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REVIEW

Lung cancer screening program factors that influence psychosocial outcomes: A systematic review

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Abstract

Objectives: Lung cancer screening (LCS) programs are being designed and implemented globally. Early data suggests that the psychosocial impacts of LCS are influenced by program factors, but evidence synthesis is needed. This systematic review aimed to elucidate the impact of service-level factors on psychosocial outcomes to inform optimal LCS program design and future implementation.

Methods: Four databases were searched from inception to July 2023. Inclusion criteria were full-text articles published in English that reported an association between any program factors and psychosocial outcomes experienced during LCS. Study quality was appraised, and findings were synthesised narratively.

Results: Thirty-two articles were included; 29 studies were assessed at high or moderate risk of bias. Study designs were RCT (n = 3), pre-post (n = 6), cross-sectional (n = 12), mixed-methods (n = 1), and qualitative (n = 10) studies, and conducted primarily in the USA (n = 25). Findings suggested that targeted interventions can improve smoking-related or decisional psychosocial outcomes (e.g., smoking cessation interventions increase readiness/motivation to quit) but impacts of interventions on other psychological outcomes were varied. There was limited evidence reporting association between service delivery components and psychological outcomes, and results suggested moderation by individual aspects (e.g., expectation of results, baseline anxiety). Opportunities for discussion were key in reducing psychological harm.

Conclusions: Certain program factors are reportedly associated with psychosocial impacts of LCS, but study heterogeneity and quality necessitate more real-world studies. Future work should examine (a) implementation of targeted interventions and high-value discussion during LCS, and (b) optimal methods and timing of risk and result communication, to improve psychosocial outcomes while reducing time burden for clinicians.

Rachael H. Dodd and Nehmat Houssami should be considered joint senior authors.

KEYWORDS
cancer, cancer screening, diagnostic screening programs, implementation science, oncology, psycho-oncology

1 | INTRODUCTION

Lung cancer is the leading cause of cancer death worldwide, primarily attributed to late-stage diagnosis.[1] Earlier diagnosis can be achieved by screening asymptomatic, high-risk individuals with low-dose computed tomography (LDCT) of the chest. Two landmark randomised trials have demonstrated a 20%–24% reduction in the relative risk of lung cancer mortality for those screened with LDCT.[2,3] Following these results, organised lung cancer screening (LCS) programs are being designed and implemented globally. While cancer screening can significantly decrease cancer-related mortality, there are a myriad of associated psychosocial impacts including both harms (e.g., anxiety, distress), as well as benefits (e.g., reassurance, self-efficacy). Psychosocial experiences can then have downstream impacts on other outcomes, such as screening participation.[4,5] Many LCS programs experience suboptimal uptake, therefore removing psychosocial barriers may play an important role in improving screening participation rates.[5]

There are unique aspects of LCS compared to other types of cancer screening that may have psychosocial consequences for participants, including false-positive and incidental (non-lung cancer) findings, and commonly found indeterminate nodules that require ongoing surveillance. Lung cancer screening is also the only type of cancer screening where eligibility is primarily based on the behaviour of smoking tobacco. This presents an opportunity for "teachable moments" for clinicians to promote smoking cessation through the screening pathway but can add another layer of psychological complexity by bringing up feelings of stigma, shame, and regret around current or former smoking behaviour.[6] In view of this, how LCS programs are designed, delivered, communicated, and implemented can have important impacts on the psychosocial experiences of participants. Existing evidence supports this position, suggesting that both LCS service design components and targeted interventions implemented along the screening pathway can influence psychosocial outcomes.

With the scale of population-based screening programs, program design is complex and requires patient, healthcare provider, and system-level considerations.[7] While system-related issues such as workforce capacity, technology, governance, and financing may have indirect impacts on participants' psychosocial experiences, direct consequences stem from service delivery.[8] For psychosocial outcomes, key service delivery design issues can include both logistic (e.g., service accessibility, wait times, LDCT procedures) and outreach-based aspects (e.g., recruitment and invitation, communication of results, referral processes). In cervical and breast cancer screening programs, service delivery components that have been shown to impact outcomes like anxiety include the method of results communication (letter, telephone, in-person), wait times between different touchpoints on the screening pathway, and patient-centred interactions with healthcare staff.[9,10]

In addition to inherent (but modifiable) service delivery components, screening programs often implement targeted interventions either to help achieve the program's primary goal (e.g., interventions to improve uptake) or to capitalise on opportunities for improving other outcomes (e.g., interventions to promote smoking cessation). Interventions which have been regularly shown to reduce psychosocial burden in cancer screening include the use of patient decision aids in shared decision-making (SDM), and multi-faceted interventions incorporating emotional support and patient education.[11,12] Some relaxation technique interventions, including meditation and massage therapy, can also be effective in reducing psychological harm.[12]

The evidence base for LCS program factors that impact psychosocial experiences is less developed than for other cancer screening programs. There is early data suggesting associations between LCS program factors and psychosocial outcomes, but the literature has not yet been synthesised. The aim of this systematic review is to summarise this evidence for the first time, providing a synthesis and critical appraisal, and identifying key gaps in knowledge. As part of a broader evidence review of psychosocial outcomes of LCS, this review focuses on the impact of modifiable aspects of program design to inform future research and LCS implementation.

2 | MATERIALS AND METHODS

2.1 | Search strategy

Medline, Embase, PsycINFO and Cumulative Index of Nursing and Allied Health Literature databases were searched to 12 July 2023. A search strategy was developed for Medline in consultation with a research librarian, pilot tested, then modified to suit the required syntax for other databases (Medline search strategy provided in Supplementary Table E1). No date, language or geographic search limits were applied. A forward (citing articles) and backward (referenced articles) citation search of included studies was also conducted.

2.2 | Study inclusion and exclusion criteria

Studies were included if they were original research articles reporting quantitative or qualitative psychosocial outcomes associated with program-related elements of LCS. Studies had to be full-text articles and were excluded if they were reviews, case studies, case reports,

opinions, comments, or editorials. Relevant populations were participants in LCS (either in a study/trial or real-world program), where screening was completed using LDCT (i.e., not X-Ray or other). For this review, LCS refers to the entire cancer screening pathway (including enrolment, results disclosure, follow-up), while LDCT refers only to a scan itself. Participants at any stage of LCS were included (e.g., any initial consultation, SDM or pre-LDCT eligibility screening). Samples from the general population who were simply eligible for LCS and had not engaged in the LCS pathway were excluded.

Relevant factors and outcomes are listed in Table 1. Included outcomes were any psychological or social outcome, including those related to decision-making, and smoking or cessation (e.g., motivation, readiness to quit), though behavioural smoking outcomes (e.g., cessation rates) were excluded as these have been covered in other systematic reviews.[13,14] This review included only experienced psychosocial outcomes, so studies that reported prospectively on anticipated impacts of LCS were excluded. Relevant factors were any predictor, moderator, mediator, or co-variate of an outcome of interest. These included service delivery components (e.g., recruitment methods, screening setting) and interventions (e.g., for decision-making or smoking cessation).

2.3 | Data extraction and synthesis

The lead investigator (KM) undertook title and abstract, and full-text screening, with a second investigator (BN or AS) independently assessing a 20% subset at both stages of screening to ensure agreement and consistency. Any discrepancies were discussed with reference to the pre-defined inclusion and exclusion criteria, with consultation by a third investigator if required. Data extraction of study characteristics was performed by the lead investigator (KM) and checked for accuracy by another investigator (BN, TL, CJJ). Results were extracted independently by two investigators (KM and either BN, TL or CJJ). Evidence was summarised by factor and outcome of interest; given the heterogeneity across studies, meta-analysis and subgroup analysis were not considered appropriate, and instead results were synthesised narratively.

2.4 | Quality assessment

Quality assessment was completed independently by two investigators (KM and either BN, TL or CJJ), using validated tools from the Joanna Briggs Institute (JBI) with any discrepancies resolved via discussion.[15] Study quality was assessed based on the number of appraisal checklist items fulfilled and the reviewers' determination of overall potential for bias—studies were reported as having a low, moderate, or high risk of bias based on these assessments. Articles were not excluded from the review based on methodological quality, but this was considered in interpretation and conclusions.

2.5 | Protocol and registration

This review was completed in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[16] The protocol for this review was prospectively registered with

TABLE 1 List of factors and outcomes examined in identified studies.

Factors	Outcomes
Interventions - Smoking cessation - Shared decision-making - Educational	**General psychological** - Worry, distress, stress - Anxiety - Depression - Health-related quality of life (HRQoL) - General emotional response; positive and negative affect
Service delivery components Objective: - Referring provider - Screening setting - Personalised cancer risk information (PCRI, e.g., results from risk prediction models) - Lung function test - Spirometry test result - LDCT procedure - LDCT result communication	**Lung cancer or LCS-specific psychological** - Lung cancer risk perception (absolute, comparative); uncertainty about lung cancer risk - Lung cancer-related worry, distress, fear - LCS or LDCT-related anxiety, worry, distress, discomfort, other psychological burden - Reassurance
Subjective: - Referral clarity - Perceived accuracy of LDCT scan - Trust/relationship with clinician or healthcare system	**Decision-related** - Decisional regret - Decisional satisfaction/comfort - Decisional conflict - Decisional balance
	Smoking-related - Motivation/interest in quitting smoking - Confidence/self-efficacy to quit smoking - Readiness to quit smoking

PROSPERO (CRD42022334634). This study reports the program-related factors review that is part of the broader registered evidence review on factors associated with psychosocial outcomes of LCS. A companion review is currently underway to address participant-level factors related to psychosocial experiences of LCS.

3 | RESULTS

3.1 | Study characteristics

A PRISMA flow diagram of search results is presented in Figure 1.[16] Following screening, 32 articles were selected for inclusion; key characteristics are summarised in Table 2.[6,17–47] Study designs included RCTs (n = 3), pre-post studies (n = 6), cross-sectional studies (n = 12), mixed-methods studies (n = 1), and qualitative studies (n = 10). Studies were published between 2004 and 2023 and conducted primarily in the USA (n = 25) (Table 2). Summary results for each study are presented in Supplementary Table E8.

Supplementary Tables E2 and E3 summarise the factor-outcome combinations (e.g., the impact of SDM (factor) on distress (outcome)) examined across the studies. Factors were collapsed broadly into two factor domains: service delivery components and interventions. Evidence was heterogeneous across factor-outcome combinations examined. Risk of bias was assessed as high for 15 studies, moderate for 14 studies, and low for 3 studies. The outcomes of interest for this review were often a secondary or tertiary outcome in the primary studies which may have affected the quality rating. For quantitative studies, quality assessments were also hindered by a lack of randomised or controlled designs, use of non-validated measures, and small sample sizes. We note that the experimental critical appraisal tools are not designed specifically for behavioural interventions, so some appraisal items were not fulfilled for some studies. Full quality appraisals according to the JBI tool checklists are provided in Supplementary Tables E4-E7.

3.2 | Shared decision-making

Fifteen studies examined the impact of SDM for LCS, most (n = 10) in relation to decisional psychosocial outcomes. Overall, findings indicated that SDM was effective for reducing decisional conflict and regret, and improving satisfaction and comfort about the decision to participate in LCS.[28,31,34,37,39–41] Three quantitative studies compared different methods of SDM[37,39,41]; results showed that a decision aid based on option grids compared to an online decision aid,[39] and an extra informational video compared to a booklet only[37] resulted in lower decisional conflict/regret when deciding whether to participate in LCS. All studies (n = 3) which examined quality of life psychological outcomes indicated generally no additional, or lowered, distress or anxiety from SDM,[23,35,43] though one qualitative study also suggested that SDM brought up feelings of fear and guilt.[43] Another study found that a higher proportion of people who received

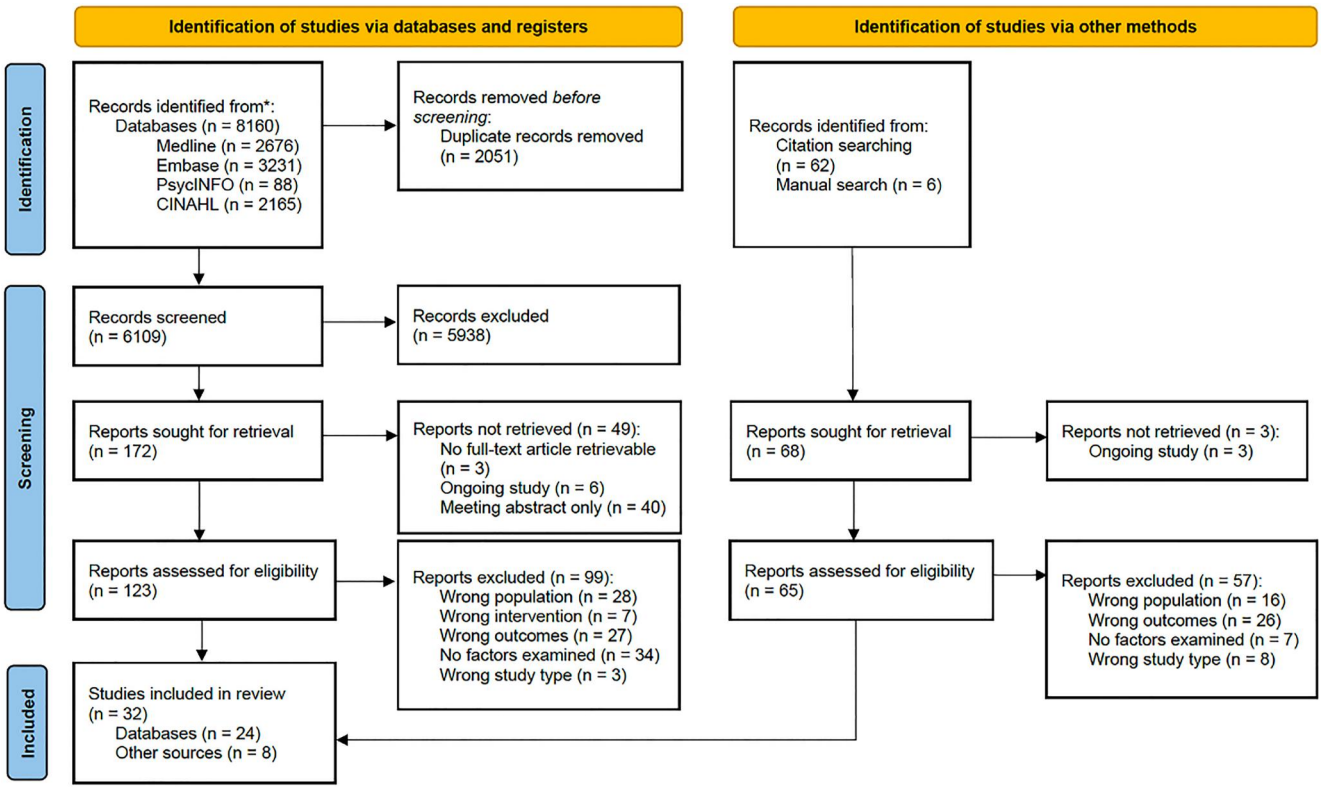

FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

TABLE 2 Key characteristics of included studies ($n = 32$).

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Bade et al., 2016[17]	Germany (LUSI)	Pre-post	To measure the impact of smoking cessation counselling on smoking habits and cessation attitudes.	LUSI trial participants (LDCT or control arm) who were currently smoking at the time of randomisation taking part in a smoking counselling intervention. $N = 1179$	• Before intervention • After intervention	Smoking cessation counselling intervention	Readiness to stop smoking	2 items converted into Stages of Change Model	Moderate
Clark et al., 2004[18]	USA	RCT	To examine the effectiveness of standard self-help materials for nicotine dependence, compared to materials consisting of internet-based resources, on smoking abstinence rates in a population participating in LCS.	Individuals completing LCS randomised to one of two smoking cessation interventions. $N = 171$ Internet-based self-help resources: $N = 85$ Standard smoking cessation information: $N = 86$	• Baseline • 1 month post enrolment in intervention • 1 year follow up	Comparison of two smoking cessation interventions: • Internet-based self-help resources • Standard smoking cessation information	Readiness to quit smoking	Stages of Change Model	High
Crothers et al., 2023[19]	USA	Mixed methods (qualitative for outcome of interest)	To understand patient- and clinician-identified gaps in understanding and communication of LCS results, and ways communication of results could be improved through a patient-oriented tool.	Participants who had undergone LCS in the year prior. $N = 31$	• Up to 1 year post-LDCT	LDCT result communication, including a "commonly asked questions" sheet	Worry	Interviews, focus groups	Low

(Continues)

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Deros et al., 2021[20]	USA	Pre-post	To observe whether undergoing LCS, along with receiving minimal cessation resources, impacted short-term smoking-related outcomes.	Individuals completing LCS who were currently smoking. *N* = 87	• Baseline (prior to LCS) • After LCS and receipt of the screening results (median = 12.5 days post-LDCT).	Smoking cessation resources (BecomeAnEx cessation booklet and resource list)	Readiness to quit smoking	Contemplation Ladder	Moderate
Eberth et al., 2022[21]	USA	Cross-sectional	To explore how patients who were referred for LDCT by their healthcare provider describe the SDM visit.	Individuals completing LDCT following SDM with referring healthcare provider. *N* = 75	Within 10 days of LDCT being ordered	• Referring provider • Value elicitation quality during SDM	Decisional conflict	Items adapted from the SURE scale (4-item short version of DCS)	High
Ferketich et al., 2012[22]	USA	Pre-post	To measure the proportion of participants currently smoking who complied with a 12-week tobacco dependence treatment and LDCT program, and estimate abstinence and quit attempts, and cognitive social health information processing (C-SHIP) constructs.	Individuals who were randomised to receive a tobacco dependence treatment intervention either before or after LDCT. *N* = 18 Intervention before CT: *N* = 9 Intervention after CT: *N* = 9	• Baseline • 4 months post-intervention	Comparison of tobacco dependence treatment intervention administered at different times during LCS: • Intervention before CT • Intervention after CT	• Risk perception (absolute) • Risk perception (comparative) • Worry about lung cancer Depressive symptoms Decisional balance Self-efficacy to quit smoking	1 item per outcome CES-D Decisional Balance Inventory for smoking (Proscons of smoking scale) Smoking Situations Confidence Scale	High

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Golden et al., 2020a[23]	USA	Qualitative	To evaluate patient information needs, subjective reasons for (dis)satisfaction with the decision-making process, associated distress, and patients' role in the decision-making process for LCS.	Individuals who had completed SDM for LCS during routine care. *N* = 51 Elected LDCT: *N* = 43 Declined LDCT: *N* = 8	After SDM and either before LDCT for electors, or within 3 weeks post-SDM for decliners.	• SDM • Trust in clinician/ healthcare system	• Decisional satisfaction • Distress	Semi-structured interviews	Moderate
Golden et al., 2020b[6]	USA	Qualitative	To use the LCS decision discussion as a case study to understand possible underlying components of a teachable moment to enhance motivation for smoking cessation.	Individuals who had completed SDM for LCS during routine care. *N* = 51 Elected LDCT: *N* = 43 Declined LDCT: *N* = 8	After SDM and either before LDCT for electors, or within 3 weeks post-SDM for decliners.	SDM, including discussion of lung cancer risk	Motivation to quit	Semi-structured interviews	Moderate
Golden et al., 2022[24]	USA	Qualitative	To (1) determine whether teachable moments for smoking cessation occur downstream from the initial LCS decision-making interaction, (2) to investigate patient experiences with smoking cessation and recommendations for improving cessation rates within LCS.	Individuals who had completed SDM for LCS during routine care. *N* = 39 (61 interviews) T1: *N* = 32 T2: *N* = 29 Elected LDCT: *N* = 32 Declined LDCT: *N* = 7	• T1 = 2–4 weeks post-LDCT for electors; 4 weeks post-SDM for decliners. • T2 = 12 months after SDM (regardless of LDCT decision)	• SDM • LDCT scan result communication • Relationship with clinician	• Motivation to quit smoking • Distress	Semi-structured interviews	Moderate
Hall et al., 2018[25]	USA	Cross-sectional	To (1) quantify referral clarity and perceived accuracy during LCS; (2)	Individuals who had recently completed LDCT. *N* = 169	• After LDCT (within a few weeks)	• Referral clarity • Perceived accuracy of LDCT scan	Perceived stress Anxiety	PSS-4 GAD-2	High

(Continues)

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
			identify sociodemographic, medical, smoking behaviour, and numeracy correlates to LCS uncertainty; (3) demonstrate associations between LCS uncertainty and emotional functioning.						
Han et al., 2019[26]	USA	Mixed-methods (pre-post surveys, post-SDM qualitative interviews)	To evaluate the effects of providing PCRI to individuals referred for LDCT screening.	Individuals referred for LDCT and received PCRI. Surveys: $N = 60$ Interviews: $N = 17$	Surveys: • Immediately pre-SDM • Immediately post-SDM Interviews: Within 2 weeks of SDM	PCRI via $PLCO_{m2012}$ delivered as part of 40-min SDM consultation including use of a decision aid based on option grids	• Perceived lung cancer risk • Perceived uncertainty about lung cancer risk • Interest in quitting smoking • Reassurance	• 1 item per outcome • Semi-structured interviews	Moderate (Pre-post surveys = High; Qualitative = Low)
Hancox et al., 2022[27]	Scotland (ECLS)	RCT	To assess the psychological outcomes of the EarlyCDT-Lung antibody blood test.	Participants in the ECLS trial who received positive or negative EarlyCDT-Lung blood test results, or control participants. $N = 1032$ Test-positive: $N = 321$ Test-negative: $N = 361$ Control: $N = 350$	• Baseline • 1, 3, 6 and 12-month post-trial recruitment • 18, 24 months post-trial recruitment (test-positive group only)	EarlyCDT-lung blood test result	Positive and negative affect Lung cancer-specific distress LCS-specific distress	PANAS CWS IES	Moderate
Ito Fukunaga et al., 2021[28]	USA	Pre-post	To evaluate the feasibility and effects of a decision aid during SDM on decisional conflict about LCS.	Individuals referred for LCS. $N = 23$	• Before intervention • After intervention	Decision aid based on option grids (first reviewed alone by the participant, then in SDM discussion with pulmonologist)	Decisional conflict	DCS	Moderate

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Kummer et al., 2020[29]	England (LSUT)	Qualitative	To explore the spectrum of psychological and behavioural responses among individuals with indeterminate and incidental LDCT results.	Participants who had received a Lung Health Check as part of the LSUT trial. *N* = 28	4–8 months (average 6 months) after LDCT as part of a Lung Health Check	Spirometry test result	• Lung cancer risk perception • Worry • Emotional response	Semi-structured interviews	Moderate
Lillie et al., 2017[30]	USA	Cross-sectional	To (1) identify which factors people consider most important in making LCS decisions; (2) explore whether factors considered important vary by participant characteristics; (3) detect whether perceived importance of benefits and harms of screening varied by LCS completion.	Veterans randomised to receive direct LCS invitation with decision aid or usual care. *N* = 588 Intervention (direct LCS invitation): *N* = 384 Usual care (provider referral for LCS): *N* = 204	3 months post-randomisation to intervention or usual care group	Comparison of: • Direct invitation to LCS with decision aid • Usual care	• Risk perception • Fear of lung cancer • Anxiety of waiting for LDCT results	1 item per outcome (measured as % of participants rating certain decision-making factors as important)	High
Mazzone et al., 2017[31]	USA	Pre-post (cross-sectional for outcome of interest)	To evaluate the impact of a counselling and SDM visit as part of LCS.	Individuals undergoing SDM for LCS. *N* = 122	Immediately following SDM (for outcome of interest)	SDM discussion (including PCRI via $PLCO_{m2012}$ using shouldiscreen.com)	Comfort in decision	1 item	High
Nishi et al., 2021[32]	USA	Cross-sectional	To describe the quality of SDM among participants recently screened for lung cancer.	Participants who had completed LDCT within 12 months. *N* = 266	Within 12 months of last LDCT	Screening setting	Decisional conflict	SURE scale (4-item short version of DCS)	High
Olson et al., 2022[33]	Australia (ILST)	Qualitative	To examine participants'	Individuals who currently smoke undergoing LDCT	Immediately post-LDCT and prior	Elements of LCS process (LDCT	• LCS-related anxiety	Semi-structured interviews	Low

(Continues)

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
			emotionally imbued experiences of LCS.	as part of the ILST trial. *N* = 27	to receiving results	scan, lung function test)	• Emotional response		
Owens et al., 2023[34]	USA	Cross-sectional	To investigate the feasibility, acceptability, usability, and preliminary effectiveness of a computer-based decision aid.	Individuals eligible for LCS at two academic medical centres invited to complete SDM and subsequently LCS.	After receiving decision aid and before SDM discussion	Computer-based decision aid ("Is Lung Cancer Screening for You?")	Decisional conflict	DCS	High
Raz et al., 2018[35]	USA	Pre-post	To pilot test a scalable video intervention to promote psychological preparedness for LCS and to determine the effect of this intervention on anxiety.	Participants who were scheduled for an LDCT, randomised to either intervention or control group. *N* = 16 Intervention (5-min video and 9-page booklet): *N* = 8 Usual care: *N* = 8	• Baseline (1–2 weeks before LDCT) • Immediately post-LDCT • 1-week, 3-months and 7-months post-LDCT	Comparison of: • Intervention (5 min video and 9-page booklet) as part of SDM • Usual care	HRQoL Anxiety LCS-related psychological burden Perceived risk of lung cancer (absolute and comparative)	SF-12 STAI COS-LC 2 items	Moderate
Roberts et al., 2021[36]	USA	Qualitative	To examine how people who currently and formerly smoke understand and respond to personalised risk estimates from the risk-based NLST outcomes tool (RNOT).	Individuals from a national military medical centre who were eligible for and engaged in LCS. *N* = 10	• After LCS clinic appointment	Online algorithm tool to predict risk of lung cancer diagnosis and death with and without LCS, as well as risk of false positive result based on clinical and demographic information.	• Relief • Risk perception	Semi-structured interviews	High
Ruparel et al., 2019[37]	England (LSUT)	RCT	To evaluate the impact of a novel information film on informed decision-	Participants attending for a Lung Health Check as part of the LSUT trial.	• Baseline (before intervention)	Comparison of:	Decisional conflict	9 items adapted from low literacy DCS	High

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
			making in individuals considering participating in LCS.	*N* = 229 SDM film and information booklet: *N* = 120 SDM information booklet only (control): *N* = 109	• Immediately following intervention	• SDM intervention (informational film and booklet) • Control (booklet only)			
Sakoda et al., 2020[38]	USA	Pre-post (cross-sectional for outcomes of interest)	To evaluate the effectiveness of a patient education class (including smoking cessation content) on knowledge and SDM about LCS.	Individuals who were referred by primary care physicians and were interested in LCS (before attending a personal face-to-face SDM visit). *N* = 705 (post-class survey completion)	After intervention	Patient education class on LCS, taught by clinician specialists prior to SDM	Motivation to quit smoking Decisional conflict	1 item 3 items from DCS	High
Sferra et al., 2021[39]	USA	Pre-post (cross-sectional for outcome of interest)	To compare two SDM decision aids for efficacy, decision regret and knowledge.	Individuals who were referred to a LCS program by a physician and had received LDCT results. *N* = 237 Option grids: *N* = 128 Shouldiscreen.com: *N* = 109	3–6 months after SDM, LDCT and result discussion	Comparison of two decision aids: • Option grids • Online decision aid including PCRI via $PLCO_{m2012}$ (shouldiscreen.com)	Decisional regret	Ottawa Decision Regret Scale	High
Tan et al., 2022[40]	USA	Cross-sectional	To assess the impact of SDM process on knowledge about LCS, decisional conflict, intentions to adhere to screening recommendations, and its role in LCS decision-making.	Individuals completing LDCT. *N* = 264	• T0 = After LDCT • T1 = 1 month after T0 (T1 only used to establish reliability)	SDM process score (SDM efficacy)	Decisional conflict	SURE scale (4-item short version of DCS)	High

(Continues)

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Tanner et al., 2019[41]	USA	Pre-post (cross-sectional for outcomes of interest)	To determine the effect of an SDM visit delivered by two different methods on patient satisfaction and decisional conflict.	Individuals eligible for LCS undertaking SDM. *N* = 137 In-person SDM: *N* = 69 Telephone SDM: *N* = 68	1-month after SDM	Comparison of two SDM methods (both with a paper decision aid and PCRI via $PLCO_{m2012}$): • In-person (also including use of a web-based interactive decision aid) • Telephone	Decisional conflict Decisional satisfaction	DCS Satisfaction With Decisions Scale	Moderate
Van den Bergh et al., 2008[42]	Netherlands (NELSON)	Pre-post	To assess discomfort experienced by participants during LDCT and while waiting for results, and explore the impact of LDCT on HRQoL over time.	Participants in the NELSON trial who received a negative or indeterminate baseline LDCT result (positive results excluded from analysis). *N* = 324 (returned T1 questionnaire) *N* = 270 (returned all questionnaires)	• T1 = 1 week before baseline LDCT • T2 = 1 day after baseline LDCT (no results received) • T3 = 6-month after baseline LDCT (post-results)	Most discomforting part of LDCT scan	Anxiety LC-specific distress Discomfort experienced during LDCT HRQoL	STAI-6 IES Multiple items • EQ-5D • SF-12	Moderate
Wiener et al., 2018[43]	USA	Qualitative	To characterise experiences of participants and clinicians from diverse early adopting LCS programs regarding communication and decision-making.	Participants who had LCS within the previous 12 months. *N* = 49 Interviews: *N* = 37 Focus groups: *N* = 12	Within 12 months of LCS	Elements of SDM (information sharing, use of decision aids, deliberation and decision-making)	• Worry • Emotional responses	• Semi-structured interviews • Focus groups	Moderate
Wiener et al., 2020[44]	USA	Qualitative	To characterise perceptions of communication and results notification after LCS from the participant and clinician perspectives.	Participants who had LCS within the previous 12 months. *N* = 49 Interviews: *N* = 37 Focus groups: *N* = 12	Within 12 months of LCS	Method of LDCT result delivery	• Emotional responses • Distress • Worry	• Semi-structured interviews • Focus groups	Moderate

TABLE 2 (Continued)

Author, year	Location (trial/ program)	Study design	Study aim(s)	Participant description, N (for outcome of interest)	Measurement point(s)	Factors	Outcomes of interest	Measurement tool	Risk of bias[a]
Williams et al., 2022[45]	USA (LSTH)	Pre-post (cross-sectional for outcome of interest)	To examine participant characteristics of engagement in a smoking cessation trial.	Participants eligible for LCS who had registered for, but not yet completed, LDCT, randomised to a smoking cessation intervention. *N* = 618 Intensive: *N* = 312 Minimal: *N* = 306	• Randomisation (post-LDCT) • Post-intervention (either 3, 6 or 12-month follow-up)	Comparison of two smoking cessation interventions: • Intensive: 8 × 20 min telephone counselling sessions and <8 weeks of nicotine patches • Minimal: 3 × 20 min telephone counselling sessions and 2 weeks of nicotine patches	Readiness to quit smoking	2 items	High
Young et al., 2018[46]	Scotland (ECLS)	Qualitative	To understand how LCS influences individual motivations about smoking, including in those who have stopped smoking since screening.	Participants in the ECLS trial who received positive or negative EarlyCDT-Lung test results. *N* = 31	After receipt of EarlyCDT-Lung test result	EarlyCDT-lung blood test result (test-positive, test-negative)	• Motivation to quit smoking • Emotional responses	Semi-structured interviews	Low
Zeliadt et al., 2018[47]	USA	Cross-sectional	To demonstrate that proactive outreach from a telephone counsellor outside of participant's usual care team is feasible and acceptable to participants.	Individuals who currently smoked and were scheduled for LCS but had not been screened (intervention) or had completed LCS and received results (control). *N* = 83 Intervention = 27 Control = 56	Approximately 4 weeks post-intervention	Comparison of: • Smoking cessation intervention (2 telephone counselling sessions) • Control	Motivation, readiness to quit smoking Confidence in quitting smoking	• Contemplation Ladder • Stages of Change Model 1 item	High

Abbreviations: C-SHIP, cognitive social health information processing; CES-D, Center for Epidemiologic Studies Depression Scale; COS-LC, Consequences of Screening in Lung Cancer questionnaire; CWS, Cancer Worry Scale; DA, decision aid; DCS, Decisional Conflict Scale; ECLS, Early Diagnosis of Lung Cancer Scotland Trial; HRQoL, health-related quality of life; IES, Impact of Events Scale; LCS, lung cancer screening; LDCT, low-dose CT scan; LSTH, Lung Screening, Tobacco, and Health Trial; LSUT, Lung Screen Uptake Trial; LUSI, German Lung Cancer Screening Intervention Trial; NELSON, Dutch–Belgian Randomised Controlled Lung Cancer Screening Trial; NLST, National Lung Screening Trial; PANAS, Positive and Negative Affect Schedule; PCRI, personalised cancer risk information; PSS-4, 4-item Perceived Stress Scale; RNOT, Risk-based NLST Outcomes Tool; SDM, shared decision-making; SF-12, 12-Item Short Form Health Survey; STAI, State-Trait Anxiety Inventory.

[a]Assessed using the relevant JBI critical appraisal tool.

a decision aid, compared to those who did not, rated anxiety as important when making LCS decisions.[30] Lung cancer risk perception decreased following SDM in two studies (one which included the provision of personalised cancer risk information (PCRI)),[26,35] though SDM had no impact on the reported importance of risk in LCS decision-making in one study.[30] Three studies suggested no impact of SDM on motivation or intention to quit smoking.[6,24,26]

3.3 | Smoking cessation interventions

Smoking cessation interventions were examined across six studies. All findings suggested that cessation interventions in the LCS context can improve smoking-related psychosocial outcomes—specifically self-efficacy, confidence, readiness, or motivation to quit smoking.[17,18,20,22,45,47] Further, one study found that a high intensity (vs. low intensity) program improved readiness to quit smoking significantly more,[45] while another showed no difference for internet-based versus standard paper delivery of cessation resources.[18] The only study examining the optimal time to deliver smoking cessation interventions during the LCS pathway was a small pilot trial which did not compare groups due to small sample sizes.[22]

3.4 | Objective service delivery components

Eleven studies examined objective aspects of LCS service delivery. Communication of non-LDCT results as part of LCS was examined in four studies.[27,29,36,46] An RCT for the novel Early-CDT Lung blood test (to detect lung cancer tumour antibodies) showed some psychological harm for those with a positive (i.e., at risk of lung cancer) Early-CDT Lung test result, and vice versa for up to 6 months after the blood test, though any differences were small and unlikely to be clinically meaningful.[27] Risk estimates provided via an online tool resulted in little change in risk perception in one study, though some participants expressed relief that their absolute risk was lower than expected.[36] Two qualitative studies suggested that non-LDCT results (Early-CDT Lung or spirometry test results) may prime paritcipants' subsequent psychological experiences of LDCT results.[29,46] That is, in one study, patients with "good" spirometry results reported optimism and psychological resilience around future scans, while those with "bad" spirometry results experienced more distress related to "bad" or indeterminate LDCT results.[29]

Regarding the LDCT scan experience, two studies reported that it was not an issue for most participants.[33,42] In one instance, compared with people most worried about the prospect of scanning or waiting for results, the few people who cited that they were most concerned about the actual LDCT experienced more discomfort during scanning.[42] The same study also found that those who reported dread or discomfort while waiting for their result had significantly worse anxiety and lung cancer-specific distress (but not health-related quality of life) overall than those who were not concerned about the result.[42]

Findings from two studies suggested that the opportunity for discussion or counselling when receiving LDCT results reduced psychological burden.[24,44] Further, one study reported that participants who received no results or results by mail (vs. in-person) reported increased and lingering distress due to unanswered questions.[44] In another study, providing a "commonly asked questions" sheet with results letters was expected to reduce fear and worry.[19]

3.5 | Subjective service delivery components

Three studies examined subjective aspects of service delivery on psychological outcomes. One qualitative study found trust in clinician or healthcare system was associated with lower distress, and trust was developed from past encounters, feelings of having all the important information, and confidence in clinicians' expertise.[23] "Honesty" of the clinician was also mentioned in relation to lower distress after nodule diagnosis.[24] Another study found that high referral clarity (i.e., do you know why you got a LDCT?), but not perceived accuracy of the scan, was related to lower stress and anxiety.[25]

4 | DISCUSSION

This is the first review to synthesise the existing evidence on program factors that impact psychosocial experiences of LCS. Although the included studies were heterogeneous in design and LCS setting, some clear themes and avenues for future research emerged. Findings suggested that targeted interventions can be effective in improving specific smoking-related or decisional psychosocial outcomes (i.e., smoking cessation interventions improve readiness/motivation to quit, SDM reduces decisional burden about LCS). However, the impacts on other psychological outcomes were conflicting. Findings also suggested that certain service delivery components of LCS (i.e., methods of disclosing scan results, communication about risk) likely have important impacts on psychosocial experiences, however there is a lack of evidence for each factor. This review provides evidence to support development and implementation of LCS programs to manage participants' psychosocial experiences and outcomes.

4.1 | Opportunity for high-value discussion and the role of patient-provider trust

Results from this review indicated that providers' opportunities for discussion with a participant during LCS is vital for reducing psychosocial harms.[24,40,41,43,44] This aligns with evidence from breast and cervical screening programs highlighting patient preference for two-way, verbal communication methods.[10,48] SDM interactions, as mandated in the USA for LCS,[49] should provide the opportunity for this high-value discussion—but data indicates this clinician-led

conversation often does not take place.[50] Providers cite lack of time as a key barrier to effective SDM in practice for LCS,[51] therefore methods of SDM which can minimise hands-on clinician time may be important to consider. The review findings suggested that such interventions which reduce clinician time burden (e.g., group patient education classes or pre-perusal of decision aids before SDM conversations) can be effective in reducing decisional conflict,[28,38] though noting that other outcomes may be equally or more important in psychosocial burden reduction and evidence in this area is lacking. Additionally, considered approaches for implementation of any participant-led preparation in culturally and linguistically diverse or deprived communities are needed, as study samples to date mostly do not represent these groups. Participants also vary in how much they want to be involved in decisions about their care, which has recently been confirmed in the LCS context.[52] Tailoring levels of SDM may therefore be both cost-effective in reducing time burden, as well as better align with individual preferences.

One study included in this review indicated that even though participants may not be completing SDM as conventionally defined,[53] trust in their clinician drove decisional satisfaction and reduced distress.[23] This implies a potential mediating relationship of clinician trust for the effects of SDM on psychological burden. Across other studies in this review and the wider LCS literature, there are similar themes around healthcare provider trust and managing psychological harm.[4,24] This is therefore a key issue for LCS programs: how can trust between patients and clinicians be translated into different LCS program models? Options for population-based screening programs include varying levels of primary care involvement or community engagement.[54] Most LCS program models to date are "centralised",[54] typically following a screening centre-led LDCT and assessment pathway, which may prohibit development of trust via past encounters or patients' confidence in clinicians' expertise.[23] In "hybrid" centralised models, such as the Manchester Lung Health Check pilot, a community-based team facilitate entry into the LCS program, with the delivery and quality assessment completed by a screening centre.[54] The hybrid model provides an initial trust-based approach of informed choice for participants, while ensuring efficiency and quality control via central coordination. Another consideration is the post-LDCT results care pathway; for suspicious nodules or where lung cancer is suspected, patients are referred to specialists or a multi-disciplinary team. Care continuity, with a focus on managing trust between patients and clinicians during these handovers, is key.

For underserved populations, such as participants living in rural or remote areas, innovative methods of building and maintaining trust in an LCS program may be required. The use of screening "navigators" was successful in providing end-to-end support for participants in a recent LCS pilot by Ontario Health.[55] This trial was specifically effective in their recruitment and retention of participants (including underserved populations) and attributed much of the success to the navigator system. In the pilot evaluation paper, the authors' inferred participants' trust in the program navigators; participants reported navigators as being "essential to the screening process".[55] Navigators were also responsible for discussion of benefits and risks of screening for patients, which may be an option for shifting some (or all) of the SDM time burden away from primary care practitioners while still enabling high-value discussion.

4.2 | LDCT result communication

There is a lack of evidence about the most effective ways for clinicians to communicate LCS results (and for other types of cancer screening) in a way that minimises psychological burden, in particular anxiety.[4,10] While our review results suggest patient-clinician contact during result disclosure is preferred, recent data from a real-world sample in the UK found that most participants who had nodules requiring a 3-month follow-up scan favoured receiving results via letter (noting that patients had opportunities for face-to-face discussion with a clinician before their repeat scan).[56] This suggests that the opportunity for a single, high-quality discussion at some point during LCS may mitigate the need for communicating results in-person or continued patient-clinician interaction, when considering ways to manage psychological burden during LCS. Supplemental information such as a "commonly asked questions" sheet[19] as part of LDCT result communication may be effective in supporting participants' knowledge and understanding, while avoiding implementation challenges related to personalised communication (e.g., extra logistics, privacy concerns). Recent dialogue summarises the balancing act required by communication in LCS; it must be timely, consistent, and cost- and time-efficient, while also minimising distress, supporting SDM and empowering patients.[57] Further investigation on how best to manage communication and information needs of participants alongside workforce burden and capacity in real-world LCS programs is needed.

The impact of terminology used during LDCT result disclosure should also be further explored. Research exists for incidentally (non-screening) detected nodules, but there is minimal evidence in the LCS context. For incidental findings, the use of the term "nodule" itself when providing results can be confusing and consequently distressing for patients.[58,59] There is also debate about dichotomising results into "positive" and "negative" in screening generally,[60] with one study in this review suggesting that this type of result disclosure may lend itself to improper understanding of risk and subsequent impacts on other psychosocial outcomes.[46]

4.3 | Risk and non-LDCT result communication

Aside from the LDCT scan itself, which is recommended for participants generally every 1–2 years in LCS programs, LCS comprises multiple points where participants receive some form of personal health information. Lung function tests and PCRI (using risk calculators such as $PLCO_{m2012}$) are common, with pre-LDCT blood tests for cancer risk biomarkers also on the horizon.[61] Indeed, England's Targeted Lung Health Check incorporates other lung health test

components in order to capitalise on a singular visit, as well as to frame screening in a holistic lung health context to support uptake.[62] This review suggests that these other forms of health information disclosure during LCS can have psychosocial impacts, but the evidence is still early. Wider LCS trial literature may support this—some control groups in trials experienced worse psychological outcomes than LDCT groups, and it is hypothesised that this may be due to receiving risk information during eligibility screening, and then not having the reassurance or "value of knowing" that a scan can provide.[4] Further investigation in this area is warranted; in this review, it was often unclear if PCRI was provided within SDM interactions, and if it was, the impacts of PCRI alone (as opposed to the entire SDM process) were not discernible.[26] Pre-screening PCRI in the melanoma setting,[63] and during or post-screening in the breast cancer setting,[64] has shown no effect on, or reductions in, anxiety. This is promising for the LCS context, however risk calculation and eligibility for LCS is primarily (and uniquely) based on smoking behaviours and so separate investigation is needed. Another critical aspect of risk communication is how it is conceptualised, with evidence indicating that understanding of lung cancer risk is often inaccurate and grounded in individual biases.[26,65,66] Future work will therefore need to consider how to navigate misunderstanding or misbelief of risk information.

4.4 | Smoking-related psychosocial factors

Integration of smoking cessation into LCS programs has been identified as a priority for programs. While there is a breadth of research on how LCS programs can impact on behavioural smoking outcomes,[13,14] there was limited evidence for impacts on smoking-related psychosocial outcomes. This was surprising considering psychosocial aspects of smoking (self-efficacy, motivation, readiness to quit) have been shown to mediate actual quit rates and abstinence maintenance.[67,68,69] It would therefore follow that understanding how LCS program design can foster positive psychosocial smoking outcomes would have important impacts on the primary goal of cessation. In addition, evidence from this review suggests that LCS, even with embedded smoking cessation interventions, is not always a teachable moment and participants need to feel "ready to quit" for cessation support to be effective.[6,24] This further emphasises the role of psychosocial outcomes in impacting smoking behaviour as part of LCS programs.

4.5 | Clinical implications

Improving psychosocial outcomes in LCS programs relies heavily on participants' opportunity for high-value discussion with a trusted healthcare provider. Clinicians involved in LCS should ensure participants' have engaged in discussion, ideally during SDM, and have had their questions answered. With the identified issues in time and workforce capacity for large-scale LCS programs,[8] non-medical led models of care,[57] in tandem with other scalable interventions to decrease psychological burden (such as supplemental information materials or decision aids), may be optimal but require further investigation.

4.6 | Study limitations

There was a paucity of evidence across factor-outcome combinations to enable conduct of a meta-analysis. For this reason, we have provided a robust synthesis and discussion of the available data, noting the limitations of most included studies generally being completed in a trial context or within a single institution. Generalisability to the actual population who would receive LCS, including vulnerable sub-groups, is therefore limited. Quality appraisal assessed most of the included studies as at moderate or high risk of bias, although the outcomes of interest for this review were often a secondary or tertiary outcome in the primary studies which may have affected the quality rating. No studies in this review reported social outcomes, which is likely to reflect the lack of real-world settings. In addition, the intricacies of individual moderators need to be considered. Multiple studies reported that associations between program factors and an outcome of interest were (or were potentially) influenced by participant factors, which may have implications for our conclusions. As discussed, the broader registered evidence review will consider and synthesise these individual-level factors.

5 | CONCLUSIONS

Our review suggests key considerations for LCS program implementation, noting that the ability to draw robust conclusions is limited by both the quantity (paucity) and quality (risk of bias) of studies. Findings highlight the need for use of implementation science-based approaches to design screening programs, particularly in translation of pilot or trial evidence around managing psychosocial outcomes into actual LCS programs. With many LCS programs in design or early implementation globally, measuring psychosocial impacts of LCS in real-world settings is feasible and needed, particularly with more diverse representation in samples.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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REFERENCES

1. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 Countries. *CA Cancer J Clin*. 2021;71(3):209-249. https://doi.org/10.3322/CAAC.21660
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(6):503-513. https://doi.org/10.1056/NEJMOA1911793/SUPPL_FILE/NEJMOA1911793_DATA-SHARING.PDF
3. The National Lung Screening Trial Research Team. Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med*. 2011;365(5):395-409. https://doi.org/10.1056/NEJMOA1102873/SUPPL_FILE/NEJMOA1102873_DISCLOSURES.PDF
4. Quaife SL, Janes SM, Brain KE. The person behind the nodule: a narrative review of the psychological impact of lung cancer screening. *Transl Lung Cancer Res*. 2021;10(5):2427-2440. https://doi.org/10.21037/TLCR-20-1179
5. Carter-Harris L. Hidden in plain sight: psychological barriers to participation in lung cancer screening. *Thorax*. 2020;75(12):1033-1034. https://doi.org/10.1136/thoraxjnl-2020-216191
6. Golden SE, Ono SS, Melzer A, et al. "I already know that smoking ain't good for me": patient and clinician perspectives on lung cancer screening decision-making discussions as a teachable moment. *Chest*. 2020;158(3):1250-1259. https://doi.org/10.1016/J.CHEST.2020.03.061
7. Carter-Harris L, Gould MK. Multilevel barriers to the successful implementation of lung cancer screening: why does it have to be so hard? *Ann Am Thorac Soc*. 2017;14(8):1261-1265. https://doi.org/10.1513/ANNALSATS.201703-204PS/SUPPL_FILE/DISCLOSURES.PDF
8. Wait S, Alvarez-Rosete A, Osama T, et al. Implementing lung cancer screening in Europe: taking a systems approach. *JTO Clin Res Rep*. 2022;3(5):100329. https://doi.org/10.1016/J.JTOCRR.2022.100329
9. Pai VR, Rebner M. How to minimize patient anxiety from screening mammography. *J Breast Imag*. 2021;3(5):603-606. https://doi.org/10.1093/JBI/WBAB057
10. Williamson S, Patterson J, Crosby R, et al. Communication of cancer screening results by letter, telephone or in person: a mixed methods systematic review of the effect on attendee anxiety, understanding and preferences. *Prev Med Rep*. 2019;13:189-195. https://doi.org/10.1016/J.PMEDR.2018.12.016
11. McAlpine K, Lewis KB, Trevena LJ, Stacey D. What is the effectiveness of patient decision aids for cancer-related decisions? A systematic review subanalysis. *JCO Clin Cancer Inf*. 2018(2):1-13. https://doi.org/10.1200/cci.17.00148
12. Bui KT, Liang R, Kiely BE, Brown C, Dhillon HM, Blinman P. Original research: scanxiety: a scoping review about scan-associated anxiety. *BMJ Open*. 2021;11(5):43215. https://doi.org/10.1136/BMJOPEN-2020-043215
13. Iaccarino JM, Duran C, Slatore CG, Wiener RS, Kathuria H. Combining smoking cessation interventions with LDCT lung cancer screening: a systematic review. *Prev Med*. 2019;121:24-32. https://doi.org/10.1016/J.YPMED.2019.02.016
14. Cadham CJ, Jayasekera JC, Advani SM, et al. Smoking cessation interventions for potential use in the lung cancer screening setting: a systematic review and meta-analysis. *Lung Cancer*. 2019;135:205-216. https://doi.org/10.1016/J.LUNGCAN.2019.06.024
15. The Joanna Briggs Institute. Critical Appraisal Tools; 2022. Published December. Accessed 7 December 2022. https://jbi.global/critical-appraisal-tools
16. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021:372. https://doi.org/10.1136/BMJ.N71
17. Bade M, Bähr V, Brandt U, et al. Effect of smoking cessation counseling within a randomised study on early detection of lung cancer in Germany. *J Cancer Res Clin Oncol*. 2016;142(5):959-968. https://doi.org/10.1007/S00432-015-2105-0
18. Clark MM, Cox LS, Jett JR, et al. Effectiveness of smoking cessation self-help materials in a lung cancer screening population. *Lung Cancer*. 2004;44(1):13-21. https://doi.org/10.1016/j.lungcan.2003.10.001
19. Crothers K, Shahrir S, Kross EK, et al. Patient and clinician recommendations to improve communication and understanding of lung cancer screening results. *Chest*. 2023;163(3):707-718. https://doi.org/10.1016/J.CHEST.2022.09.038
20. Deros DE, Hagerman CJ, Kramer JA, et al. Change in amount smoked and readiness to quit among patients undergoing lung cancer screening. *J Thorac Dis*. 2021;13(8):4947-4955. https://doi.org/10.21037/JTD-20-3267
21. Eberth JM, Zgodic A, Pelland SC, Wang SY, Miller DP. Outcomes of shared decision-making for low-dose screening for lung cancer in an academic medical center. *J Cancer Educ*. 2022;38(2):1-16. Published online April 30. https://doi.org/10.1007/S13187-022-02148-W/TABLES/5
22. Ferketich AK, Otterson GA, King M, Hall N, Browning KK, Wewers ME. A pilot test of a combined tobacco dependence treatment and lung cancer screening program. *Lung Cancer*. 2012;76(2):211-215. https://doi.org/10.1016/J.LUNGCAN.2011.10.011
23. Golden SE, Ono SS, Thakurta SG, et al. "I'm putting my trust in their hands": a qualitative study of patients' views on clinician initial communication about lung cancer screening. *Chest*. 2020;158(3):1260-1267. https://doi.org/10.1016/J.CHEST.2020.02.072
24. Golden SE, Schweiger L, Melzer AC, et al. "It's a decision I have to make": patient perspectives on smoking and cessation after lung cancer screening decisions. *Prev Med Rep*. 2022;30:102014. https://doi.org/10.1016/J.PMEDR.2022.102014
25. Hall DL, Lennes IT, Carr A, Eusebio JR, Yeh GY, Park ER. Lung cancer screening uncertainty among patients undergoing LDCT. *Am J Health Behav*. 2018;42(1):69-76. https://doi.org/10.5993/AJHB.42.1.7
26. Han PKJ, Lary C, Black A, et al. Effects of personalized risk information on patients referred for lung cancer screening with low-dose CT. *Med Decis Making*. 2019;39(8):950-961. https://doi.org/10.1177/

0272989X19875966/ASSET/IMAGES/LARGE/10.1177_0272989X19875966-FIG2.JPEG
27. Hancox J, Ayling K, Bedford L, et al. Psychological impact of lung cancer screening using a novel antibody blood test followed by imaging: the ECLS randomized controlled trial. *J Public Health*. 2022;45(2):e275-e284. Published online March 14. https://doi.org/10.1093/PUBMED/FDAC032
28. Ito Fukunaga M, Balwan A, Janis JA, Gutheil C, Yahwak J, Han PKJ. Pilot study of an encounter decision aid for lung cancer screening. *J Cancer Educ*. 2021;37(4):1161-1165. https://doi.org/10.1007/S13187-020-01933-9
29. Kummer S, Waller J, Ruparel M, Cass J, Janes SM, Quaife SL. Mapping the spectrum of psychological and behavioural responses to low-dose CT lung cancer screening offered within a Lung Health Check. *Health Expect*. 2020;23(2):433-441. https://doi.org/10.1111/hex.13030
30. Lillie SE, Fu SS, Fabbrini AE, et al. What factors do patients consider most important in making lung cancer screening decisions? Findings from a demonstration project conducted in the Veterans Health Administration. *Lung Cancer*. 2017;104:38-44. https://doi.org/10.1016/J.LUNGCAN.2016.11.021
31. Mazzone PJ, Tenenbaum A, Seeley M, et al. Impact of a lung cancer screening counseling and shared decision-making visit. *Chest*. 2017;151(3):572-578. https://doi.org/10.1016/J.CHEST.2016.10.027
32. Nishi SPE, Lowenstein LM, Mendoza TR, et al. Shared decision-making for lung cancer screening: how well are we "sharing". *Chest*. 2021;160(1):330-340. https://doi.org/10.1016/J.CHEST.2021.01.041
33. Olson RE, Goldsmith L, Winter S, et al. Emotions and lung cancer screening: prioritising a humanistic approach to care. *Health Soc Care Community*. 2022;00(6):1-11. https://doi.org/10.1111/HSC.13945
34. Owens OL, McDonnell KK, Newsome BR, Humphrey M. Development and testing of "is lung cancer screening for you?" A computer-based decision aid. *Cancer Causes Control*. 2023;34(3):287-294. https://doi.org/10.1007/S10552-022-01650-2
35. Raz DJ, Nelson RA, Kim JY, Sun V. Pilot study of a video intervention to reduce anxiety and promote preparedness for lung cancer screening. *Cancer Treat Res Commun*. 2018;16:1-8. https://doi.org/10.1016/J.CTARC.2018.04.004
36. Roberts MC, Seaman EL, Klein WMP, et al. Patient perspectives on the risk-based NLST outcomes tool for lung cancer screening. *J Cancer Educ*. 2021;37(5):1-8. Published online March 9. https://doi.org/10.1007/S13187-021-01977-5/TABLES/2
37. Ruparel M, Quaife SL, Ghimire B, et al. Impact of a lung cancer screening information film on informed decision-making: a randomized trial. *Ann Am Thorac Soc*. 2019;16(6):744-751. https://doi.org/10.1513/ANNALSATS.201811-841OC
38. Sakoda LC, Meyer MA, Chawla N, et al. Effectiveness of a patient education class to enhance knowledge about lung cancer screening: a quality improvement evaluation. *J Cancer Educ*. 2020;35(5):897-904. https://doi.org/10.1007/S13187-019-01540-3
39. Sferra SR, Cheng JS, Boynton Z, et al. Aiding shared decision making in lung cancer screening: two decision tools. *J Public Health*. 2021;43(3):673-680. https://doi.org/10.1093/PUBMED/FDAA063
40. Tan NQP, Nishi SPE, Lowenstein LM, et al. Impact of the shared decision-making process on lung cancer screening decisions. *Cancer Med*. 2022;11(3):790-797. https://doi.org/10.1002/CAM4.4445
41. Tanner NT, Banas E, Yeager D, Dai L, Hughes Halbert C, Silvestri GA. In-person and telephonic shared decision-making visits for people considering lung cancer screening: an assessment of decision quality. *Chest*. 2019;155(1):236-238. https://doi.org/10.1016/J.CHEST.2018.07.046
42. Van Den Bergh KAM, Essink-Bot ML, Bunge EM, et al. Impact of computed tomography screening for lung cancer on participants in a randomized controlled trial (NELSON trial). *Cancer*. 2008;113(2):396-404. https://doi.org/10.1002/CNCR.23590
43. Wiener RS, Koppelman E, Bolton R, et al. Patient and clinician perspectives on shared decision-making in early adopting lung cancer screening programs: a qualitative study. *J Gen Intern Med*. 2018;33(7):1035-1042. https://doi.org/10.1007/S11606-018-4350-9/TABLES/3
44. Wiener RS, Clark JA, Koppelman E, et al. Patient vs clinician perspectives on communication about results of lung cancer screening: a qualitative study. *Chest*. 2020;158(3):1240-1249. https://doi.org/10.1016/J.CHEST.2020.03.081
45. Williams RM, Eyestone E, Smith L, et al. Engaging patients in smoking cessation treatment within the lung cancer screening setting: lessons learned from an NCI SCALE trial. *Curr Oncol*. 2022;29(4):2211-2224. https://doi.org/10.3390/CURRONCOL29040180
46. Young B, Vedhara K, Kendrick D, et al. Determinants of motivation to quit in smokers screened for the early detection of lung cancer: a qualitative study. *BMC Publ Health*. 2018;18(1):1-13. https://doi.org/10.1186/S12889-018-6211-1/FIGURES/2
47. Zeliadt SB, Greene PA, Krebs P, et al. A proactive telephone-delivered risk communication intervention for smokers participating in lung cancer screening: a pilot feasibility trial. *J Smok Cessat*. 2018;13(3):137-144. https://doi.org/10.1017/JSC.2017.16
48. Kenny JD, Karliner LS, Kerlikowske K, Kaplan CP, Fernandez-Lamothe A, Burke NJ. Organization communication factors and abnormal mammogram follow-up: a qualitative study among ethnically diverse women across three healthcare systems. *J Gen Intern Med*. 2020;35(10):3000-3006. https://doi.org/10.1007/S11606-020-05972-2/TABLES/2
49. Centers for Medicare & Medicaid Services. Decision Memo for Screening for Lung Cancer with Low Dose Computed Tomography (LDCT); 2015. Accessed 1 February 2023. https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274
50. Lewis JA, Wiener RS, Slatore CG, Spalluto LB. Doing versus documenting shared decision-making for lung cancer screening—are they the same? *J Am Coll Radiol*. 2022;19(8):954-956. https://doi.org/10.1016/j.jacr.2022.03.019
51. Tanner NT, Silvestri GA. Shared decision-making and lung cancer screening: let's get the conversation started. *Chest*. 2019;155(1):21-24. https://doi.org/10.1016/J.CHEST.2018.10.013
52. Bonfield S, Ruparel M, Waller J, Dickson JL, Janes SM, Quaife SL. Preferences for decision control among a high-risk cohort offered lung cancer screening: a brief report of secondary analyses from the lung screen uptake trial (LSUT). *MDM Policy Pract*. 2023;8(1):23814683231163190. https://doi.org/10.1177/23814683231163190/ASSET/IMAGES/LARGE/10.1177_23814683231163190-FIG1.JPEG
53. Elwyn G, Frosch D, Thomson R, et al. Shared decision making: a model for clinical practice. *J Gen Intern Med*. 2012;27(10):1361-1367. https://doi.org/10.1007/S11606-012-2077-6/FIGURES/1
54. Balata H, Evison M, Sharman A, Crosbie P, Booton R. CT screening for lung cancer: are we ready to implement in Europe? *Lung Cancer*. 2019;134:25-33. https://doi.org/10.1016/J.LUNGCAN.2019.05.028
55. Darling GE, Tammemägi MC, Schmidt H, et al. Organized lung cancer screening pilot: informing a province-wide program in Ontario, Canada. *Ann Thorac Surg*. 2021;111(6):1805-1811. https://doi.org/10.1016/J.ATHORACSUR.2020.07.051
56. Dickson JL, Bhamani A, Quaife SL, et al. The reporting of pulmonary nodule results by letter in a lung cancer screening setting. *Lung Cancer*. 2022;168:46-49. https://doi.org/10.1016/J.LUNGCAN.2022.04.009
57. Adams SJ, Stone E, Baldwin DR, Vliegenthart R, Lee P, Fintelmann FJ. Lung cancer screening. *Lancet*. 2023;401(10374):390-408. https://doi.org/10.1016/S0140-6736(22)01694-4

58. Slatore CG, Press N, Au DH, Curtis JR, Wiener RS, Ganzini L. What the heck is a "nodule"? a qualitative study of Veterans with pulmonary nodules. *Ann Am Thorac Soc*. 2013;10(4):330-335. https://doi.org/10.1513/ANNALSATS.201304-080OC
59. Wiener RS, Gould MK, Woloshin S, Schwartz LM, Clark JA. What do you mean, a spot? a qualitative analysis of patients' reactions to discussions with their physicians about pulmonary nodules. *Chest*. 2013;143(3):672-677. https://doi.org/10.1378/CHEST.12-1095
60. Goyder E, Barratt A, Irwig LM. Telling people about screening programmes and screening test results: how can we do it better? *J Med Screen*. 2000;7(3):123-126. https://doi.org/10.1136/JMS.7.3.123
61. Sullivan FM, Mair FS, Anderson W, et al. Earlier diagnosis of lung cancer in a randomised trial of an autoantibody blood test followed by imaging. *Eur Respir J*. 2021;57(1):2000670. https://doi.org/10.1183/13993003.00670-2020
62. Grover H, Ross T, Fuller E. Implementation of targeted screening for lung cancer in a high-risk population within routine NHS practice using low-dose computed tomography. *Thorax*. 2020;75(4):348-350. https://doi.org/10.1136/THORAXJNL-2019-214303
63. Smit AK, Allen M, Beswick B, et al. Impact of personal genomic risk information on melanoma prevention behaviors and psychological outcomes: a randomized controlled trial. *Genet Med*. 2021;23(12):2394-2403. https://doi.org/10.1038/s41436-021-01292-w
64. Xie Z, Wenger N, Stanton AL, et al. Risk estimation, anxiety, and breast cancer worry in women at risk for breast cancer: a single-arm trial of personalized risk communication. *Psycho Oncol*. 2019;28(11):2226-2232. https://doi.org/10.1002/PON.5211
65. Park ER, Streck JM, Gareen IF, et al. A qualitative study of lung cancer risk perceptions and smoking beliefs among national lung screening trial participants. *Nicotine Tob Res*. 2014;16(2):166-173. https://doi.org/10.1093/NTR/NTT133
66. Krosnick JA, Malhotra N, Mo CH, et al. Perceptions of health risks of cigarette smoking: a new measure reveals widespread misunderstanding. *PLoS One*. 2017;12(8):e0182063. https://doi.org/10.1371/journal.pone.0182063
67. Crespo FS, Jaén-Moreno MJ, Gutiérrez-Rojas L, et al. "Readiness to change" predicts efficacy of reduction among smokers with severe mental illness. *Eur Addict Res*. 2019;25(5):256-262. https://doi.org/10.1159/000500450
68. Piñeiro B, López-Durán A, del Río EF, Ú M, Brandon TH, Becoña E. Motivation to quit as a predictor of smoking cessation and abstinence maintenance among treated Spanish smokers. *Addict Behav*. 2016;53:40-45. https://doi.org/10.1016/J.ADDBEH.2015.09.017
69. Worley MJ, Isgro M, Heffner JL, Lee SY, Daniel BE, Anthenelli RM. Predictors of reduced smoking quantity among recovering alcohol dependent men in a smoking cessation trial. *Addict Behav*. 2018;84:263-270. https://doi.org/10.1016/J.ADDBEH.2018.05.004

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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