

BMJ Open Barriers and facilitators of lung cancer screening uptake: protocol of a mixed methods systematic review

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ABSTRACT

Introduction The global uptake rates of lung cancer screening (LCS) with low-dose CT remain low. Since numerous factors contribute to the underuse of LCS, a theory-informed approach to identify and address the uptake of LCS barriers and facilitators is required. This study aims to document the methods which were used to identify, appraise, and synthesise the available qualitative, quantitative, and mixed methods evidence, addressing the barriers and facilitators at the individual and healthcare provider level, according to the social–ecological model, before identifying gaps to aid future practices and policies.

Methods and analysis The following databases will be searched: PubMed, Ovid (Journals @ Ovid Full Text and Ovid MEDLINE), EMBASE, CINAHL, PsycINFO, Cochrane Library, Chinese Biomedical Database, Chinese National Knowledge Infrastructure, and Wanfang database, from their creation up to 31 December 2020. Two reviewers will be involved in independently screening, reviewing, and synthesising the data; and calibration exercises will be conducted at each stage. Disagreements between the two reviewers will be resolved by arbitration by a third reviewer. The Critical Appraisal Checklist for Studies Reporting Prevalence Data from the Joanna Briggs Institute, the Critical Appraisal Skills Programme criteria adapted for qualitative studies, and the 16-item Quality Assessment Tool (QATSDD) will be used in the quality assessment of primary studies. We will perform data synthesis using the Review Manager software, V.5.3.

Ethics and dissemination This study is a review of published data and therefore needs no ethical approval. The findings of this systematic review will be published in a peer-reviewed journal.

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INTRODUCTION

Lung cancer is the second most commonly diagnosed type of cancer, as well as the leading cause of cancer-related deaths. Worldwide, an estimated 2.2 million new lung cancer cases and 1.8 million deaths occurred in 2020, representing approximately 1 in 10 (11.4%) cancers diagnosed and 1 in 5 (18.0%) deaths.¹ The International Agency for Cancer Research reported that the incidence of lung cancer has been increasing globally, especially in China.² The country accounts for the largest number of patients with lung cancer

Strengths and limitations of this study

- The mixed-method systematic review answers complementary research questions about the facilitators and barriers of lung cancer uptake practices at the level of participants and healthcare providers.
- The social–ecological model enables our analysis to illustrate the complex interplay of the individual, interpersonal, health system, and socio/environmental aspects influencing the lung cancer screening (LCS) uptake.
- Our review first analyses similarities and differences between barriers and facilitators among individuals with different risk statuses and screening times, and between adults and healthcare providers, which helps to provide tailored LCS recommendations or interventions for specific individuals.
- This review does not include grey literature and studies published in languages other than English and Chinese, which leads to reporting bias.

worldwide and is expected to reach 1 million by 2025.^{2,3} Due to the asymptomatic nature of lung cancer, patients are often diagnosed at an advanced stage when the prognosis is poor or futile, with only 12%–16% survival rate at 5 years.^{4,5} The same 5-year survival rate increases to 60%–70% when the disease is diagnosed at an early stage.^{5,6} This evidence highlights the importance of secondary prevention to decrease lung cancer mortality and improve the 5-year survival rate.

Low-dose CT (LDCT) has been proven as a sensitive tool for the detection of early-stage lung cancer.⁷ Compared with chest X-ray (CXR), LDCT can significantly decrease the lung cancer mortality rate by 20% and all-cause mortality by 7%.⁸ In 2013, the United States Preventive Services Task Force recommended (grade B) annual LDCT screening for high-risk individuals.⁹ In 2018, a survey of 100 000 urban Chinese smokers aged 45–80 years found that LDCT screening would reduce lung cancer mortality by 17.2% and 24.2%, compared with CXR screening and no screening, respectively.⁶ Therefore, LDCT



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may be effective in reducing lung cancer morbidity and mortality rates, alleviating social burden.¹⁰

Despite the overall support for lung cancer screening (LCS) with LDCT, its uptake rates remain low.^{2 5 11} In the USA, the percentage of eligible individuals who have received LCS increased only slightly from 3.3% in 2010 to 3.9% in 2015.¹² In China, from 2009 to 2012, the Cancer Screening Program has been launched successively in rural and urban areas, but the uptake rates of LDCT are still low, ranging from 6.4% to 31.91%.^{13–15} Furthermore, the uptake of LCS varies according to the screening time and the risk status of the participants.^{2 16} Thus, understanding the barriers and facilitators of the LCS uptake practice is an important premise to promote the successful implementation of LCS programmes and maximise the secondary prevention effect of LDCT.

Barriers and facilitators are factors that inhibit or encourage an individual to participate in LCS services. Many original studies relevant to the underuse of LCS suggest a range of barriers related to individuals, healthcare professionals, health organisations, and the system level.^{2 5} Numerous factors, including the lack of awareness, the lack of opportunity/access, individual beliefs, economic obstacles, and others, have been described as barriers to participation in LCS.^{2 5 17 18} However, the participants, research settings, and outcomes of those studies varied. For example, regarding smoking history, Duong *et al.* found that current smokers showed less adherence to LCS than patients who smoked less than they used to or quit smoking,¹⁹ which conflicted with the findings of Delmerico *et al.*,²⁰ who reported no difference among various groups with smoking status. To draw well-informed conclusions of LCS practices that would aid the shaping of future public health efforts, it is necessary to conduct a systematic review of the current research on factors affecting the LCS uptake.

There have been several systematic reviews addressing the LCS practice; however, most publications examine the benefits, harms, and effectiveness of LDCT.^{3 10 21 22} To the best of our knowledge, only three systematic reviews address the barriers and facilitators of the LCS uptake. Schütte *et al.* reviewed 14 studies,²³ evaluating the gender and social differences of participants in LCS programmes, but the review evidence did not analyse the factors influencing the LCS practice. According to the socioecological theory, health behaviour, such as LCS uptake behaviour, is influenced by biological, psychological, sociocultural and environmental factors.²⁴ The second integrative review⁵ summarised 10 articles on the barriers of LCS with LDCT but focused exclusively on the eligible US population, and the quality of the articles included was not assessed, which influenced the generalisation of review evidence. The third systematic review summarised 15 articles on high-risk patients' adherence to periodic LCS reported in cohort studies but included only those studies that were conducted in the US. In addition, the heterogeneity of the LCS eligibility criteria among the included studies suggests that future studies should consider how

differences in risk statuses affect individuals' adherence to screening.²⁵ Furthermore, the relevant reviews explored the views of participants, not healthcare providers, who may also provide relevant insights into the factors related to health systems and resources.²⁶

Therefore, the aim of this mixed-method systematic review is to identify, appraise, and synthesise the available qualitative, quantitative, or mixed-method literature to improve our understanding of: (1) What are the facilitators of and barriers to LCS practice uptake at the level of participants and healthcare providers? (2) What are the differences or similarities of barriers and facilitators to LCS uptake among subgroups (eg, participants vs healthcare providers, initial vs ongoing LCS behaviour, high-risk vs moderate-risk vs low-risk individuals)? (3) What are some remaining gaps in the literature which we can examine to inform and aid future implementation practices? Our findings can help identify effective strategies regarding barriers and leverage facilitators which may aid the development of LCS promotional and education programmes to increase screening uptake among eligible adults, ultimately improving timely lung cancer diagnosis and reducing the disease's mortality.

METHODS AND ANALYSIS

This systematic review will adopt a mixed methods methodology to answer its complementary research questions. The review will be conducted following the Evidence for Policy and Practice Information and Co-ordinating Centre approach for mixed methods reviews²⁷ and reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Protocol guidelines.²⁸ This review has been registered with the International Prospective Register of Systematic Reviews (registration number: CRD42020162802).

Search strategy

To develop the search strategy for this systematic review, we break down the review question into PICO components (see [table 1](#)). Boolean terms 'OR' and 'AND', medical subject heading and truncation '*' are used. The search strategy is mainly composed of words expressing P, I and O. The search strategy of PubMed is shown in [table 2](#), and the full search strategy is available in online supplemental appendix 1, which has been reviewed and edited by a university librarian. The search strategies for selecting titles, abstracts or keywords will be adjusted according to different database characteristics. Studies will be exported to EndNote V.X9, and duplicates will be deleted.

Search databases

We will perform an all-round search for published studies in nine electronic databases, from their creation up to 31 December 2020: PubMed, Ovid (Journals @ Ovid Full Text and Ovid MEDLINE), EMBASE, CINAHL, PsycINFO, Cochrane Library, Chinese Biomedical Database, Chinese

Table 1 Eligibility criteria for studies to be included in the systematic review

PICOS item	Inclusion criteria	Exclusion criteria
P-population	Studies involving lung cancer screened or unscreened adults or healthcare providers involved in LCS.	Previously received a diagnosis of lung cancer or any other cancer.
I-interest of research	<ol style="list-style-type: none"> 1. Studies describing barriers or facilitators to LCS uptake at the individuals level, including the actual LCS behaviour and intention or decision to LCS; 2. Studies describing barriers or facilitators to uptake LCS at healthcare providers level. 	Studies with no research method examining LCS barriers or facilitators.
C-comparison	Not applicable, if a paper also reported on the differences between individuals with and without screening as part of the study then this information was synthesised as part of the analysis.	
O-outcome(s)	<ol style="list-style-type: none"> 1. Barriers to uptake of and adherence to LCS. (including the actual LCS behaviour and intention or decision to LCS) 2. Facilitators of uptake of and adherence to LCS (including the actual LCS behaviour and intention or decision to LCS) 3. Rates of uptake of and adherence to LCS (including the actual LCS behaviour and intention or decision to LCS) 	Studies that do not describe at least one of: barriers, facilitators or determinants of uptake/adherence of LCS.
S-study design	Quantitative, qualitative or mixed-method studies	<ol style="list-style-type: none"> 1. Conference abstracts, reviews, editorials, opinion pieces, dissertations, letters, books and full text would not be presented or the original data were made available even on requesting from the author. 2. Unpublished manuscripts. 3. Duplicate studies: for studies published with the same or different titles or in more than one journal, the most updated version shall be considered.

LCS, lung cancer screening.

National Knowledge Infrastructure and Wanfang databases. The database search will be supplemented with Google Scholar searches, manually examining reference lists of systematic reviews and articles.

Table 2 Search strategy of PubMed

Search items	
1	(Small Cell Lung Carcinoma) OR (Carcinoma, Non-Small-Cell Lung)
2	Lung cancer OR NSCLC OR NSCLC OR SLC OR SCLC
3	Lung neoplasm*
4	1 OR 2 NOT 3
5	(low dose computed tomography) OR (low dose CT) OR LDCT
6	scan* or screen*
7	5 AND 6
8	(lung cancer screen*) OR LCS
9	(Early Detection of Cancer)
10	7 OR 8 OR 9
11	Knowledge OR (Health Knowledge, Attitudes, Practice) OR Awareness OR Attitude OR (Attitude to Health) OR Behaviour OR (Patient Compliance) OR Perception
12	barrier* OR facilitator* OR utilisation* OR awareness OR knowledge OR attitudes OR practice OR belief OR adherence OR compliance OR perception OR perspective
13	11 OR 12
14	4 AND 10 AND 13

Eligibility criteria

Quantitative, qualitative, or mixed-method studies published in English or Chinese examining the barriers and/or facilitators of LCS uptake practice will be included. In this study, the LCS uptake practice will include LCS behaviours and the intention or decisions about LCS. [Table 1](#) summarises the elements of the inclusion and exclusion criteria based on population, study interest, comparison, outcome, and study design. Quantitative studies will be included to identify associations between various factors and screening behaviour, while qualitative studies will be used to explore screening barriers and facilitators reported by participants. Mixed methods studies whose quantitative or qualitative components meet the inclusion criteria will be included.

Study selection

According to the predefined eligibility criteria, two reviewers (Y-aL and YtH) with experience in conducting systematic reviews will independently assess the titles and abstracts and excluded irrelevant articles. Then, all potentially relevant full-text articles will be assessed for eligibility. Any disagreements arising will be resolved by a discussion with a third reviewer (FfH), who also has experience with systematic reviews. Cohen's kappa coefficient will be calculated to assess selection consistency between them. The study selection process will be documented using a PRISMA flow diagram.

Data extraction

One primary reviewer will independently extract data from selected studies using structured and standardised data extraction forms (see online supplemental appendix 2), which will be then cross-checked by another reviewer.

If any, we will attempt to contact the corresponding author to obtain the required data. When multiple publications are related to the same study, these will be reported together. The following domains will be retrieved: author name, year of publication, country and setting, sample characteristics, study design, research focus and findings. For the study findings, the barriers and facilitators associated with LCS practice will be extracted and mapped onto the social–ecological model.²⁴ That is, the factors will be assigned to one of the four general categories: individual, interpersonal, health system and socio/environmental. The results of the quantitative study will be recorded (eg, r coefficient, β value, p values). Data from the qualitative studies will be used to form a narrative analysis of LCS barriers and facilitators based on emergent themes.

Quality assessment

Quality assessment will be undertaken for eligible primary studies to illustrate the potential sources of bias. As we anticipate that the majority of eligible studies will be observational, studies will not be automatically excluded on the basis of ‘low’ quality assessment if they are considered to contribute with relevant information. We propose using the Critical Appraisal Checklist for Studies Reporting Prevalence Data from the Joanna Briggs Institute,²⁹ the Critical Appraisal Skills Programme criteria adapted for qualitative studies for evaluating qualitative research,³⁰ and the 16-item Quality Assessment Tool (QATSD) for a mixed methods study.³¹ Quality assessment of the primary studies will be undertaken independently by two reviewers and recorded in an Excel spreadsheet. An overall assessment of ‘high’, ‘medium’, ‘low’, or ‘unclear’ will be assigned and reported.

Data synthesis

For our first objective, the extracted data will be further summarised and classified using the social–ecological model from the five nested, hierarchical levels: individual, interpersonal, health system and socio/environmental factors (see online supplemental appendix 3).

Regarding quantitative studies, heterogeneity will be assessed by a visual inspection of the forest plot, which will be used to present the effect sizes for each included study in aggregate and the combined effect sizes in summary, and χ^2 test as well as quantified using the I^2 statistic before the pooling of studies. If there is statistical homogeneity between the studies ($I^2 < 50\%$), a fixed-effect model will be used for meta-analysis. If there is statistical heterogeneity ($I^2 \geq 50\%$) between the studies without clinical heterogeneity, the random effect model will be used for analysis. In the event of statistically significant heterogeneity, we will report our results as a narrative.^{32 33} Heterogeneity will be further explored using subgroup analysis. If sufficient data are reported in this study, we will propose three subgroup analyses, comparing the impact of LCS by (1) screening time (initial vs ongoing), (2) risk status (high risk vs moderate risk, vs low risk), according to the criteria from LCS, Version 3,¹⁶ and (3) social groups (participants

vs healthcare providers). In the case of homogeneity, a meta-analysis will be performed.

Regarding the qualitative studies, Thomas and Harden’s thematic synthesis method³⁴ will be adopted. That is, we will pool results from individual primary studies by initially separating the findings, coding and interpreting the text, and then combining them through identifying the key themes across the studies, including similarities and differences within those themes.

Regarding our second objective, we will overarch and compare the differences and similarities explored within the domains from the data synthesis mentioned above, between the participants and healthcare providers, and adults with different screening times and lung cancer risk statuses.

Regarding our third objective, we will examine the themes with no or few barriers and facilitators identified. The paucity of identified barriers and facilitators within these themes may represent areas irrelevant for LCS uptake or where a gap in the literature may exist. We will discuss them and provide examples of barriers and facilitators that have not been captured in previous research. In addition, we will analyse the data on the study limitations or implications described by the authors to distinguish areas for further research.

Patient and public involvement

There is no patient or public involvement in the design or planning of the study.

ETHICS AND DISSEMINATION

The current study is based on a review of published data and therefore requires no ethical approval. Our protocol follows a rigorous methodology, using a theory-based approach providing a systematic understanding of the factors contributing to the underuse of LCS. To the best of our knowledge, this will be the first systematic review to collate comprehensive evidence relating to barriers and facilitators of LCS programmes uptake based on the social–ecological model. We anticipate that the results of this study may be of interest to national and international stakeholders interested in improving uptake in adult LCS programmes.

First, the findings of this review will illustrate the complex interplay of the individual, interpersonal, health system, and socioenvironmental barriers that inhibit individuals from LCS uptake, highlighting key enabling factors. Our findings will provide information on how LCS uptake can be improved and are particularly important since LCS uptake in developed or developing countries is low, though lung cancer remains to be a pressing public health issue. In China, although municipal or city-level screening programmes have increased since the launch of the Rural China Screening Program in 2009 and the Cancer Screening Program in Urban China in 2012, there is still a desperate lack of pragmatic clinical trials (referring to proving the effectiveness of

LCS or evaluating different implementation strategies to increase the uptake of LCS in eligible patients) on LCS and its low uptake rate.²

Second, this review will focus on the views of both adults and healthcare providers, which will provide valuable information from the perspective of both the target group for screening and the professionals providing this service. The collective evidence may guide the development of health promotion programmes incorporating the views of the target group.

Third, the similarities and differences between barriers and facilitators among individuals with different risk statuses and screening time, and adults and healthcare providers, will be summarised in this review to help provide tailored LCS recommendations or interventions for specific individuals. Furthermore, this review will also provide evidence about the associations and effects of LCS barriers and facilitators perceived by individuals and healthcare providers and about how healthcare is organised and financed transcend culture and geography. Specifically, we will search a large number of relevant information to understand the organisational form, culture and environment of healthcare in the country or region where the eligible studies were conducted. Besides, we will further explore the barriers and facilitators in different cultural backgrounds, classify and summarise them, so as to analysis their similarities and differences, and explore the underlying reasons.

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Contributors All authors have read and approved the final manuscript. FFH: conception and design of the study, drafting of the manuscript. HmX: participated in the design of the study, refinement of the literature search strategy and drafting of the protocol. Y-aL: assisted with the review of the literature and drafting of the initial manuscript. YtH and BnC: design of the study and formulation of the data extraction procedure for outcomes of interest.

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Competing interests None declared.

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