Enhancing Lung Cancer Outcomes Through Preventative and Early Detection Strategies in the United States

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SUMMARY
Lung cancer is the leading cause of cancer-related death worldwide, though it is often detected at advanced stages when treatment is limited. Preventive and early detection strategies, such as low-dose computed tomography (LDCT) screening, offer opportunities to shift diagnoses toward earlier, more treatable stages. This systematic review synthesized 14 U.S.-based studies (2010–2025) following PRISMA guidelines. Findings show LDCT screening reduces lung cancer mortality by up to 24% among high-risk populations, with further benefits when combined with education modules such as smoking cessation interventions. Expanding screening eligibility beyond traditional criteria and incorporating novel methods, such as lung nodule detection and artificial intelligence, may improve outcomes and address disparities. Further barriers remain that also must be addressed, such as restricted insurance coverage and limited accessibility for non-traditional risk groups. Policy changes and preventive initiatives are needed to enhance early detection and reduce disparities to ultimately improve survival outcomes.

KEYWORDS
Early Detection, Diagnosis, LDCT, Low-Dose Computed Tomography, Lung Cancer, Mortality, Prevention, Screening, Stage, Survival Rate

INTRODUCTION
Lung cancer is the leading cause of cancer-related death worldwide, reaching approximately 1.8 million deaths in 2020. Early detection through public health interventions, such as low-dose computed tomography (LDCT) screening, has significantly reduced lung cancer mortality by identifying tumors at a treatable stage. Major studies such as the National Lung Screening Trial and the NELSON trial demonstrated that LDCT screening in high-risk populations (e.g., heavy smokers aged 50 and older) significantly reduces mortality. These findings inform current U.S. Preventive Services Task Force guidelines recommending annual LDCT screening for adults aged 50 to 80 with a significant smoking history. Despite progress, lung cancer is still often diagnosed at an advanced stage when curative options are limited and disparities in access to screening remains a challenge. To improve outcomes, further public health initiatives are essential.

METHODS
This systematic review aimed to synthesize original research on preventive and early detection strategies for lung cancer within the United States, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility throughout the process. PubMed was searched to identify studies published between 2010 and 2025, with filters applied to include only articles written in English and studies conducted on human subjects. A total of 241 records were identified, with 14 studies meeting final inclusion criteria after screening (Figure 1).

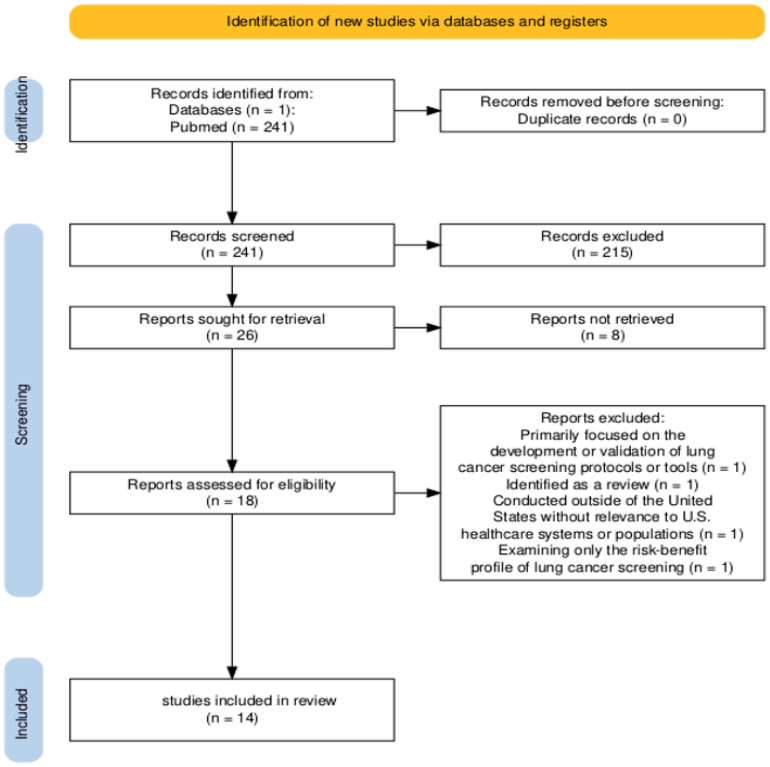

Figure 1. PRISMA Flow Diagram depicting identification of studies to be included in the conducted systematic review.

Inclusion Criteria

Studies were included if they addressed lung cancer prevention or early detection, including awareness efforts with measurable prevention or detection outcomes. Eligible studies were conducted in the U.S. or presented data applicable to the U.S. healthcare system. Only original research published in English from 2010 onward was included, with a focus on human subjects to ensure relevance to current screening practices and technologies.

Exclusion Criteria

Studies were excluded if they did not directly address prevention or early detection outcomes, such as those focusing solely on treatment, biological mechanisms, other diseases, or the risk-benefit profile of screening (e.g., overdiagnosis or radiation exposure). Studies on screening uptake without preventive outcomes, awareness efforts without measurable behavior change, studies conducted outside the U.S. without relevance, and those limited to narrow subpopulations (e.g., HIV-positive individuals, asbestos-exposed workers, Medicare recipients) were also excluded. Economic analyses, non-original research, articles published before 2010, and non-English publications were also excluded.

RESULTS AND DISCUSSION

Three key themes emerged. First, LDCT screening improves early detection and reduces lung cancer mortality, especially for non-small cell lung cancer. Modeling studies estimated a 20–24% mortality reduction in eligible adults, supporting U.S. guidelines for annual screening in those aged 50–80 with a 20 pack-year smoking history (smoking 20 cigarettes a day for a year). Experts also suggest using AI to improve scan accuracy and speed. Second, combining LDCT with smoking cessation improves outcomes. Trials show that cessation counseling during screening increases the rate of quitting, and modeling suggests greater mortality reduction when both strategies are combined. Third, current screening criteria may be too limited. Studies have found lung cancer in people outside eligibility guidelines, including younger adults with minimal smoking history.

Expanding prevention efforts could further reduce mortality. Integrating the Lung Nodule Program, which screens adults starting at 35 years old regardless of smoking history, could address gaps, especially for small cell lung cancer. Broader insurance coverage and public awareness are also critical. LDCT uptake and early diagnosis could be boosted with initiatives based on models like Japan's workplace screening programs.

CONCLUSIONS

This systematic review examined U.S.-based studies (2010–2025) on lung cancer prevention and early detection, focusing on interventions with measurable outcomes. LDCT screening was consistently shown to reduce mortality by up to 24% in high-risk populations, with greater benefits when combined with smoking cessation efforts.

However, many at-risk individuals fall outside current screening criteria, and access remains limited due to insurance and infrastructure barriers. Expanding eligibility, improving coverage, and integrating broader programs like the Lung Nodule Program could enhance early detection, reduce disparities, and improve survival outcomes.

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