmonary disease on standard screening low-dose chest CT in the US[78].

Another study from Taiwan embedded AI algorithm-assisted CT screening in the hospital picture archiving and communication system, finding increased sensitivity of detecting nodules sized 4–5 mm, 6–10 mm, 11–20 mm, and > 20 mm by 41%, 11.2%, 10.3%, and 18.7%, respectively, including detecting ground glass nodules (GGN) [77].

A Western China telemedicine-enabled LCS in underserved communities where CT scans were remotely reported by radiologists aided by AI diagnostic systems, tracked through an integrated hospital network of 19,517 participants, identified 2.68% with high-risk pulmonary nodules and diagnosed 0.55% with lung cancer after a 1-year follow-up [78].

A Taiwanese study of an artificial neural network (ANN) found better sensitivity compared to Lung-RADS for the detection of lung cancer in an Asian population and more refined discriminative ability for lung cancer risk stratification [79] (80 Hsu BMC Cancer 2020).

A fusion algorithm of handcrafted features (HF) with a 3D deep convolutional neural network reported promising AUC, accuracy, sensitivity, and specificity scores [80].

A study of NLST images found that, compared to Lung-RADS, semantic features defined by border definition and contour performed similarly or better [81]. Other studies suggest radiomics may play a role in distinguishing features of malignancy and differentiation of cancer from benign lesions [82–84]. For subsolid nodules detected during LCS (89 in 86 LCS participants; 42 pure ground-glass nodules (GGNs) and 47 part-solid GGNs), 28 SSNs were diagnosed as lung cancer histopathologically, with various CT texture parameters showing predictive value between malignant pulmonary nodules and others [85].

Another approach used an open-source deep-learning algorithm 'Sybil' to analyse 10,573 LDCTs from 6127 consecutive LCS participants, yielding AUCs of 0.89 (95% CI: 0.85–0.93) for females and 0.89 (95% CI: 0.85–0.94) for males for predicting LC risk at 1 year, $p = 0.92$, and performed better at 6 years for females, AUC 0.87 (95% CI: 0.83–0.93) than males, AUC 0.79 (95% CI: 0.72–0.86) [86].

8 | The Impact of Incidental Findings—Not a Trivial Issue

8.1 | Bone Density

A Chinese study of opportunistic screening for osteoporosis suggested lumbar spine CT-derived bone mineral density (BMD) may be able to identify low lumbar BMD [87].

8.2 | Cardiac Disease

The SUMMIT Investigators found that a standardised reporting and management protocol showed the most common incidental findings to be coronary artery calcification (64.2%) and emphysema (33.4%), which estimated the number of participants requiring review for clinically relevant findings in primary care as 1 in 20, and the number potentially requiring review in secondary care as 1 in 25 [88].

A Polish LCS observational study noted a high prevalence of cardiovascular risk factors, with 83.7% of men and 40.7% of women classified with a very high CVD SCORE risk (> 10%), and coronary artery calcification (CAC) was reported in 190 (47%) participants [89]. In LSUT, QRISK2 CVD risk assessment [90] was positively associated with increasing CAC grade, and of those who qualified for statin primary prevention (QRISK2 ≥ 10%), 56.8% did not report a history of statin use [91]. Review of a prospective cohort of 8618 smokers also found that aortic valve calcification (AVC) prevalence increased with the increasing severity of the CAC categories, and each alone was a significant predictor of cardiovascular disease death [92].

8.3 | Airways and Lung Disease

The Lung Screen Uptake Trial (LSUT) Investigators found that 57% in their study had prebronchodilator spirometry consistent with COPD; 67% did not have a prior history of COPD and were termed 'undiagnosed'. Emphysema prevalence in those with known and 'undiagnosed' COPD was 73% and 68%, respectively. A total of 32% of those with 'undiagnosed COPD' had no emphysema on LDCT [93]. The SUMMIT Study observed airflow obstruction as an independent risk factor for lung cancer risk on baseline LDCT (adjusted OR 2.74, 95% CI 1.73–4.34; $p < 0.001$), with a high risk seen in those with undiagnosed COPD (adjusted OR 2.79, 95% CI 1.67–4.64; $p < 0.001$) [66].

The SUMMIT sub-analysis suggested concurrent spirometry alongside LCS may facilitate accurate diagnosis of COPD and identified downstream challenges from offering this additional test [88, 94]. Another study of an LCS cohort who had spirometry found the presence of CT emphysema (RR, 2.51; 95% CI, 1.01–6.23) but not airway obstruction (RR, 2.10; 95% CI, 0.79–5.58) was associated with increased risk of lung cancer [95]. In participants with negative baseline LDCT screens in the

NLST ($n = 16{,}624$), radiographic emphysema was independently associated with nearly double the hazard of lung cancer diagnosis at both the second (T1) and third (T2) annual LDCT [96].

8.4 | Thyroid Disease

A secondary analysis of the NLST identified 60 thyroid cancers, with the early and persistent excess in the CT arm however suggesting overdiagnosis of thyroid incidentalomas [97].

8.5 | Smoking Cessation Still Critical for Effective LCS Benefit

A randomised trial of a web-based educational video about LCS or usual care found no difference in abstinence from smoking between 1281 smokers aged 55–80 LCS-eligible individuals, while effective in improving utilisation of LDCT [98]. A population-based screening cohort in rural China surveyed twice showed a slight decrease in smoking prevalence from 52.6% to 49.1%. The chance of smoking abstinence in baseline current smokers was reduced by over 80% in those who attended 5 rounds of screening compared to smokers who only received baseline screening, but the risk of smoking initiation in baseline non-smokers was significantly higher in those with a negative screening result [99].

9 | Discussion

Even modest increases in screening uptake can be anticipated to save lives, including from lung cancer [100]. With this narrative review, we intend to provide a rapid review of recent screening research and LCS trials from around the world to identify potential enablers and under-recognised barriers to encourage global adoption of this life-saving technology when it can be implemented safely and efficiently in the target communities.

We find some issues are universal of global significance, such as low participation rates, whereas others can be very context specific, for example, LCS in Asia, especially for people who have never smoked. We discuss our learnings in the following format with a focus on the trials that we are involved in and the Asia Pacific region, while acknowledging the huge efforts and technological advances globally.

9.1 | Updated Data on Occupational Exposures

Asbestos is the most prevalent occupational lung carcinogen worldwide [101]. A study of 1260 LCS screening participants with significant occupational lung carcinogen exposure, including asbestos, reported a detection rate of 1.6% for NSCLC at the baseline scan [102]. A French study of 5662 people with occupational asbestos exposure showed a nearly 2-fold increase in lung cancer in those with pulmonary nodules compared to the reference general population, with a standardised incidence ratio (SIR) of 1.95 (95% CI 1.22–2.95) [103]. A West Australian study of 1743 participants with occupational asbestos exposure reported detection of 26 (1.5%) lung cancer cases with LDCT as part of the annual review [104]. Critically, most participants (74.5%) and most cases with lung cancer (17/26, 65.4%) would not have met eligibility criteria for most lung cancer screening programmes. Further discussion on recent trials, cost-effectiveness, and implementation barriers to screening can be found here [105].

9.2 | LCS is Increasingly Implemented in Many Regions Including the Asia– Pacific

Extended participant follow-up of pivotal screening trials confirms the reported benefits from LCS, including consistent number needed to screen [14] and reduced LC mortality and overall mortality [19]. MILD data also suggest biennial rather than annual screening may perform similarly with fewer CT scans [19].

The large US LCSR analysis of over 1 million participants showed broad implementation of LCS is feasibly conducted with high fidelity to contemporaneous eligibility criteria, resulting in an overall baseline cancer detection rate of 0.56% and consistent stage shift. On the other hand, only 1 in 5 participants had the repeat annual scan (albeit higher rates with extended follow-up) [7]. Furthermore, screenees were likelier to be older, female, and current smokers. Thus, better engaging potentially eligible at-risk people and ongoing participation remain important programmatic challenges.

Welcome additions to the international LCS experience come from Asia, particularly China, with multiple publications of demonstration and or implementation LCS projects in several regions [20–24, 27]. Another very large data set came from the Chinese study of over a million participants, which further attests to the feasibility of large scale LCS [20].

The Korean Lung Cancer Screening Project (K-LUCAS) has reported initial results from the national health screening program [25] and other large scale efforts have been reported in Korea [26]. Some Korean LCS studies have included never-smokers, suggesting that the rate of lung cancer diagnosis is lower than that from LCS of ever smokers [43, 44] is a key issue in the Asia Pacific region given the numbers of lung cancer found in never smokers.

Taiwan has contributed a major trial from this region addressing this point; the groundbreaking Taiwan Lung Cancer Screening in Never-Smoker Trial (TALENT) [41] (Author disclosure PCY PI) demonstrated the potential for LCS in never or lighter smokers in this population. TALENT reported a lung cancer diagnosis rate of 2.6% from 12 011 participants; as 2.1% of the participants had invasive lung cancer and 0.5% had adenocarcinomas in situ, the important issue of potential overdiagnosis has also been discussed, given a Taiwanese ecological cohort study reported an increased incidence of early-stage lung cancer over a recent period without change in the incidence of late-stage disease after the introduction of LCS, consistent with the concept of potential overdiagnosis [106].

A Chinese prospective study of both smokers and nonsmokers reported a lower proportion of non-smokers meeting a high-risk score model compared to smokers. Additionally, compared with

participants who were not screened, LCS in smokers resulted in a higher lung cancer incidence and reduced lung cancer and all-cause mortality, but there were no such differences seen in non-smokers (noting smaller sample size) [45].

Further work to define the effectiveness of LCS in non-smokers is required, given the large burden of disease and horizon scanning for the future with the great benefit of reducing.

Nonetheless, currently, more than 600 million people in the Asia Pacific region smoke. Smoking cessation remains a key part of LCS programmes, improving health outcomes and cost-effectiveness; resulting in trials of smoking cessation tools, including web-based educational videos [98] with local environmental factors anticipated to influence uptake and effectiveness for this teachable moment for smoking cessation. In addition, air pollution affects much of the region at high levels and contributes to lung cancer risk. Broader policy goals for lung cancer must therefore also include action to reduce air pollution smoking rates.

9.3 | LCS Efficiency Can Be Improved

There has been considerable interest in the scientific concept of risk prediction model for selecting eligible LS participants. These new models recognise and incorporate additional putative or established risk factors to the archetypal categorical factors of age, smoking pack-years, such as integrating variables of gender, family history of lung cancer, personal cancer history, BMI, lung function test, CEA, bilirubin, AFP, CRP with differential performance for never smokers, light smokers, and heavy smokers [48].

In Germany, ESTHER compared the performance of 11 different LC risk models in screening-age adults, suggested that various risk models can identify people at highest risk for LCS selection [49].

There is much interest in the performance of invitation methods, both generic and for high priority populations [55, 56], with some evidence that small modifications may result in useful improvements in participation rate [54]. For electronic-based primary health care systems, prompts and shared decision-making tools appear to be useful [67].

Expectedly, barriers to LCS include healthcare and socioeconomic issues prevalent in rural communities [68, 70], male sex, current smoking, depressive symptoms, delays in initiating LDCT scans, and lack of publicity and navigation assistance [69]. Interestingly, mobile LCS, relatively implemented in the UK, has also been trialled in New York, where participant demography may be heterogenous [107]. Reports of racial and ethnic disparities for LCS participation and outcomes suggest the need for ongoing attention [73, 74].

9.4 | Better Nodule Management

Comparative research suggests two of the most common nodule management algorithms [Pan-Canadian Early Detection of Lung Cancer Nodule Risk Classification and ACR Lung Screening Reporting and Data System (Lung-RADS)] perform well [108], with the latter premised on annual screens and the former only validated in baseline scans. Biomarker-augmented management is also emerging as a potential aid to enhance nodule care [58–60]. Management of LCS-detected nodules is a hot topic, given the impact not only on health outcomes and safety of an LCS programme but also its cost-effectiveness and consumption of scarce health care dollars. Reassuringly, in real-world experience, a US cohort study reported downstream imaging and invasive procedures from LCS at 31.9% and 2.8%, generally lower complication rates than NLST[62]. The potential role of CAD, radiomics, or AI is very actively researched for mainstream LCS implementation, evidenced by early reports of a multitude of systems used in a variety of ways [76–86, 109].

9.5 | Better Management of Incidental (Additional) Findings

It is also clear that the discovery of incidental findings can lead to detection of both significant pathology as well as abnormalities of little clinical consequence. Well-studied incidental findings include osteoporosis [87], COPD [94, 110–111], emphysema [93, 95–96], coronary artery calcification [89, 91–92], with a review rate for clinically relevant findings in primary care estimated in one study to be 1 in 20 [94]. The increased identification of thyroid cancers raised the concept of overdiagnosis of thyroid incidentalomas [97]. While there can be some increased anxiety in some LCS participants [108], and higher cancer distress with a positive screening result [64], overall QOL does not appear to be significantly impacted by LCS participation. Custom tools such as preparatory written information and providing letters with results seem to be well accepted [66].

9.6 | Call To Action; Implementation with an Emphasis on Asia Pacific Region

Successful implementation of lung cancer screening for the Asia Pacific region involves challenges and subsequent pressing policy implications. Stigma driven by negative public health messaging about tobacco may prevent LCS uptake through avoidance, psychological distress, delays in seeking help, and reductions in efforts toward early detection [105].

Multiple logistical and operational matters coalesce in LCS, including the determination of eligibility, integration of smoking cessation, nodule management, incidental findings, data registration and the integration of emerging technologies [112, 113]. Uncertainties persist about key implementation steps including recruitment, optimal selection criteria (categorical or risk-based), evidence-based screening intervals, nodule evaluation, optimal smoking cessation strategies, sex-based differences in screening, cost-effectiveness and the impact on health care resources.

A comparison of LCS policy development across Europe stratified key issues into six stages: assessment of evidence, economic evaluation, local feasibility studies, commitment to programme setup, national protocols, and organisational setup [114].

Critical components of a screening system include governance, information and communication, adequate (and adequately trained) healthcare workforce, high quality medical technologies, streamlined service delivery along with commitments to quality, safety, equity of access, efficiency, and integration into public health programs [114]. Indeed, multinational coordination and collaboration is likely to be of great importance, such as in The Strengthening the Screening of Lung Cancer in Europe (SOLACE) project, a pioneering new EU4Health project under Europe's Beating Cancer Plan. The aim is to facilitate the implementation of lung cancer screening programmes across Europe and could conceivably be a model for the Asia-Pacific.

LCS issues pertinent to China, which accounts for more than 40% of all lung cancer cases worldwide [115], include emerging data registries, the need for relevant risk models for selection and for nodule evaluation, smoking cessation integration and the role of community-based recruitment [116, 117]. In limited resource settings, even a seemingly simple issue such as the relative unavailability of publicly funded CT scanners may prevent access to LCS.

In practice, the complexities of lung cancer screening implementation underscore the need to look to established programs and active research to design successful programs. Low and middle-income countries (LMICS), which form a considerable part of the Asia Pacific region, can draw upon high-income country (HIC) experience in data management and cost-effectiveness studies as well as considering specific issues such as community-based recruitment ('one-stop health checks' and mobile scanners), workforce limitations and culturally appropriate screening approaches that acknowledge stigma and social disparities [118]. Community health care worker education can improve the understanding of lung cancer screening and support community-based recruitment [119] and community-based 'lung health checks' may foster very high LCS participation rates [120]. Coordination of primary care, speciality care and community input can boost participation in LCS in rural settings [121]. Telehealth can reach potential participants and provide smoking cessation advice [122].

The Asia and the Pacific region is home to 60% of the world's population. Successful implementation of LCS in the Asia Pacific has the potential for sustained improvements in lung cancer outcomes for many populations. High rates of non-smoking related lung cancer in the region will continue to drive screening research in populations with other toxic exposures and with significant family history [41]. Ongoing research will contribute to LCS in the region's indigenous populations such as Aotearoa New Zealand's Māori community [55, 123] and Australia's Aboriginal and Torres Strait Islander peoples [124].

The volume of data, rapidly emerging studies and steady rollout of LCS worldwide likely herald a new era in lung cancer medicine where sophisticated imaging and novel technologies will support early diagnosis, minimally invasive therapies and, we hope, dramatic improvements in outcomes for patients, families and their communities. Coordinated, cooperative multidisciplinary efforts in our region that encompass diversity, equity and inclusion such as the APSR Big 5 Lung Diseases Workshop and Toolkit (The Big Five (apsresp.org)) will be needed to help upscale effective early lung cancer detection and treatment health technologies. No one deserves lung cancer; people at risk deserve screening for early detection.

Author Contributions

All authors contributed to review design, literature research and analysis, writing and manuscript revision.

Acknowledgements

With thanks to Ms. Julie Williams, Research Services Librarian | Walter McGrath Library. Open access publishing facilitated by University of New South Wales, as part of the Wiley - University of New South Wales agreement via the Council of Australian University Librarians.

Conflicts of Interest

E.S.: Speaker honoraria—Astra Zeneca, Merck Sharp & Dohme, The Limbic, support for travel: Astra Zeneca LOBES 2022, Ad hoc advisory board payment—Bristol Myers Squibb. H.M.: grants from NHMRC, MRFF; Lecture fees: Astra Zeneca honorarium; Australian National Lung Cancer Screening Program EAG. P.C.-Y.: grant: National Science and Technology Council, Taiwan. K.M.F.: Competitive Research Grants; MRFF and NHMRC, Royalties: UpToDate Reviewer and Cochrane Clinical Answers Reviewer, Travel support for various meetings from meeting Organisers/Societies; Support with loan bronchoscopes for the purpose of a research trial by Olympus, Software licensing for Computer Aided Diagnosis research in the International Lung Screen Trial (ILST) from Mevis Veolity.

References

1. F. Bray, M. Laversanne, H. Sung, et al., "Global Cancer Statistics 2022: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries," *CA: A Cancer Journal for Clinicians* 74, no. 3 (2024): 229–263.

2. National Lung Screening Trial Research Team, D. R. Aberle, A. M. Adams, et al., "Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening," *New England Journal of Medicine* 365, no. 5 (2011): 395–409.

3. H. J. de Koning, C. M. van der Aalst, P. A. de Jong, et al., "Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial," *New England Journal of Medicine* 382 (2020): 503–513.

4. U. Pastorino, M. Silva, S. Sestini, et al., "Prolonged Lung Cancer Screening Reduced 10-Year Mortality in the MILD Trial: New Confirmation of Lung Cancer Screening Efficacy," *Annals of Oncology* 30, no. 10 (2019): 1672.

5. A. Bonney, R. Malouf, C. Marchal, et al., "Impact of Low-Dose Computed Tomography (LDCT) Screening on Lung Cancer-Related Mortality," *Cochrane Database of Systematic Reviews* 8 (2022): CD013829.

6. E. Stone, R. H. Dodd, H. Marshall, B. Bonevski, and N. M. Rankin, "Lung Cancer Screening: The Hidden Public Health Emergency," *Public Health Research & Practice* 33, no. 1 (2023): 3312302.

7. G. A. Silvestri, L. Goldman, J. Burleson, et al., "Characteristics of Persons Screened for Lung Cancer in the United States: A Cohort Study," *Annals of Internal Medicine* 175, no. 11 (2022): 1501–1505.

8. G. A. Silvestri, L. Goldman, N. T. Tanner, et al., "Outcomes From More Than 1 Million People Screened for Lung Cancer With Low-Dose CT Imaging," *Chest* 164, no. 1 (2023): 241–251.

9. J. K. Gohagan, P. M. Marcus, R. M. Fagerstrom, et al., "Final Results of the Lung Screening Study, A Randomized Feasibility Study of Spiral

CT Versus Chest X-Ray Screening for Lung Cancer," *Lung Cancer* 47, no. 1 (2005): 9–15.

10. J. Gohagan, P. Marcus, R. Fagerstrom, et al., "Baseline Findings of a Randomized Feasibility Trial of Lung Cancer Screening with Spiral CT Scan vs Chest Radiograph: the Lung Screening Study of the National Cancer Institute," *Chest* 126, no. 1 (2004): 114–121.

11. M. Infante, S. Cavuto, F. R. Lutman, et al., "A Randomized Study of Lung Cancer Screening with Spiral Computed Tomography: Three-Year Results from the DANTE Trial," *American Journal of Respiratory and Critical Care Medicine* 180, no. 5 (2009): 445–453.

12. M. Infante, S. Cavuto, F. R. Lutman, et al., "Long-Term Follow-up Results of the DANTE Trial, a Randomized Study of Lung Cancer Screening with Spiral Computed Tomography," *American Journal of Respiratory and Critical Care Medicine* 191, no. 10 (2015): 1166–1175.

13. N. Becker, E. Motsch, A. Trotter, et al., "Lung Cancer Mortality Reduction by LDCT Screening-Results from the Randomized German LUSI trial," *International Journal of Cancer* 146, no. 6 (2020): 1503–1513.

14. National Lung Screening Trial Research Team, "Lung Cancer Incidence and Mortality with Extended Follow-up in the National Lung Screening Trial," *Journal of Thoracic Oncology: Official Publication of the International Association for the Study of Lung Cancer* 14, no. 10 (2019): 1732–1742.

15. J. K. Field, S. W. Duffy, D. R. Baldwin, 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* 71, no. 2 (2016): 161–170.

16. A. Kerpel-Fronius, Z. Monostori, G. Kovacs, et al., "Nationwide Lung Cancer Screening with Low-Dose Computed Tomography: Implementation and First Results of the HUNCHEST Screening Program," *European Radiology* 32, no. 7 (2022): 4457–4467.

17. U. Pastorino, N. Sverzellati, S. Sestini, et al., "Ten-Year Results of the Multicentric Italian Lung Detection Trial Demonstrate the Safety and Efficacy of Biennial Lung Cancer Screening," *European Journal of Cancer (Oxford, England: 1990)* 1990, no. 118 (2019): 142–148.

18. U. Pastorino, M. Rossi, V. Rosato, et al., "Annual or Biennial CT Screening versus Observation in Heavy Smokers: 5-Year Results of the MILD Trial," *European Journal of Cancer Prevention* 21, no. 3 (2012): 308–315.

19. N. Sverzellati, M. Silva, G. Calareso, et al., "Low-Dose Computed Tomography for Lung Cancer Screening: Comparison of Performance between Annual and Biennial Screen," *European Radiology* 26, no. 11 (2016): 3821–3829.

20. N. Li, F. Tan, W. Chen, et al., "One-off Low-Dose CT for Lung Cancer Screening in China: a Multicentre, Population-Based, Prospective Cohort Study," *Lancet Respiratory Medicine* 10, no. 4 (2022): 378–391.

21. L. W. Guo, Z. Y. Lyu, Q. C. Meng, et al., "A Risk Prediction Model for Selecting High-Risk Population for Computed Tomography Lung Cancer Screening in China," *Lung Cancer* 163 (2022): 27–34.

22. Z. Yu, P. Ni, H. Yu, T. Zuo, Y. Liu, and D. Wang, "Effectiveness of a Single Low-Dose Computed Tomography Screening for Lung Cancer: a Population-Based Perspective Cohort Study in China," *International Journal of Cancer* 154, no. 4 (2024): 659–669.

23. G. Ji, T. Bao, Z. Li, et al., "Current Lung Cancer Screening Guidelines May Miss High-Risk Population: a Real-World Study," *BMC Cancer* 21, no. 1 (2021): 50.

24. M. N. Wei, Z. Su, J. N. Wang, et al., "Performance of Lung Cancer Screening with Low-Dose CT in Gejiu, Yunnan: A Population-Based, Screening Cohort Study," *Thoracic Cancer* 11, no. 5 (2020): 1224–1232.

25. J. Lee, Y. Kim, H. Y. Kim, et al., "Feasibility of Implementing a National Lung Cancer Screening Program: Interim Results from the Korean Lung Cancer Screening Project (K-LUCAS)," *Translational Lung Cancer Research* 10, no. 2 (2021): 723–736.

26. Y. W. Kim, M. Jeon, M. J. Song, et al., "Differences in Detection Patterns, Characteristics, and Outcomes of Central and Peripheral Lung Cancers in Low-Dose Computed Tomography Screening," *Translational Lung Cancer Research* 10, no. 11 (2021): 4185–4199.

27. W. Yang, F. Qian, J. Teng, et al., "Community-Based Lung Cancer Screening with Low-Dose CT in China: Results of the Baseline Screening," *Lung Cancer (Amsterdam, Netherlands)* 117 (2018): 20–26.

28. F. Barbone, F. Barbiero, O. Belvedere, et al., "Impact of Low-Dose Computed Tomography Screening on Lung Cancer Mortality among Asbestos-Exposed Workers," *International Journal of Epidemiology* 47, no. 6 (2018): 1981–1991.

29. Y. Zhang, S. Jheon, H. Li, et al., "Results of Low-Dose Computed Tomography as a Regular Health Examination among Chinese Hospital Employees," *Journal of Thoracic and Cardiovascular Surgery* 160, no. 3 (2020): 824–831.e4.

30. K. L. Cleven, B. Vaeth, R. Zeig-Owens, et al., "Performance of Risk Factor-Based Guidelines and Model-Based Chest CT Lung Cancer Screening in World Trade Center-Exposed Fire Department Rescue/Recovery Workers," *Chest* 159, no. 5 (2021): 2060–2071.

31. J. L. Heffner, S. Coggeshall, C. L. Wheat, et al., "Receipt of Tobacco Treatment and One-Year Smoking Cessation Rates Following Lung Cancer Screening in the Veterans Health Administration," *Journal of General Internal Medicine* 37, no. 7 (2022): 1704–1712.

32. K. P. Seastedt, M. J. Luca, J. L. Antevil, et al., "Patient Motivations for Non-Adherence to Lung Cancer Screening in a Military Population," *Journal of Thoracic Disease* 12, no. 10 (2020): 5916–5924.

33. M. Hinojos, X. Li, S. Mikesell, et al., "Impact of Low-dose Chest CT Screening on the Association Between Rurality and Lung Cancer Outcomes," *American Journal of Clinical Oncology* 45, no. 12 (2022): 519–525.

34. H. R. Kang, J. H. Song, K. B. Chung, B. J. Lee, J. H. Lee, and C. T. Lee, "Impact of Lung Cancer Screening with Low-Dose Chest Computed Tomography on an Older Population: a Retrospective Cohort Study," *Translational Lung Cancer Research* 12, no. 10 (2023): 2068–2082.

35. V. K. Lam, M. Miller, L. Dowling, S. Singhal, R. P. Young, and E. C. Cabebe, "Community Low-Dose CT Lung Cancer Screening: A Prospective Cohort Study," *Lung* 193, no. 1 (2015): 135–139.

36. L. B. E. Shields, J. G. Wilkett Barnes, C. Buckley, et al., "Multidisciplinary Approach to Low-Dose CT Screening for Lung Cancer in a Metropolitan Community," *Family Practice* 37, no. 1 (2020): 25–29.

37. F. M. Svartman, M. M. R. Leite, A. P. G. Sartori, et al., "Lung Cancer Screening with Low-Dose CT Integrated with Pulmonary Care in a Public Hospital in Southern Brazil: Results from the First 712 Patients," *Jornal Brasileiro de Pneumologia e Sociedade Brasileira de Pneumologia e Tisiologia* 48, no. 5 (2022): e20220146.

38. J. LoPiccolo, A. Gusev, D. C. Christiani, and P. A. Jänne, "Lung Cancer in Patients Who Have Never Smoked—An Emerging Disease," *Nature Reviews. Clinical Oncology* 21, no. 2 (2024): 121–146.

39. D. C. L. Lam, C. K. Liam, S. Andarini, et al., "Lung Cancer Screening in Asia: An Expert Consensus Report," *Journal of Thoracic Oncology* 18, no. 10 (2023): 1303–1322.

40. C. L. Wang, K. H. Hsu, Y. H. Chang, et al., "Low-Dose Computed Tomography Screening in Relatives With a Family History of Lung Cancer," *Journal of Thoracic Oncology* 18, no. 11 (2023): 1492–1503.

41. G. C. Chang, C. H. Chiu, C. J. Yu, et al., "Low-Dose CT Screening among Never-Smokers With or Without a Family History of Lung Cancer in Taiwan: A Prospective Cohort Study," *Lancet Respiratory Medicine* 12, no. 2 (2024): 141–152.

42. T. H. H. Chen, K. P. Huang, L. J. Lin, and C. C. Wu, "Taiwan National Lung Cancer Early Detection Program for Heavy Smokers and Non-Smokers with Family History of Lung Cancer," *Journal of Clinical Oncology [Internet]* 42, no. suppl 16 (2024), https://ascopubs.org/doi/10.1200/JCO.2024.42.16_suppl.8009.

43. H. R. Kang, J. Y. Cho, S. H. Lee, et al., "Role of Low-Dose Computerized Tomography in Lung Cancer Screening among Never-Smokers," *Journal of Thoracic Oncology* 14, no. 3 (2019): 436–444.

44. H. Y. Kim, K. W. Jung, K. Y. Lim, et al., "Lung Cancer Screening with Low-Dose CT in Female Never Smokers: Retrospective Cohort Study with Long-term National Data Follow-up," *Cancer Research and Treatment* 50, no. 3 (2018): 748–756.

45. L. Wang, Y. Wang, F. Wang, et al., "Disparity in Lung Cancer Screening Among Smokers and Nonsmokers in China: Prospective Cohort Study," *JMIR Public Health and Surveillance* 9 (2023): e43586.

46. C. H. Chiu and P. C. Yang, "Never Say No to Never-Smokers," *Journal of Thoracic Oncology: Official Publication of the International Association for the Study of Lung Cancer* 18, no. 6 (2023): 689–693.

47. "Stage Shift Improves Lung Cancer Survival: Real-World Evidence," PubMed [Internet], accessed Jul 8, 2024, https://pubmed.ncbi.nlm.nih.gov/37650698/.

48. X. Wu, C. P. Wen, Y. Ye, et al., "Personalized Risk Assessment in Never, Light, and Heavy Smokers in a Prospective Cohort in Taiwan," *Scientific Reports* 6 (2016): 36482.

49. M. Bhardwaj, B. Schöttker, B. Holleczek, and H. Brenner, "Comparison of Discrimination Performance of 11 Lung Cancer Risk Models for Predicting Lung Cancer in a Prospective Cohort of Screening-Age Adults from Germany Followed over 17 Years," *Lung Cancer* 174 (2022): 83–90.

50. M. C. Tammemägi, M. Ruparel, A. Tremblay, et al., "USPSTF2013 Versus Plcom2012 Lung Cancer Screening Eligibility Criteria (International Lung Screening Trial): Interim Analysis of a Prospective Cohort Study," *Lancet Oncology* 23, no. 1 (2022): 138–148.

51. K. P. Lim, H. Marshall, M. Tammemägi, et al., "Protocol and Rationale for the International Lung Screening Trial (ILST)," *Annals of the American Thoracic Society* 17, no. 4 (2020): 503–512.

52. B. Maller, V. N. Simmons, M. M. Byrne, and T. Tanvetyanon, "Characteristics and Outcomes of Lung Cancer Screening Among Individuals With or Without Cancer History," *Clinical Lung Cancer* 22, no. 4 (2021): e629–e636, https://pubmed.ncbi.nlm.nih.gov/33441268/.

53. E. O'Dwyer, D. F. Halpenny, and M. S. Ginsberg, "Lung Cancer Screening in Patients with Previous Malignancy: Is this Cohort at Increased Risk for Malignancy?," *European Radiology* 31, no. 1 (2021): 458–467.

54. N. M. Carroll, A. N. Burnett-Hartman, C. A. Joyce, et al., "Real-World Clinical Implementation of Lung Cancer Screening-Evaluating Processes to Improve Screening Guidelines-Concordance," *Journal of General Internal Medicine* 35, no. 4 (2020): 1143–1152.

55. K. Parker, S. Colhoun, K. Bartholomew, et al., "Invitation Methods for Indigenous New Zealand Māori in Lung Cancer Screening: Protocol for a Pragmatic Cluster Randomized Controlled Trial," *PLoS One* 18, no. 8 (2023): e0281420.

56. S. L. Quaife, M. Ruparel, J. L. Dickson, et al., "Lung Screen Uptake Trial (LSUT): Randomized Controlled Clinical Trial Testing Targeted Invitation Materials," *American Journal of Respiratory and Critical Care Medicine* 201, no. 8 (2020): 965–975.

57. S. Randhawa, S. R. Sferra, C. Das, L. R. Kaiser, G. X. Ma, and C. P. Erkmen, "Examining Gender Differences in Lung Cancer Screening," *Journal of Community Health* 45, no. 5 (2020): 1038–1042.

58. E. Paci, D. Puliti, A. Lopes Pegna, et al., "Mortality, Survival and Incidence Rates in the ITALUNG Randomised Lung Cancer Screening Trial," *Thorax* 72, no. 9 (2017): 825–831.

59. F. M. Carozzi, S. Bisanzi, L. Carrozzi, et al., "Multimodal Lung Cancer Screening Using the ITALUNG Biomarker Panel and Low Dose Computed Tomography. Results of the ITALUNG Biomarker Study," *International Journal of Cancer* 141, no. 1 (2017): 94–101.

60. A. Lopes Pegna, G. Picozzi, F. Falaschi, et al., "Four-Year Results of Low-Dose CT Screening and Nodule Management in the ITALUNG Trial," *Journal of Thoracic Oncology* 8, no. 7 (2013): 866–875.

61. K. A. Rendle, C. A. Saia, A. Vachani, et al., "Rates of Downstream Procedures and Complications Associated With Lung Cancer Screening in Routine Clinical Practice: A Retrospective Cohort Study," *Annals of Internal Medicine* 177, no. 1 (2024): 18–28.

62. N. Ali, K. J. Lifford, B. Carter, et al., "Barriers to Uptake among High-Risk Individuals Declining Participation in Lung Cancer Screening: a Mixed Methods Analysis of the UK Lung Cancer Screening (UKLS) Trial," *BMJ Open* 5, no. 7 (2015): e008254.

63. D. Cavers, M. Nelson, J. Rostron, et al., "Understanding Patient Barriers and Facilitators to Uptake of Lung Screening Using Low Dose Computed Tomography: a Mixed Methods Scoping Review of the Current Literature," *Respiratory Research* 23, no. 1 (2022): 374.

64. K. Brain, K. J. Lifford, B. Carter, et al., "Long-Term Psychosocial Outcomes of Low-Dose CT Screening: Results of the UK Lung Cancer Screening Randomised Controlled Trial," *Thorax* 71, no. 11 (2016): 996–1005.

65. N. Taghizadeh, A. Tremblay, S. Cressman, et al., "Health-Related Quality of Life and Anxiety in the PAN-CAN Lung Cancer Screening Cohort," *BMJ Open* 9, no. 1 (2019): e024719.

66. A. Bhamani, C. Horst, F. Bojang, et al., "The SUMMIT Study: Utilising a Written 'Next Steps' Information Booklet to Prepare Participants for Potential Lung Cancer Screening Results and Follow-up," *Lung Cancer* 176 (2023): 75–81.

67. P. V. Kukhareva, H. Li, T. J. Caverly, et al., "Implementation of Lung Cancer Screening in Primary Care and Pulmonary Clinics: Pragmatic Clinical Trial of Electronic Health Record-Integrated Everyday Shared Decision-Making Tool and Clinician-Facing Prompts," *Chest* 164, no. 5 (2023): 1325–1338.

68. B. Bodily, J. Ashurst, J. Fredriksen, et al., "Results of Lung Cancer Screening in a Rural Setting: A Retrospective Cohort Study," *Cureus* 14, no. 3 (2022): e23299.

69. W. Cao, F. Tan, K. Liu, et al., "Uptake of Lung Cancer Screening with Low-Dose Computed Tomography in China: A Multi-Centre Population-Based Study," *EClinicalMedicine* 52 (2022): 101594.

70. C. Neslund-Dudas, A. Tang, E. Alleman, et al., "Uptake of Lung Cancer Screening CT After a Provider Order for Screening in the PROSPR-Lung Consortium," *Journal of General Internal Medicine* 39, no. 2 (2024): 186–194.

71. R. U. Osarogiagbon, W. Liao, N. R. Faris, et al., "Lung Cancer Diagnosed Through Screening, Lung Nodule, and Neither Program: A Prospective Observational Study of the Detecting Early Lung Cancer (DELUGE) in the Mississippi Delta Cohort," *Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology* 40, no. 19 (2022): 2094–2105.

72. R. U. Osarogiagbon, W. Liao, N. R. Faris, et al., "Evaluation of Lung Cancer Risk Among Persons Undergoing Screening or Guideline-Concordant Monitoring of Lung Nodules in the Mississippi Delta," *JAMA Network Open* 6, no. 2 (2023): e230787.

73. N. T. Tanner, M. Gebregziabher, C. Hughes Halbert, E. Payne, L. E. Egede, and G. A. Silvestri, "Racial Differences in Outcomes within

the National Lung Screening Trial. Implications for Widespread Implementation," *American Journal of Respiratory and Critical Care Medicine* 192, no. 2 (2015): 200–208, https://pubmed.ncbi.nlm.nih.gov/25928649/.

74. C. E. S. Oshiro, T. B. Frankland, J. Mor, et al., "Lung Cancer Screening by Race and Ethnicity in an Integrated Health System in Hawaii," *JAMA Network Open* 5, no. 1 (2022): e2144381.

75. B. B. Pua, B. C. O'Neill, A. K. Ortiz, et al., "Results from Lung Cancer Screening Outreach Utilizing a Mobile CT Scanner in an Urban Area," *Journal of the American College of Radiology* 21, no. 5 (2024): 778–788.

76. H. Hall, M. Ruparel, S. L. Quaife, et al., "The Role of Computer-Assisted Radiographer Reporting in Lung Cancer Screening Programmes," *European Radiology* 32, no. 10 (2022): 6891–6899.

77. H. S. Chao, C. Y. Tsai, C. W. Chou, et al., "Artificial Intelligence Assisted Computational Tomographic Detection of Lung Nodules for Prognostic Cancer Examination: A Large-Scale Clinical Trial," *Biomedicine* 11, no. 1 (2023): 147.

78. W. Tao, X. Yu, J. Shao, R. Li, and W. Li, "Telemedicine-Enhanced Lung Cancer Screening Using Mobile Computed Tomography Unit with Remote Artificial Intelligence Assistance in Underserved Communities: Initial Results of a Population Cohort Study in Western China," *Telemedicine and e-Health: The Official Journal of the American Telemedicine Association* 30, no. 6 (2024): e1695–e1704.

79. Y. C. Hsu, Y. H. Tsai, H. H. Weng, et al., "Artificial Neural Networks Improve LDCT Lung Cancer Screening: a Comparative Validation Study," *BMC Cancer* 20, no. 1 (2020): 1023.

80. S. Li, P. Xu, B. Li, et al., "Predicting Lung Nodule Malignancies by Combining Deep Convolutional Neural Network and Handcrafted Features," *Physics in Medicine and Biology* 64, no. 17 (2019): 175012.

81. Q. Li, Y. Balagurunathan, Y. Liu, et al., "Comparison Between Radiological Semantic Features and Lung-RADS in Predicting Malignancy of Screen-Detected Lung Nodules in the National Lung Screening Trial," *Clinical Lung Cancer* 19, no. 2 (2018): 148–156.e3.

82. Y. Li, J. Liu, X. Yang, et al., "An Ordinal Radiomic Model to Predict the Differentiation Grade of Invasive Non-Mucinous Pulmonary Adenocarcinoma Based on Low-Dose Computed Tomography in Lung Cancer Screening," *European Radiology* 33, no. 5 (2023): 3072–3082.

83. Y. Li, J. Liu, X. Yang, et al., "Prediction of Invasive Adenocarcinomas Manifesting as Pure Ground-Glass Nodules Based on Radiomic Signature of Low-Dose CT in Lung Cancer Screening," *British Journal of Radiology* 95, no. 1133 (2022): 20211048.

84. J. Liu, H. Xu, H. Qing, et al., "Comparison of Radiomic Models Based on Low-Dose and Standard-Dose CT for Prediction of Adenocarcinomas and Benign Lesions in Solid Pulmonary Nodules," *Frontiers in Oncology* 10 (2020): 634298.

85. Q. Sun, Y. Huang, J. Wang, et al., "Applying CT Texture Analysis to Determine the Prognostic Value of Subsolid Nodules Detected during Low-Dose CT Screening," *Clinical Radiology* 74, no. 1 (2019): 59–66.

86. J. Simon, P. Mikhael, I. Tahir, et al., "Role of Sex in Lung Cancer Risk Prediction Based on Single Low-Dose Chest Computed Tomography," *Scientific Reports* 13, no. 1 (2023): 18611.

87. X. Cheng, K. Zhao, X. Zha, et al., "Opportunistic Screening Using Low-Dose CT and the Prevalence of Osteoporosis in China: A Nationwide, Multicenter Study," *Journal of Bone and Mineral Research: the Official Journal of the American Society for Bone and Mineral Research* 36, no. 3 (2021): 427–435.

88. S. Tisi, A. W. Creamer, J. Dickson, et al., "Prevalence and Clinical Characteristics of Non-Malignant CT Detected Incidental Findings in the SUMMIT Lung Cancer Screening Cohort," *BMJ Open Respiratory Research* 10, no. 1 (2023): e001664.

89. P. Kasprzyk, A. Undrunas, K. Dziadziuszko, et al., "Evaluation of Conventional Cardiovascular Risk Factors and Ordinal Coronary Artery Calcium Scoring in a Lung Cancer Screening Cohort," *Journal of Cardiovascular Development and Disease* 11, no. 1 (2024): 16.

90. J. Hippisley-Cox, C. Coupland, and P. Brindle, "Development and Validation of QRISK3 Risk Prediction Algorithms to Estimate Future Risk of Cardiovascular Disease: Prospective Cohort Study," *BMJ (Clinical Research ed.)* 357 (2017): j2099.

91. M. Ruparel, S. L. Quaife, J. L. Dickson, et al., "Evaluation of Cardiovascular Risk in a Lung Cancer Screening Cohort," *Thorax* 74, no. 12 (2019): 1140–1146.

92. Y. Zhu, R. Yip, J. Shemesh, A. C. Jirapatnakul, D. F. Yankelevitz, and C. I. Henschke, "Combined Aortic Valve and Coronary Artery Calcifications in Lung Cancer Screening as Predictors of Death from Cardiovascular Disease," *European Radiology* 30, no. 12 (2020): 6847–6857.

93. M. Ruparel, S. L. Quaife, J. L. Dickson, et al., "Prevalence, Symptom Burden, and Underdiagnosis of Chronic Obstructive Pulmonary Disease in a Lung Cancer Screening Cohort," *Annals of the American Thoracic Society* 17, no. 7 (2020): 869–878.

94. S. Tisi, J. L. Dickson, C. Horst, et al., "Detection of COPD in the SUMMIT Study Lung Cancer Screening Cohort Using Symptoms and Spirometry," *European Respiratory Journal* 60, no. 6 (2022): 2200795.

95. J. P. de Torres, G. Bastarrika, J. P. Wisnivesky, et al., "Assessing the Relationship between Lung Cancer Risk and Emphysema Detected on Low-Dose CT of the Chest," *Chest* 132, no. 6 (2007): 1932–1938.

96. P. C. Yong, K. Sigel, J. P. de-Torres, et al., "The Effect of Radiographic Emphysema in Assessing Lung Cancer Risk," *Thorax* 74, no. 9 (2019): 858–864.

97. H. A. Loomans-Kropp, B. K. Dunn, B. S. Kramer, and P. Pinsky, "Thyroid Incidentalomas in Association With Low-Dose Computed Tomography in the National Lung Screening Trial," *American Journal of Epidemiology* 189, no. 1 (2020): 27–33.

98. D. J. Raz, M. H. Ismail, E. C. Haupt, et al., "Improving Utilization of Lung Cancer Screening Through Incorporating a Video-Based Educational Tool Into Smoking Cessation Counseling," *Clinical Lung Cancer* 22, no. 2 (2021): 83–91.

99. Z. Su, X. Li, H. Wu, et al., "The Impact of Low-Dose CT on Smoking Behavior among Non-Smokers, Former-Smokers, and Smokers: a Population-Based Screening Cohort in Rural China," *Cancer Medicine* 12, no. 4 (2023): 4667–4678.

100. A. B. Knudsen, A. Trentham-Dietz, J. J. Kim, et al., "Estimated US Cancer Deaths Prevented With Increased Use of Lung, Colorectal, Breast, and Cervical Cancer Screening," *JAMA Network Open* 6, no. 11 (2023): e2344698.

101. S. B. Markowitz, "Lung Cancer Screening in Asbestos-Exposed Populations," *International Journal of Environmental Research and Public Health* 19, no. 5 (2022): 2688.

102. L. S. Welch, J. M. Dement, K. Cranford, et al., "Early Detection of Lung Cancer in a Population at High Risk Due to Occupation and Smoking," *Occupational and Environmental Medicine* 76, no. 3 (2019): 137–142.

103. B. Clin, A. Luc, F. Morlais, et al., "Pulmonary Nodules Detected by Thoracic Computed Tomography Scan after Exposure to Asbestos: Diagnostic Significance," *International Journal of Tuberculosis and Lung Disease* 15, no. 12 (2011): 1707–1714.

104. F. J. H. Brims, E. J. A. Harris, C. Murray, et al., "Lung Cancer Screening an Asbestos Exposed Population: Existing Lung Cancer Risk Criteria Are not Sufficient," *Respirology (Carlton, Vic.)* 28, no. 6 (2023): 543–550.

105. N. M. Rankin, A. McWilliams, and H. M. Marshall, "Lung Cancer Screening Implementation: Complexities and Priorities," *Respirology* 25, no. Suppl 2 (2020): 5–23.

106. W. Gao, C. P. Wen, A. Wu, and H. G. Welch, "Association of Computed Tomographic Screening Promotion With Lung Cancer Overdiagnosis Among Asian Women," *JAMA Internal Medicine* 182, no. 3 (2022): 283–290.

107. B. B. Pua, E. Dou, K. O'Connor, and C. B. Crawford, "Integrating Smoking Cessation into Lung Cancer Screening Programs," *Clinical Imaging* 40, no. 2 (2016): 302–306.

108. A. Tremblay, N. Taghizadeh, J. H. MacGregor, et al., "Application of Lung-Screening Reporting and Data System Versus Pan-Canadian Early Detection of Lung Cancer Nodule Risk Calculation in the Alberta Lung Cancer Screening Study," *Journal of the American College of Radiology* 16, no. 10 (2019): 1425–1432.

109. J. Chamberlin, M. R. Kocher, J. Waltz, et al., "Automated Detection of Lung Nodules and Coronary Artery Calcium Using Artificial Intelligence on Low-Dose CT Scans for Lung Cancer Screening: Accuracy and Prognostic Value," *BMC Medicine* 19, no. 1 (2021): 55.

110. C. Bradley, A. Boland, L. Clarke, et al., "Diagnosis and Treatment Outcomes from Prebronchodilator Spirometry Performed Alongside Lung Cancer Screening in a Lung Health Check Programme," *Thorax* 78, no. 6 (2023): 543–550.

111. C. Bradley, P. Alexandris, D. R. Baldwin, et al., "Measuring Spirometry in a Lung Cancer Screening Cohort Highlights Possible Underdiagnosis and Misdiagnosis of COPD," *ERJ Open Research* 9, no. 4 (2023): 203–2023.

112. D. R. Aberle, "Implementing Lung Cancer Screening: the US Experience," *Clinical Radiology* 72, no. 5 (2017): 401–406.

113. C. M. van der Aalst, K. Ten Haaf, and H. J. de Koning, "Implementation of Lung Cancer Screening: What Are the Main Issues?," *Translational Lung Cancer Research* 10, no. 2 (2021): 1050–1063.

114. S. Wait, A. Alvarez-Rosete, T. Osama, et al., "Implementing Lung Cancer Screening in Europe: Taking a Systems Approach," *JTO Clinical and Research Reports* 3, no. 5 (2022): 100329.

115. "Cancer Today," accessed May 14, 2020, http://gco.iarc.fr/today/home.

116. Y. I. Cheng, M. P. A. Davies, D. Liu, W. Li, and J. K. Field, "Implementation Planning for Lung Cancer Screening in China," *Precision Clinical Medicine* 2, no. 1 (2019): 13–44.

117. B. Hochhegger, S. Camargo, G. B. da Silva Teles, et al., "Challenges of Implementing Lung Cancer Screening in a Developing Country: Results of the Second Brazilian Early Lung Cancer Screening Trial (BRELT2)," *JCO Global Oncology* 8 (2022): e2100257.

118. E. Edelman Saul, R. B. Guerra, M. Edelman Saul, et al., "The Challenges of Implementing Low-Dose Computed Tomography for Lung Cancer Screening in Low- and Middle-Income Countries," *Nature Cancer* 1, no. 12 (2020): 1140–1152.

119. L. B. Williams, B. J. Shelton, M. L. Gomez, Y. D. Al-Mrayat, and J. L. Studts, "Using Implementation Science to Disseminate a Lung Cancer Screening Education Intervention Through Community Health Workers," *Journal of Community Health* 46, no. 1 (2021): 165–173.

120. P. A. Crosbie, H. Balata, M. Evison, et al., "Implementing Lung Cancer Screening: Baseline Results from a Community-Based 'Lung Health Check' Pilot in Deprived Areas of Manchester," *Thorax* 74, no. 4 (2019): 405–409.

121. J. Currier, D. Howes, C. Cox, et al., "A Coordinated Approach to Implementing Low-Dose CT Lung Cancer Screening in a Rural Community Hospital," *Journal of the American College of Radiology: JACR* 19, no. 6 (2022): 757–768.

122. R. M. Hoffman, J. A. Lang, G. J. Bailey, et al., "Implementing a Telehealth Shared Counseling and Decision-Making Visit for Lung Cancer Screening in a Veterans Affairs Medical Center," *Federal Practitioner: For Healthcare Professionals of the VA, DoD, and PHS* 40, no. Suppl 3 (2023): S83–S90.

123. S. R. Colhoun, K. Parker, S. McCook, et al., "Perspectives of Potentially Eligible Indigenous Māori on a Lung Cancer Screening Programme: A Qualitative Study," *New Zealand Medical Journal* 137, no. 1593 (2024): 45–55.

124. A. Brown, G. Garvey, N. M. Rankin, C. Nightingale, and L. J. Whop, "Lung Cancer Screening for Aboriginal and Torres Strait Islander People: An Opportunity to Address Health Inequities," *Medical Journal of Australia* 219, no. 9 (2023): 398–401.