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Learning Objectives:

Upon completion of this activity, participants will be able to:

- Integrate into professional practice the updates to the NCCN Guidelines for Lung Cancer Screening
- Describe the rationale behind the decision-making process for developing the NCCN Guidelines for Lung Cancer Screening

Disclosure of Relevant Financial Relationships

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Jamie L. Studts, PhD, Panel Member, has disclosed receiving consulting fees from Genentech, Inc. and Johnson & Johnson.

To view disclosures of external relationships for the NCCN Guidelines panel, go to NCCN.org/guidelines/guidelines-panels-and-disclosure/disclosure-panels

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Lung Cancer Screening, Version 1.2025
Featured Updates to the NCCN Guidelines

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Abstract

The NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Lung Cancer Screening provide criteria for selecting individuals for screening and offer recommendations for evaluating and managing lung nodules detected during initial and subsequent annual screening. These NCCN Guidelines Insights focus on recent updates to the NCCN Guidelines for Lung Cancer Screening.

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Overview

Lung cancer is the leading cause of cancer-related mortality in the United States and worldwide.[1] In 2024, an estimated 234,580 new cases of lung and bronchial cancer (116,310 in males and 118,270 in females) are expected to be diagnosed, with 125,070 lung cancer–related deaths (65,790 in males and 59,280 in females) projected in the United States.[2] Most patients present with advanced-stage lung cancer at initial diagnosis. The success of screening in improving outcomes for patients with cervical, colon, and breast cancers inspired efforts to develop an effective lung cancer screening test.[3–5] In the decade since the United States Preventive Services Task Force (USPSTF) first recommended lung cancer screening in 2013, a stage shift has occurred toward a higher percentage of early lung cancers and fewer late-stage cancers at the time of diagnosis.[6]

The goal of any cancer screening is to detect disease at an early stage when it is not causing symptoms and when treatment will be most successful. The ideal screening test should (1) improve outcomes; (2) be scientifically validated (eg, have acceptable levels of sensitivity and specificity) with low false-positive rates, preventing unnecessary additional testing; and (3) be low risk, reproducible, accessible, and cost-effective. Low-dose CT (LDCT) of the chest is an effective option to screen select individuals who are at high risk for lung cancer.[5,7,8] LDCT screening of the chest (category 1) is recommended for individuals at high risk for lung cancer. This recommendation is based on data from the National Lung Screening Trial (NLST) and NELSON trials, with the extended upper age limit informed by Cancer Intervention and Surveillance Modeling Network (CISNET) analyses included in the USPSTF recommendations.[5,7,9,10] In 2022, up to 18.1% of eligible individuals underwent lung cancer screening based on the 2021 USPSTF criteria.[11,12] Even with this low degree of uptake, lung cancer screening is likely responsible for the observed stage shift at diagnosis from advanced- to early-stage cancer.[6,13,14]

The NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Lung Cancer Screening were developed in 2011 and have been subsequently updated at least once every year.[15] These guidelines refer primarily to the detection of non–small cell lung cancer, although LDCT has also detected cases of small cell lung cancer. In addition to the primary reason for lung cancer screening, which is the early detection of lung cancer, other findings that may be of clinical significance include coronary arterial calcification, interstitial and obstructive lung diseases, aortic aneurysms, and masses that may represent cancer in the lower

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The full and most current version of these NCCN Guidelines is available at NCCN.org.

neck, upper abdomen, and chest outside of lung cancer.[16–21] The NCCN Guidelines for Lung Cancer Screening (1) describe risk factors for lung cancer; (2) recommend criteria for selecting individuals for screening; (3) recommend evaluation and follow-up of lung nodules found during initial and subsequent screening; (4) discuss the accuracy of chest LDCT screening protocols and imaging modalities; and (5) discuss the benefits and risks of LDCT screening. These NCCN Guidelines Insights focus on select eligibility criteria, with emphasis on the removal of the 15-year quit date exclusion, prioritizing shared decision-making between clinicians and patients over using an upper age limit, considering total years of cigarette smoking, and discussing the risks and benefits of screening (Figure 1).

Individuals Eligible for Lung Cancer Screening

NCCN was the first organization to develop lung cancer screening guidelines recommending LDCT screening based on the NLST data.[15] The International Association for the Study of Lung Cancer (IASLC) supports the NCCN Guidelines by emphasizing the need for a guidelines-recommended multidisciplinary team approach and integrated smoking cessation programs (Figure 2).[22] Most professional organizations in the United States, including the American College of Radiology (ACR), American Cancer Society (ACS), American Lung Association, and American College of Chest Physicians (ACCP), recommend LDCT screening for individuals at high risk for lung cancer as defined by age and smoking history.[23]

All Individuals With a ≥20-Year History of Cigarette Smoking With No Limit on Years Since Quitting

The USPSTF has a grade B recommendation for lung cancer screening with LDCT that allows screening to be covered under the Affordable Care Act for select individuals at high risk. Per the USPSTF, individuals at high risk are those aged 50 to 80 years with a cigarette smoking history of ≥20 pack-years, who either currently smoke or have quit within the past 15 years.[9,10] The CMS provides coverage for annual LDCT lung cancer screening in Medicare beneficiaries aged ≤77 years who have these risk factors if they participate in shared decision-making before their first screening.[24] An estimated 15 million individuals in the United States meet these criteria.[25]

The NCCN Guidelines differ from the USPSTF and CMS national coverage recommendations by not including time since quitting smoking as an eligibility criterion for lung cancer screening (Figure 1).[9,24] Although the panel acknowledges that cessation of cigarette smoking decreases the risk of lung cancer, they disagree with the 15-year restriction in the USPSTF and CMS recommendations. Individuals who previously smoked have a substantially higher risk of lung cancer compared with those who have never smoked, and there is no substantive drop off in that risk after 15 years since quitting (YSQ). An analysis of the Framingham Heart Study found that lung cancer risk remains more than 3-fold higher in individuals who previously smoked after 25 YSQ than in those who had never smoked, and 40.8% of lung cancers occurred in individuals who previously smoked with >15 YSQ.[26] The Iowa Women's Health Study reported that individuals who previously smoked had an elevated lung cancer risk (relative risk [RR], 6.6; 95% CI, 5.0–8.7) for up to 30 years after smoking cessation.[27] A prospective study estimated which patients with newly diagnosed lung cancer would have "missed out" on lung cancer screening using the 2013 USPSTF criteria, and by far the largest percentage who would not have been eligible for screening were solely due to having >15 YSQ.[28] Additionally, only 27% of patients being diagnosed with lung cancer would be candidates for LDCT screening using the narrow NLST criteria—individuals aged 55 to 77 years with a ≥30 pack-year smoking history (who currently smoked or had quit within the past 15 years).[29] The unintended consequences of this restriction leads to a paradox of incentives for individuals who previously smoked and wish to undergo or continue lung cancer screening. Individuals may be unintentionally encouraged to resume smoking, or to lie about their smoking history to remain eligible for screening. Furthermore, this YSQ criterion adds unnecessary complexity to screening eligibility that is a barrier to referral for lung cancer screening. Due to the clear data that a 15-YSQ cutoff does not eliminate the risk of lung cancer and other potential repercussions, the panel decided to

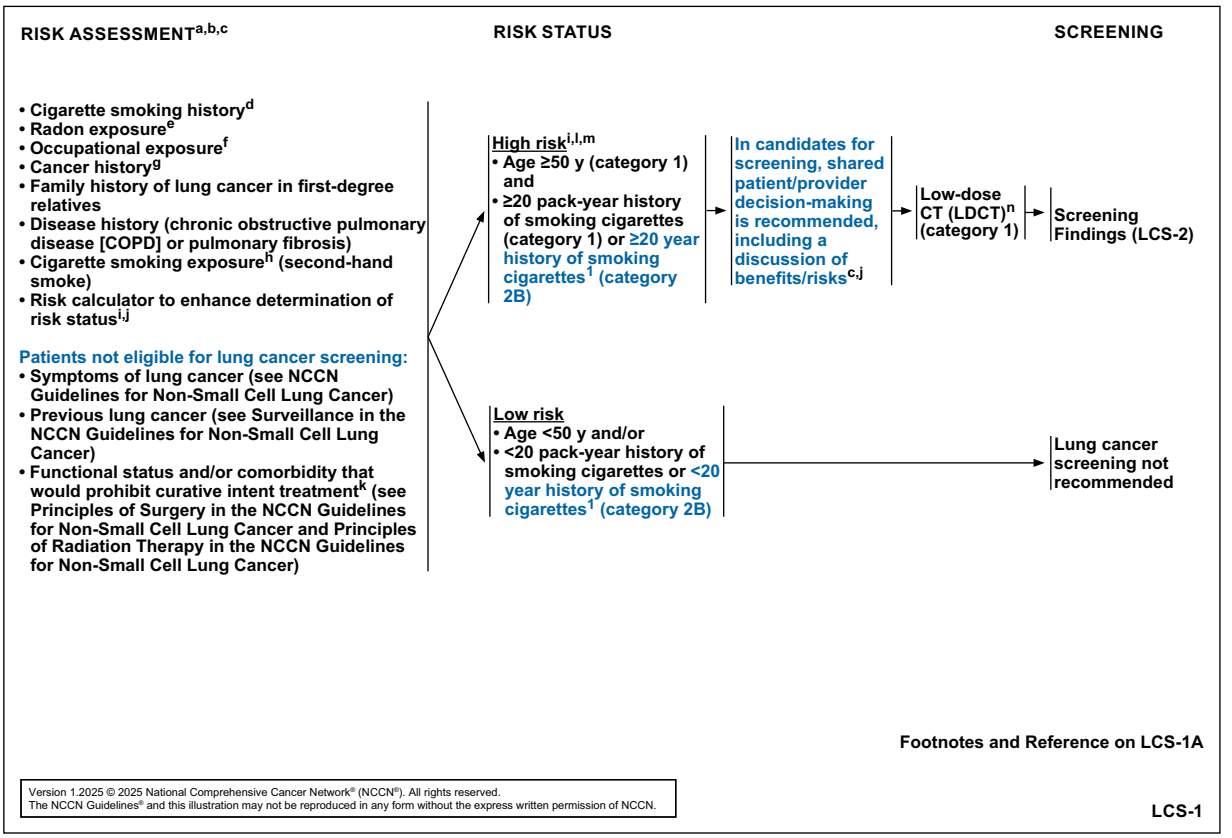


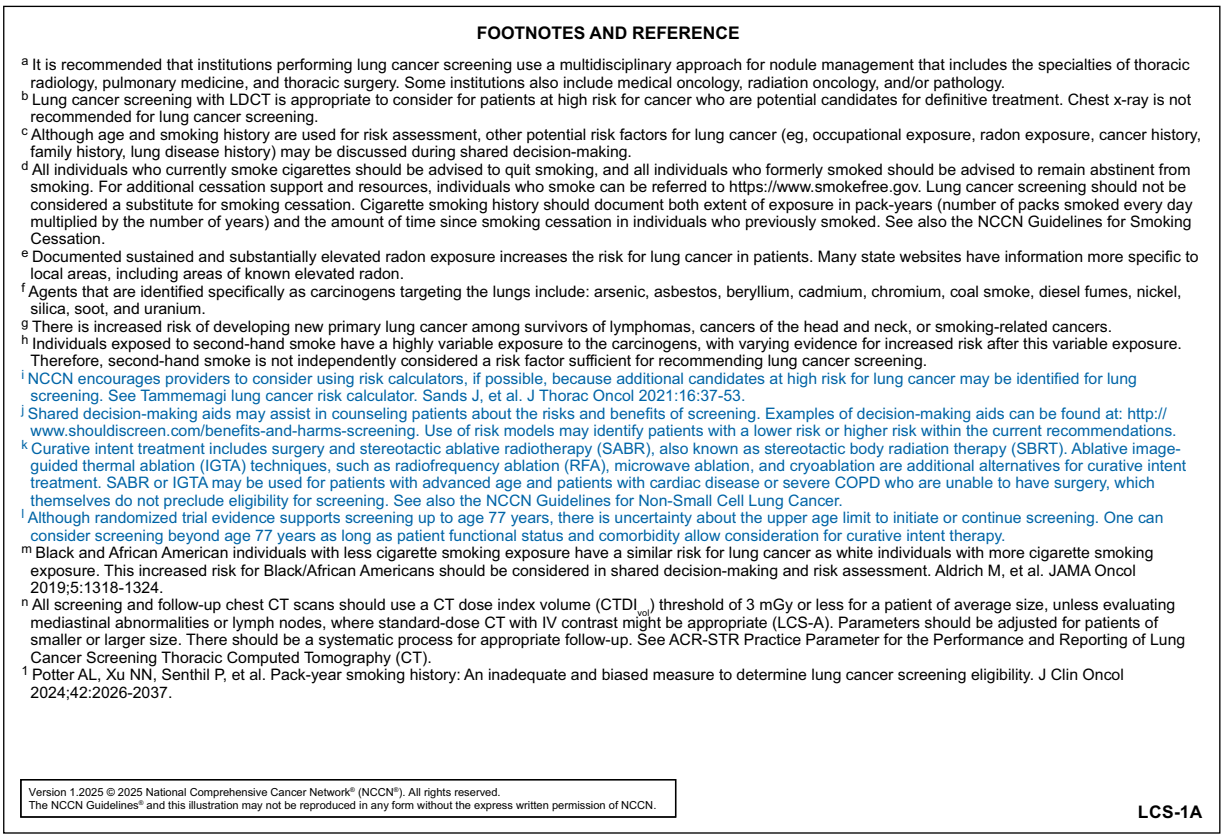
Figure 1. LCS-1. NCCN Clinical Practice Guidelines in Oncology for Lung Cancer Screening, Version 1.2025.

completely exclude a time limit after smoking cessation as an eligibility criterion for screening in 2022. In November 2023, the ACS also updated its recommendations for screening to eliminate the YSQ cutoff, increasing the number of people eligible for lung cancer screening to approximately 19.2 million and reaching 43% of individuals (aged 50–80 years) who ever smoked.[30,31] Their analyses demonstrated that the absolute lung cancer risk increased by 8.7% per year (95% CI, 7.7%–9.7%; $P<.001$) in individuals aged beyond 15-YSQ in the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial (PLCO), with similar results in NHIS and NLST.[30,31] In 2024, a study utilizing 2 different lung cancer models showed that expanding screening to individuals with >15 YSQ will result in a greater number of life-years gained and reduce the number of deaths due to lung cancer.[32,33] The new study and the existence of 2 US-based guidelines with similar recommendations emphasize the need for not using the 15-YSQ limit as a criterion for lung cancer screening.

Any Individual at High Risk for Lung Cancer With No Upper Age Cutoff

In the first NCCN Guidelines for Lung Cancer Screening (Version 1.2012), the panel recommended LDCT screening for 2 high risk groups: 1 based on NLST inclusion criteria and 1 that expanded upon NLST inclusion criteria. Group 1, based on the NLST inclusion criteria, comprised individuals aged 55 to 74 years with a ≥30 pack-year history of cigarette smoking who currently smoked or had <15 YSQ (category 1).[15,34] The NLST used only age and smoking history as inclusion criteria to facilitate the trial and enable the collection of long-term mortality data, and did not consider other risk factors for lung cancer. Using the narrow NLST criteria—individuals aged 55 to 74 years with a ≥30 pack-year smoking history (who currently smoked or had quit smoking within the past 15 years)—only 27% of patients being diagnosed with lung cancer would be candidates for LDCT screening.[29] The NCCN panel considered that limiting screening to the NLST inclusion criteria alone was arbitrary and incomplete. Therefore, the panel expanded screening to group 2, which included individuals aged ≥50 years with a ≥20 pack-year history of cigarette smoking (who either currently smoked or had quit) and had at least one additional risk factor, such as occupational exposure to lung carcinogens (Figure 1).[15]

During the annual update in 2021, the NCCN Lung Cancer Screening Panel decided to completely remove any upper age cutoff for lung cancer screening. This decision was made for several reasons. The panel felt that eligibility for screening should be determined on an individual basis and continue as long as the individual remains a candidate for curative-intent treatment, rather than relying on an arbitrary chronological age cutoff.[35,36] Individual factors to consider include functional status, comorbidities that could impede curative treatment, and patient values, including willingness to undergo treatment. Some individuals in their 60s may not be eligible for treatment and therefore should not undergo screening, whereas there are octogenarians at high risk for lung cancer who are fit for treatment and deserve the same access to early diagnosis as younger individuals. Furthermore, the median age at the time of lung cancer diagnosis is 71 years, with diagnosis occurring in approximately 27% of patients aged 75 to 84 years and 9.4% of



FOOTNOTES AND REFERENCE

[a] It is recommended that institutions performing lung cancer screening use a multidisciplinary approach for nodule management that includes the specialties of thoracic radiology, pulmonary medicine, and thoracic surgery. Some institutions also include medical oncology, radiation oncology, and/or pathology.
[b] Lung cancer screening with LDCT is appropriate to consider for patients at high risk for cancer who are potential candidates for definitive treatment. Chest x-ray is not recommended for lung cancer screening.
[c] Although age and smoking history are used for risk assessment, other potential risk factors for lung cancer (eg, occupational exposure, radon exposure, cancer history, family history, lung disease history) may be discussed during shared decision-making.
[d] All individuals who currently smoke cigarettes should be advised to quit smoking, and all individuals who formerly smoked should be advised to remain abstinent from smoking. For additional cessation support and resources, individuals who smoke can be referred to https://www.smokefree.gov. Lung cancer screening should not be considered a substitute for smoking cessation. Cigarette smoking history should document both extent of exposure in pack-years (number of packs smoked every day multiplied by the number of years) and the amount of time since smoking cessation in individuals who previously smoked. See also the NCCN Guidelines for Smoking Cessation.
[e] Documented sustained and substantially elevated radon exposure increases the risk for lung cancer in patients. Many state websites have information more specific to local areas, including areas of known elevated radon.
[f] Agents that are identified specifically as carcinogens targeting the lungs include: arsenic, asbestos, beryllium, cadmium, chromium, coal smoke, diesel fumes, nickel, silica, soot, and uranium.
[g] There is increased risk of developing new primary lung cancer among survivors of lymphomas, cancers of the head and neck, or smoking-related cancers.
[h] Individuals exposed to second-hand smoke have a highly variable exposure to the carcinogens, with varying evidence for increased risk after this variable exposure. Therefore, second-hand smoke is not independently considered a risk factor sufficient for recommending lung cancer screening.
[i] NCCN encourages providers to consider using risk calculators, if possible, because additional candidates at high risk for lung cancer may be identified for lung screening. See Tammemagi lung cancer risk calculator. Sands J, et al. J Thorac Oncol 2021:16:37-53.
[j] Shared decision-making aids may assist in counseling patients about the risks and benefits of screening. Examples of decision-making aids can be found at: http://www.shouldiscreen.com/benefits-and-harms-screening. Use of risk models may identify patients with a lower risk or higher risk within the current recommendations.
[k] Curative intent treatment includes surgery and stereotactic ablative radiotherapy (SABR), also known as stereotactic body radiation therapy (SBRT). Ablative image-guided thermal ablation (IGTA) techniques, such as radiofrequency ablation (RFA), microwave ablation, and cryoablation are additional alternatives for curative intent treatment. SABR or IGTA may be used for patients with advanced age and patients with cardiac disease or severe COPD who are unable to have surgery, which themselves do not preclude eligibility for screening. See also the NCCN Guidelines for Non-Small Cell Lung Cancer.
[l] Although randomized trial evidence supports screening up to age 77 years, there is uncertainty about the upper age limit to initiate or continue screening. One can consider screening beyond age 77 years as long as patient functional status and comorbidity allow consideration for curative intent therapy.
[m] Black and African American individuals with less cigarette smoking exposure have a similar risk for lung cancer as white individuals with more cigarette smoking exposure. This increased risk for Black/African Americans should be considered in shared decision-making and risk assessment. Aldrich M, et al. JAMA Oncol 2019;5:1318-1324.
[n] All screening and follow-up chest CT scans should use a CT dose index volume ($CTDI_{vol}$) threshold of 3 mGy or less for a patient of average size, unless evaluating mediastinal abnormalities or lymph nodes, where standard-dose CT with IV contrast might be appropriate (LCS-A). Parameters should be adjusted for patients of smaller or larger size. There should be a systematic process for appropriate follow-up. See ACR-STR Practice Parameter for the Performance and Reporting of Lung Cancer Screening Thoracic Computed Tomography (CT).
[1] Potter AL, Xu NN, Senthil P, et al. Pack-year smoking history: An inadequate and biased measure to determine lung cancer screening eligibility. J Clin Oncol 2024;42:2026-2037.

LCS-1A

Figure 2. LCS-1A. NCCN Clinical Practice Guidelines in Oncology for Lung Cancer Screening, Version 1.2025.

patients aged ≥84 years.[37–39] Although the NLST randomized trial confirmed the benefit of screening in patients aged ≤74 years, uncertainty exists regarding the appropriate duration of screening and age at which screening is no longer appropriate.[5,40,41] This is in part because fewer individuals who have been screened have been followed past their eighth decade of life; regardless, data support continued screening for individuals at high risk.[7,42,43] NCCN strongly supports shared decision-making between clinicians and patients to determine the upper age for screening cessation rather than an artificial age cutoff imposed by coverage policy.

Including All Individuals With a ≥20-Year History of Cigarette Smoking

A dose–response relationship exists between cigarette smoking and the risk of developing lung cancer; however, there is no risk-free level of cigarette exposure. The relative risk of lung cancer is approximately 20-fold higher for individuals who currently smoke than for those who never smoked.[44,45] Although cigarette smoking cessation decreases the risk of lung cancer (with a greater magnitude with each incremental year since quitting), individuals who quit smoking still have a higher risk of lung cancer compared with those who never smoked.[26–28,46,47] As a result, the panel considers a current or past history of cigarette smoking as a risk factor for developing lung cancer, irrespective of the magnitude of exposure and the time since smoking cessation (Figure 1).

For Version 1.2025 of these guidelines, individuals aged ≥50 years with a ≥20-year history of cigarette smoking (category 2B) have been added as a high-risk group for lung cancer. The panel contends that using a simpler variable of number of years smoked will be easier for primary care clinicians and their staff to collect and mitigate the challenge of calculating pack-years in individuals who have variable smoking intensity over their lifetime. Smoking duration more accurately captures individuals who are subsequently diagnosed with lung cancer, and decreases the racial disparities in lung cancer screening eligibility.[48] Across the board, use of a 20-year smoking duration in addition to a 20-pack-year cutoff will increase the proportion of patients with lung cancer who would qualify for screening. The panel believes that this would include individuals at high risk across white and Black populations equitably while capturing the "high-risk, high-burden" population. This would potentially eliminate the racial disparity in screening eligibility between Black versus white individuals. The panel notes that although electronic health records introduced a mandatory yes/no field for smoking history as part of the meaningful use criteria in 2014, the pack-years field is either not filled out or incomplete for the majority of patients.[49] Therefore, smoking duration (without pack-years) has the added benefit of being easier to calculate and being a more precise measure of smoking exposure. Some panel members noted that pack-year is a health care defining variable and there might not be sufficient evidence yet to adopt this change in clinical practice. The panel also notes that the study of smoking in years was performed using data from the Southern Community Cohort Study (SCCS) and the Black Women's Health Study (BWHS), both of which cannot be fully extrapolated to the rest of the US population and may simplify the criteria so much that it may lead to over-screening and

over-testing. For these reasons and based on discussion among the panel, the eligibility criteria of smoking history received a category 2B recommendation.

Individuals Not Eligible for Screening

Smoking exposure remains a critical element of risk assessment to determine a favorable risk/benefit ratio for screening. Individuals without a smoking history do not qualify for screening. Most of the general population does not have a high enough risk of lung cancer to justify the risks of screening. The NCCN Lung Cancer Screening Panel defines individuals at low risk for lung cancer as <50 years of age and/or with a smoking history of <20 pack-years or years duration. The NCCN panel, USPSTF, ACR, and ACS do not recommend lung cancer screening for these individuals based on the available nonrandomized studies and observational data.[9,50–52] The panel does not recommend lung cancer screening for those who do not have risk factors or are at low risk, because the chance of finding lung cancer is <1% and the risks from workup outweigh the benefits of screening.[53] The panel also suggests that individuals who are candidates for screening should not have any symptoms suggestive of lung cancer, such as cough, pain, or weight loss. Instead, these individuals should undergo an appropriate clinical diagnostic evaluation.

Individuals exposed to secondhand smoke have highly variable exposure to carcinogens, and there is inconsistent evidence for association of secondhand smoke with increased risk of lung cancer. Therefore, secondhand smoke is not an accurately quantifiable independent risk factor and on its own does not meet the criteria for recommending lung cancer screening. Good quantitative data for the "additional risk factors" are not available, so the panel recommends that instead the patient and their provider engage in shared decision-making for determining lung cancer risk and decisions to consider screening. The panel encourages individuals who think they have high-risk features to participate in clinical trials and/or researchers to find solutions that can include such individuals. Furthermore, the panel continues to keep a clear line between cancer surveillance and cancer screening for several reasons, including insurance coverage. Lung cancer surveillance continues indefinitely[54] and does not revert to screening, which is the primary reason why individuals treated for lung cancer are ineligible for lung cancer screening.

Lung cancer screening is not recommended for individuals who are not able or willing to undergo curative-intent therapy due to health problems or other major concerns.[10] Thus, the initial risk assessment should include functional status evaluation to determine whether patients can tolerate curative-intent treatment if they are found to have lung cancer. The NCCN panel's definition of curative-intent treatment includes surgery and stereotactic ablative radiotherapy (SABR), also known as stereotactic body radiation therapy (SBRT). Ablative image-guided thermal ablation (IGTA) techniques, such as radiofrequency ablation (RFA), microwave ablation, and cryoablation, are additional alternatives for curative-intent treatment (Figure 2). SABR or IGTA may be used for patients of advanced age or those with cardiac disease or severe chronic obstructive pulmonary disease (COPD) who are unable to undergo surgery, as these conditions do not, in themselves, preclude eligibility for screening.

Risks and Benefits of Screening

Effective lung cancer screening may prevent an estimated 48,000 lung cancer deaths per year in the United States, with up to 21% more deaths averted by removing the 15-YSQ criterion.[30,55] The potential benefits of lung cancer screening include a reduction in mortality and an improvement in quality of life.[5,7,23,55–57] Possible quality-of-life benefits from early lung cancer detection (as opposed to detection at the time of clinical symptoms) include: (1) reduction in disease-related morbidity; (2) reduction in treatment-related morbidity; (3) alterations in health that affect lifestyle; and (4) reduction in anxiety and psychological burden. The risks associated with lung cancer screening include false-negative and false-positive results, radiation exposure, overdiagnosis of incidental findings, futile detection of indolent disease, anxiety about test findings, unnecessary testing and procedures, physical complications from diagnostic workup, and financial costs.[57–63] The risks and benefits of lung cancer screening should be discussed with the individual before a screening LDCT scan, as is done for other screening tests.[23,64–66]

Shared Decision-Making

Shared decision-making between the patient and clinician is important before deciding whether to perform LDCT lung cancer screening, especially for patients with comorbid conditions.[10,23,67,68] Risk calculators can identify both patients who are at low risk and should not be screened, and individuals who are high risk and should be screened (Figure 2). The NCCN panel has added a caveat suggesting that providers consider using risk calculators for shared decision-making, because these tools may help identify additional candidates at high risk of lung cancer who could benefit from screening.[55,69–71] For example, the Tammemagi risk calculator includes additional variables that can help determine whether individuals are candidates for screening,[69] such as body mass index, history of COPD, highest attained education level, chest radiography within the last 3 years, and family history of lung cancer. Using this risk calculator, the threshold for screening is 1.34% to 1.51%.[69,71] Previous lung cancer screening results can also be used for risk stratification.[36,72] The Tammemagi risk calculator was used to assess 7,044 individuals in the PanCan study, and an increased incidence of early-stage lung cancer was observed when compared with the NLST (Tammemagi: 133/172 [77%] vs NLST: 593/1,040 [57%]; $P<.0001$).[69]

Summary and Conclusions

The Lung Cancer Screening Panel continues to emphasize removing the 15-YSQ exclusion and utilizing shared decision-making between individuals and their clinicians regarding screening, rather than relying on a defined upper age limit, which is still used by the USPSTF and CMS. Additionally, expanding the eligibility criteria for screening to include individuals with a ≥20-year smoking history, along with pack-years, may provide a simpler and more equitable way to assess the risk associated with smoking exposure.

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