Addressing Disparities in Lung Cancer Screening Eligibility and Healthcare Access
An Official American Thoracic Society Statement: Executive Summary

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Background: There are well-documented disparities in lung cancer outcomes across populations. Lung cancer screening (LCS) has the potential to reduce lung cancer mortality, but for this benefit to be realized by all high-risk groups, there must be careful attention to ensuring equitable access to this lifesaving preventive health measure.

Objectives: To outline current knowledge on disparities in eligibility criteria for, access to, and implementation of LCS, and to develop an official American Thoracic Society statement to propose strategies to optimize current screening guidelines and resource allocation for equitable LCS implementation and dissemination.

Methods: A multidisciplinary panel with expertise in LCS, implementation science, primary care, pulmonology, health behavior, smoking cessation, epidemiology, and disparities research was convened. Participants reviewed available literature on historical disparities in cancer screening and emerging evidence of disparities in LCS.

Results: Existing LCS guidelines do not consider racial, ethnic, socioeconomic, and sex-based differences in smoking behaviors or lung cancer risk. Multiple barriers, including access to screening and cost, further contribute to the inequities in implementation and dissemination of LCS.

Conclusions: This statement identifies the impact of LCS eligibility criteria on vulnerable populations who are at increased risk of lung cancer but do not meet eligibility criteria for screening, as well as multiple barriers that contribute to disparities in LCS implementation. Strategies to improve the selection and dissemination of LCS in vulnerable groups are described.

Keywords: lung cancer screening; disparities in lung cancer screening; barriers to lung cancer screening

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Overview

Disparities in lung cancer incidence, diagnosis, treatment, and mortality are well documented. There is concern that disparities in the implementation of and access to lung cancer screening (LCS) will further widen existing gaps in lung cancer care and mortality among racial and ethnic minorities, individuals of low socioeconomic status (SES), and uninsured or underinsured populations. We define a healthcare disparity in LCS as occurring when two people at equal lung cancer risk and who have an equal harm-to-benefit ratio from LCS are not managed equitably. Addressing disparities in eligibility, referral, healthcare access, and appropriate follow-up for LCS is critical to develop strategies by which they may be minimized.

This official American Thoracic Society (ATS) statement describes the extent to which high-risk populations currently not meeting eligibility criteria for LCS are disproportionately composed of minority and low-SES groups, identifies disparities in healthcare access to screening, and proposes strategies for improving equitable LCS implementation and dissemination.

Key Conclusions

General.

- In the United States, lung cancer incidence and mortality rates vary by race, ethnicity, sex, and SES.
- LCS saves lives, and the mortality-reduction benefit has been shown to be more favorable in African American individuals than in white individuals and is suggestive of being more favorable in women than in men.

Disparities in LCS.

- The 2013 U.S. Preventive Services Task Force (USPSTF) LCS guidelines do not consider racial, ethnic, SES, and sex-based differences in smoking behaviors or lung cancer risk and are not optimized to capture higher-risk patients.
- Shared decision-making (SDM) tools are not designed for low health literacy and numeracy or culturally diverse populations.
- Rural high-risk individuals who smoke have reduced access to the geographic availability of LCS centers.
- State-based variability in insurance coverage for LCS for Medicaid recipients marginalizes vulnerable patients, leading to widening of disparities.
- Barriers to LCS occur at multiple levels, including at the patient, provider, and healthcare-system levels and contribute to the inequities in implementation and dissemination of LCS.
  - Individuals who smoke tend to be less educated and less likely to have a primary care provider, reducing access to LCS.
  - Implicit bias and differences in trust and perception of providers based on sex, race, ethnicity, and SES negatively affect communication and patient–provider interactions.
  - Smoking carries a stigma; many who smoke have a high level of nihilism and lack awareness of LCS and benefits.
  - Patient distrust of the healthcare system and healthcare providers negatively impacts access to preventive care.
  - An inverse relationship exists between individuals at highest risk for lung cancer and access to accredited LCS programs.

- Lack of health insurance and geographic barriers to LCS facilities result in limited access to high-quality LCS services.

Proposed Strategies to Reduce Disparities in LCS

- Research scientists and healthcare providers should address existing multilevel barriers to LCS using a multipronged approach to reduce disparities.
- Healthcare institutions and organizations should propose quality metrics to evaluate equity in LCS dissemination and implementation.

Proposed Policies to Improve Access to LCS

- Engaging Advocacy Groups and Organizations

Strategies to Ensure Equity in LCS Based on Screening Individuals with Equal Risks

- Research scientists, healthcare providers, and professional organizations should consider an approach to LCS eligibility assessment that includes both USPSTF guidelines and risk-and/or life gained–based assessment for high-risk, high-benefit individuals, especially minorities and women, many of whom do not currently meet the 2013 USPSTF eligibility criteria.
Strategies to Improve Tobacco Treatment
- Healthcare providers and organizations should provide access to evidence-based tobacco treatment that includes behavioral counseling and should develop programs that address differences in cultural beliefs, language, and literacy.

Strategies to Address Healthcare-System, Provider, and Patient Barriers
- Healthcare institutions should integrate patient navigators within LCS programs to increase the uptake and adherence among vulnerable populations.
- Healthcare institutions should commit resources toward provider-level support and education to increase awareness and uptake of LCS.
- Healthcare institutions should provide training for providers on communication techniques in LCS SDM to build and improve patient trust.
- Research scientists and healthcare providers should develop and test SDM tools that are culturally sensitive and understandable by those with lower literacy and numeracy and by those of differing cultural backgrounds.
- Healthcare providers should involve mental health providers in LCS implementation to facilitate SDM discussions with individuals with severe mental illness eligible for LCS.

Strategies to Reach Vulnerable Populations
- Healthcare institutions, LCS programs, public health departments, and local and state governments should launch culturally adapted LCS marketing and outreach campaigns to reach vulnerable populations.

Strategies to Reduce Geographic Barriers
- Healthcare institutions and organizations should promote research to determine feasibility of mobile LCS units to reach populations confronting geographic barriers.

- Healthcare institutions should incorporate telehealth, in areas where resources are available, as a pragmatic approach to facilitate access to LCS services for rural populations and promote research into implementation of telehealth for LCS.

Proposed Policies to Improve Access to LCS
- Healthcare providers, institutions, and advocacy groups should mandate expansion of Medicaid coverage of LCS in all states.
- Healthcare providers, advocacy groups, and foundations should propose federal mandates similar to the 1990 Breast and Cervical Cancer Mortality Prevention Act and the Mammography Quality Standards Act that will ensure all high-risk adults have access to high-quality LCS for the detection of lung cancer in early, more treatable stages.

Engaging Advocacy Groups and Organizations
- Advocacy groups and organizations should leverage their resources to promote strategic planning, research funding, and advocacy to ensure equitable access to high-quality LCS in all populations.

Bold indicates proposed strategies selected by the majority of the committee as the most impactful.

Introduction
Lung cancer incidence and mortality in the United States vary by race, ethnicity, and sex (1–5). Prevention and early detection may reduce disparities in lung cancer outcomes, as LCS has been shown to result in a 20–24% reduction in lung cancer mortality and is recommended in high-risk individuals who smoke (6–8). However, current LCS eligibility guidelines do not consider racial, ethnic, socioeconomic, or sex-based differences in smoking patterns and lung cancer risk and may not optimally select high-risk populations (4, 9–11). We define a healthcare disparity in LCS as occurring when two people at equal lung cancer risk and who have an equal harm-to-benefit ratio from LCS are not managed equitably.

LCS uptake has been low (rates of 6–14%); varies by geography (12, 13), race, and income (14, 15); and reflects barriers at the patient, provider, and healthcare-system levels (16). Because the prevalence of current cigarette smoking is highest among individuals with low SES (17), variable state-level coverage for Medicaid recipients leaves vulnerable populations from groups that are socially, economically, demographically, or geographically defined at increased lung cancer risk without access to LCS (18). Inequitable eligibility in guidelines and multilevel barriers to implementation and dissemination of LCS may exacerbate existing lung cancer disparities.

We propose strategies to reduce disparities in LCS directed at vulnerable populations.

Methods
This ATS Thoracic Oncology Assembly project was approved by the ATS Program Review Subcommittee. A multidisciplinary panel of experts was assembled to address implications of eligibility criteria and barriers to LCS and to propose strategies to decrease disparities. Conflicts of interest were disclosed and managed according to ATS policies. The Chairs (M.P.R., M.C.A., and L.M.H.) developed an overview of current knowledge and existing knowledge gaps. An in-person meeting held on May 18, 2019, at the ATS International Conference in Dallas, Texas, consisted of presentations and breakout sessions related to three overarching themes: 1) disparities in LCS eligibility, 2) multilevel barriers to LCS, and 3) strategies to ensure equitable access to LCS. A comprehensive summary of the in-person meeting and proposed strategies to address disparities were developed by the Chairs, and the resulting manuscript was circulated to the writing committee (H.A.K., N.T.T., M.T., L.C.S., R.S.W., and L.C.-H.). Strategies selected by >70% of the panel as most impactful were identified. The manuscript was then disseminated to the entire panel for final revisions before ATS Board of Directors approval.
Results

Disparities in LCS Eligibility

Do current LCS eligibility criteria accurately identify individuals at similar risk of lung cancer in socially and economically disadvantaged populations? Although patient age, combined with smoking history, form the cornerstone of LCS eligibility criteria, lung cancer risk is complex and determined by multiple factors (Table 1) that are not considered by existing USPSTF guidelines (19). Risk modeling suggests that current USPSTF guidelines underselect vulnerable populations. (Table 2) (20) The 2020 USPSTF draft recommendation of reduced age and smoking history (21) applies to all high-risk individuals. However, it is not likely that the proposed revisions in eligibility criteria will eliminate racial and ethnic disparities in LCS. (Table 2)

Disparities by race and ethnicity. African American individuals exhibit a higher smoking-adjusted risk of lung cancer, despite smoking less than white individuals (3). One study demonstrated that lung cancer cases in African American individuals were less likely to be eligible under USPSTF LCS guidelines than lung cancer cases in white individuals (17% vs. 31%, respectively) because of fewer pack-years smoked (22). In contrast, the absolute reduction in deaths may be attenuated in Hispanic and Asian American individuals (23) because of a lower smoking-adjusted risk of lung cancer (3). Incidence rates of lung cancer are lower in Alaska Native and American Indian populations than in white populations, despite a higher prevalence of tobacco use (24, 25).

Disparities by sex. Lung cancer tends to be diagnosed in women at younger ages, and women start smoking at a later age and smoke less intensively than men (2, 26, 27). Although smoking prevalence is lower in women, the incidence rate of lung cancer in women is significantly higher than that of men, especially in white and Hispanic women, suggesting that sex differences in smoking behavior do not fully explain increased lung cancer rates in young women (4).

Disparities in special populations. HIV infection is an independent risk factor for lung cancer, the most common cause of malignancy-related death and a leading cause of mortality in PLHIV (28–32). Advanced-stage lung cancer is commonly diagnosed in PLHIV, making early detection critical (32); however, PLHIV were not included in the NLST (National Lung Screening Trial). Whether current guidelines are optimal for PLHIV, given their younger age at lung cancer presentation compared with HIV-uninfected individuals (50 vs. 54 yr, respectively), remains unclear (33–35).

Individuals with serious mental illness (SMI) also experience increased lung cancer risk because of higher smoking prevalence (36), are less likely to be recommended for cancer screening (37), and may require a tailored approach to decrease potential disparities in LCS.

Disparities based on smoking behaviors, intensity, and years since quitting. LCS guidelines do not accurately reflect lung cancer risk in individuals who smoke lightly and those who used to smoke heavily. In the United States, individuals who smoke with a history of 20–29 pack-years or individuals who used to smoke who have ≥15 years since quitting (YSQ) but averaged 45 pack-years of smoking (not recommended for screening) have risk similar to that of individuals who formerly smoked with a history of ≥30 pack-years and have had ≥15 YSQ (recommended for screening), all other risk factors being equal (10, 20). Moreover, these individuals who smoke lightly or those who used to smoke are overrepresented by women and racial and ethnic minorities (10, 20). Individuals who used to smoke heavily continue to have a substantially elevated lifetime risk for lung cancer (38). In the Framingham Heart Study, 40.8% of lung cancers in individuals who ever smoked occurred after more than 15 YSQ (39). Although smoking intensity is accounted for by pack-years in existing LCS guidelines, the relationship of smoking intensity and lung cancer risk is heterogeneous across subgroups, and the risk/benefit ratio for LCS across subgroups is unknown. Individuals who smoke at a lower intensity, often women and racial and ethnic minorities, are denied access to

Table 2. Projected Performance by Race and Ethnicity of USPSTF LCS Entry Criteria in the NHIS: U.S. Population Who Ever Smoked, Ages 50–80 Years

| Race and Ethnicity Percentages (NHIS 2015, N=44 Million) | Eligible (%) | Preventable Deaths (%) | Life-Years Gained (%) | NNS (Effectiveness) |
|----------------------------------------------------------|--------------|-------------------------|-----------------------|---------------------|
| 2013 USPSTF guidelines                                   |              |                         |                       |                     |
| White (80%)                                               | 20           | 55                      | 48                    | 195                 |
| African American (9.8%)                                  | 13           | 40                      | 33                    | 135                 |
| Asian American (2.8%)                                    | 14           | 39                      | 36                    | 419                 |
| Hispanic American (7.1%)                                 | 9            | 30                      | 25                    | 325                 |
| 2020 USPSTF draft guidelines                              |              |                         |                       |                     |
| White (80%)                                               | 36           | 67                      | 64                    | 282                 |
| African American (9.8%)                                  | 27           | 54                      | 48                    | 202                 |
| Asian American (2.8%)                                    | 22           | 48                      | 45                    | 550                 |
| Hispanic American (7.1%)                                 | 19           | 41                      | 37                    | 501                 |

Definition of abbreviations: LCS = lung cancer screening; NHIS = National Health Interview Survey; NNS = number needed to screen to prevent one death; USPSTF = U.S. Preventive Services Taskforce.

Based on data from Reference 20.

*Estimated number of individuals who ever smoked aged 50–80 years in the NHIS 2015 who meet 2013 or 2020 Draft USPSTF criteria for LCS.

Table 1. Lung Cancer Risk Factors

| Intrinsic factors                          | Extrinsic factors                        |
|--------------------------------------------|------------------------------------------|
| Genetic mutations                          | Exogenous risk factors                   |
| Female sex                                 | Tobacco smoke                            |
| Race and ethnicity                         | Occupational and environmental exposures  |
| Familial risk                              | Lifestyle and behavioral factors          |
|                                            | Socioeconomic status                     |
|                                            | Endogenous risk factors                  |
|                                            | DNA-repair capacity                      |
|                                            | Growth factors                           |
|                                            | Hormones (estrogen and progesterone)     |
|                                            | Aging                                    |
|                                            | Inflammation                             |
|                                            | HIV                                      |

Based on data from Reference 19.
LCS by current guidelines and deprived of access to incorporated tobacco treatment, further exacerbating disparities. Racial and ethnic minorities are less likely than white individuals to receive and use tobacco-cessation interventions, even after controlling for SES and healthcare factors (40).

Disparities in LCS Implementation

Multiple patient, provider, and healthcare system–level barriers (41) challenge the successful implementation and dissemination of LCS (Table 3), particularly among vulnerable populations, and may impact care across the lung cancer continuum.

Barriers to assessing smoking history and SDM. Accurately assessing smoking history is critical in determining current LCS eligibility; however, not only do disparities exist in who is asked about tobacco use (36, 42), but determining smoking history from electronic health records is also challenging for all populations (43).

Although SDM visits inclusive of decision aids are a component of LCS programs mandated by the U.S. Centers for Medicare and Medicaid Services (CMS) (44, 45), most available decision aids are written above the recommended sixth-grade reading level advised by the American Medical Association, are largely written for English speakers (46, 47), and may not be appropriate for populations with limited health literacy. Patients must understand numeracy concepts to make informed LCS decisions, yet many have a low understanding and are ill prepared to make medical decisions (48). Evaluation of Medicare recipients demonstrated that among enrollees undergoing low-dose computed tomography (LDCT) screening, only 10% had a documented SDM visit, with lower odds among black patients than among white patients (49). Furthermore, the quality of conversation for LCS currently being conducted by most physicians does not meet the criteria for SDM (50, 51). Individuals with SMI face additional SDM barriers because of difficulty with the abstract thinking needed to consider cancer risk (52).

Healthcare system– and provider-level barriers. LCS programs require substantial coordination of services for implementation (53) that may differ across populations (54, 55). A recent survey of 112 federally qualified health center (FQHC) medical directors found significant barriers to implementation under served populations (56). The brief length of physician visits also serves as a barrier (57). This is particularly true among individuals who smoke and those who used to smoke heavily who have other comorbidities that often take priority during the visit (50, 58). Limited time and resources can prevent providers from using decision aids and prevent effective SDM (59). Although clinician knowledge of LCS has improved, provider- and system-level barriers to LCS remains a significant concern (60). Implicit bias and differences in trust and perception of providers based on sex, race, ethnicity, and SES negatively affect communication and patient–provider interactions (61), further contributing to disparities in LCS implementation and dissemination.

Patient-level barriers. LCS is the first cancer screening test to base eligibility on a behavior. Individuals who smoke tend to be less educated, less likely to identify a usual source for health care, and less likely to want treatment for lung cancer than their never-smoking counterparts (62). Smoking carries a stigma and a perceived self-inflation of tobacco-related disease (41). Furthermore, patients fear a lung cancer diagnosis because of high mortality rates and believe there are few available treatments (62). Patient-level barriers to LCS include confusion about eligibility, smoking-related stigma, medical mistrust, and lack of awareness of LCS existence or of how it is performed (41, 63). Ambivalence about screening because of potential harms, nihilism, perceived low value, and knowledge avoidance are additional reasons for opting out of

Table 3. Barriers to LCS Dissemination and Implementation

| Eligibility assessment | • Screening guidelines do not account for racial, ethnic, sex, or socioeconomic differences in smoking behaviors or lung cancer risk  
| | • Guidelines may not be optimized for PLHIV  
| | • Screening varies by insurance status  
| | • Inaccurate tobacco pack-years history  
| | • Discordance between EHR smoking history and actual tobacco pack-years history preventing referral  
| SDM | • Shared decision aids may not be appropriate for populations with limited health literacy or SMI and may not be available in different languages  
| | • Individuals may not understand numeracy concepts for informed decision-making  
| Healthcare-system and provider level | • Multidisciplinary buy-in for implementation  
| | • Investment by health systems in additional resources (personnel, information technology, etc.)  
| | • Provider time constraints preventing SDM  
| | • Level of provider familiarity with LCS eligibility criteria and SDM requirements  
| | • Implicit bias and differences in trust and perception based on sex, race, ethnicity, and socioeconomic status  
| Patient level | • Individuals who smoke tend to be less educated and less likely to have a PCP, reducing access to LCS  
| | • Smoking carries a stigma, with many who smoke having a high level of nihilism  
| | • Cost and lack of health insurance  
| | • Travel to LCS facility  
| | • Medical mistrust  
| Geographic location | • An inverse relationship exists between individuals at highest risk for lung cancer and availability of accredited LCS programs  
| | • The southeastern United States has a disproportionately low number of accredited sites compared with the number of individuals who smoke and are at risk for lung cancer  

Definition of abbreviations: EHR = electronic health record; LCS = lung cancer screening; PCP = primary care provider; PLHIV = people living with HIV; SDM = shared decision-making; SMI = serious mental illness.
screening (64, 65). The workday hours during which LDCT screening is offered can be an additional barrier preventing those with nonflexible working schedules from undergoing screening (41).

Cost is a significant patient-level barrier to LCS. Although CMS covers LCS for eligible Medicare beneficiaries, LCS coverage by Medicaid is determined at the state level, and not all states provide this benefit. Because the prevalence of tobacco smoking is highest among low-SES individuals (17), lack of Medicaid coverage for LCS leaves a vulnerable portion of at-risk individuals without equitable access (16). Even among insured individuals, out-of-pocket costs associated with a positive finding are a notable barrier. Competing healthcare demands and costs may further put individuals in a position to prioritize other care needs (41).

**Geographic barriers to screening centers.** CMS reimbursement for LCS requires that patient data for those undergoing LDCT screening be reported to an accredited registry, currently the American College of Radiology (45). An inverse relationship between individuals at the utmost risk and availability of American College of Radiology–accredited screening centers exists (66–68). Although the number of designated LCS centers increased more than eightfold from 2014 to early 2017, there is geographic variability in access (67, 68). Rural residents are less likely than urban residents to have access to a center (68). The southeastern region of the United States is the poorest, has the highest smoking prevalence, and has highest lung cancer incidence, yet the availability of accredited LCS centers is suboptimal (67, 68).

**Proposed Strategies to Reduce LCS Disparities**

To ensure equitable access and use of LCS by those at highest risk for developing lung cancer who have the highest expected benefit, multilevel strategies are needed to target barriers at the patient, provider, healthcare-system, and community levels. Furthermore, organizations should invest in the development and deployment of health-equity performance measures to evaluate whether dissemination and implementation of LCS is equitable for all (69). Table 4 summarizes proposed strategies and recommendations to reduce LCS disparities.

- Research scientists and healthcare providers should address existing multilevel barriers to LCS using a multipronged approach to reduce disparities.
- Healthcare institutions and organizations should propose quality metrics to evaluate equity in LCS dissemination and implementation.

**Table 4. Proposed Strategies to Reduce LCS Disparities**

| Overall:                                                                                      |
|-----------------------------------------------------------------------------------------------|
| • Address existing multilevel barriers to LCS using a multipronged approach                     |
| • Propose quality metrics to evaluate equity in LCS dissemination and implementation             |
| 1. Strategies to ensure equity in LCS based on screening individuals with equal risk:             |
|   • Generate evidence on the benefits and risks of LCS in diverse populations                     |
|   • Consider an approach to LCS eligibility assessment that includes both USPSTF guidelines and risk- and/or life gained–based assessment for high-risk, high-benefit individuals |
| 2. Strategies to improve tobacco treatment:                                                      |
|   • Provide access to tobacco treatment and develop programs that address differences in cultural beliefs, language, and literacy |
| 3. Strategies to address healthcare system–level barriers:                                       |
|   • Integrate patient navigators within LCS programs to increase the uptake and adherence among vulnerable populations |
| 4. Strategies to address provider-level barriers:                                                  |
|   • Commit resources toward provider-level support and education to increase awareness and uptake of LCS |
|   • Offer provider-level training on communication techniques to build and improve patient trust |
| 5. Strategies to address patient-level barriers:                                                   |
|   • Develop SDM tools that are culturally sensitive and understandable by those with lower literacy and numeracy and those with SMI |
|   • Launch culturally adapted LCS marketing and outreach campaigns to reach vulnerable populations |
| 6. Strategies to reduce geographic barriers:                                                       |
|   • Determine feasibility of mobile LCS units to reach populations confronting geographic barriers |
|   • Consider telehealth as a pragmatic approach to provide access to LCS services for rural populations |
| 7. Proposed policies to improve LCS access:                                                        |
|   • Mandate expansion of Medicaid coverage for LCS                                               |
|   • Propose federal mandates similar to the 1990 Breast and Cervical Cancer Mortality Prevention Act and the Mammography Quality Standards Act to ensure that all high-risk adults have access to high-quality LCS for the detection of lung cancer in its earlier, most treatable stages |
| 8. Engage advocacy groups and organizations:                                                       |
|   • Advocacy groups and organizations should leverage their resources to promote strategic planning, research funding, and advocacy to ensure equitable access to high-quality LCS in all populations |

**Definition of abbreviations:** LCS = lung cancer screening; SDM = shared decision-making; SMI = serious mental illness; USPSTF = U.S. Preventive Services Taskforce.
Expanding LCS to healthy PLHIV. Rates of lung cancer are anticipated to rise in PLHIV over the next decade. Although a large-scale clinical trial of LCS in this population is not likely, a recent study using a modified simulation model in PLHIV with well-controlled disease projected that current USPSTF guidelines would reduce lung cancer mortality by 18.9% (70). Formal guidelines endorsing LCS in PLHIV, however, are lacking. Although screening at younger ages and with lower pack-years has the potential to detect a larger proportion of lung cancer cases among PLHIV (71), additional studies to prospectively evaluate the benefits and harms of screening at younger ages in healthy PLHIV are needed.

- Research scientists, healthcare providers, and professional organizations should generate evidence on the benefits and risks of LCS in diverse populations (including healthy PLHIV). These data are crucial for informing national and local recommendations on eligibility criteria for who should be screened.

Modifying smoking history and/or age eligibility criteria. Lung cancer is diagnosed in African Americans, women, and PLHIV at an earlier age than in white individuals, men, and non-HIV populations, and the former populations may thus benefit from a lower minimum age for eligibility (4, 34, 39, 72). Modifying smoking history (pack-years and YSQ criteria) may also benefit certain subgroups (22). Current LCS guidelines underselect women, who are more likely to smoke with low intensity or be former high-intensity smokers with ≥15 YSQ (20). Modifying the smoking history and/or age eligibility criteria for LCS, which the 2020 USPSTF draft recommendations propose, would increase the percentage of lung cancer cases eligible for screening; however, there is not sufficient evidence that this proposal alone will ensure equitable screening for all individuals who have an equal risk of lung cancer.

Assessing LCS eligibility on the basis of validated individualized risk calculators. Other LCS guidelines acknowledge that risk calculators identify individuals at high risk of dying of lung cancer who do not otherwise meet screening eligibility criteria (73) or recommend screening high-risk individuals as defined by a ≥1.3% calculated risk of lung cancer by using the 2012 modified Prostate, Lung, Colorectal, and Ovarian (PLCO_m2012) model (74, 75). Risk calculator–based screening rather than current eligibility guidelines could address risk-based disparities (76). However, because current risk models are based on few data from racially and ethnically diverse groups, they underestimate risk in these populations (74, 77, 78). Although existing risk models could greatly reduce LCS disparities induced by current USPSTF guidelines not specific to race and ethnicity (Table 2), additional improvements are needed. Finally, calculating risk does not obviate the need to assess whether a patient is sufficiently healthy to tolerate potential complications from either follow-up of LCS-detected nodules or lung cancer treatment (79).

Assessing LCS eligibility LCS on the basis of individualized life-years gained from screening. Risk-based strategies may select older individuals with comorbidities who may not live long even if their life is saved by screening and thus do not optimize life-years gained by a population (80). An alternative approach is selecting individuals who smoke for screening on the basis of their individualized life-years gained from screening (76). Drawbacks of the life-gained approach include the requirement to specify and assess the severity of multiple comorbidities that affect life expectancy, the potential reluctance of both patients and healthcare providers to discuss life expectancy, and the potential of patients and providers to forgo screening on the basis of this reluctance (81, 82).

Current understanding of the full potential of risk modeling is limited, and additional data and improvements to models are needed to inform future policy recommendations for screening. Perhaps a pragmatic approach to LCS would be based on both USPSTF guidelines and risk and/or life-gained for high-risk, high-benefit individuals who are not eligible according to the USPSTF but who have a ≥2.19% 6-year lung cancer risk according to the PLCO_m2012 model (75, 83), a ≥0.9% 5-year lung cancer death risk according to the Lung Cancer Death Risk Assessment Tool (20), or ≥16.2 days of life gained by the Life Years Gained From Screening–Computed Tomography model (76).

- Research scientists, healthcare providers, and professional organizations should consider an approach to LCS eligibility assessment that includes both USPSTF guidelines and risk- and/or life gained–based assessment for high-risk, high-benefit individuals, especially minorities and women, many of whom do not currently meet the 2013 USPSTF eligibility criteria.

Strategies to Improve Tobacco Treatment

Provide equitable access to and use of tobacco-cessation services. Ancillary analysis of NLST data demonstrated that 7 years of smoking abstinence was equally effective as LDCT screening in reducing lung cancer mortality by 20% and that abstinence combined with LCS led to an even greater mortality reduction (84). However, integration of tobacco cessation into LCS programs is variable, with no best practice or standardized approach (85). A research agenda to identify approaches and improved integration of smoking-cessation strategies in the LCS setting has recently been published by the ATS (86).

More broadly, equitable access to and coverage of tobacco-cessation treatment is needed to serve racial and ethnic minorities and vulnerable populations (87, 88). Although racial and ethnic minority groups are more likely than white individuals to attempt cessation, they are less likely to be advised to quit smoking and be offered behavioral counseling and pharmacotherapy, thus lowering their odds of success (89). Expanding insurance coverage, particularly Medicaid coverage, of tobacco treatments is one of the most important steps to increase cessation. (90) In addition, tobacco treatment interventions must be tailored to address cultural factors, language barriers, and reading level, as appropriate (90, 91).

- Healthcare providers and organizations should provide access to evidence-based tobacco treatment that includes behavioral counseling and should develop programs that address differences in cultural beliefs, language, and literacy.

Strategies to Address Barriers

At the healthcare-system level. Overcoming system-level barriers to provide high-quality LCS requires several critical factors. To implement and sustain high-quality LCS programs, institutional commitment is paramount, especially for FQHCs and other systems serving vulnerable populations. A collaborative and coordinated infrastructure is fundamental for optimizing LCS (44, 53).
Patient navigators, culturally and linguistically trained, can serve as outreach workers and have been shown to improve cancer screening rates and decrease disparities in cancer care (92–95). Furthermore, they can assist with healthcare insurance issues, transportation, and coordinating care (96), which may impact adherence to LCS in vulnerable populations. A recent study concluded that LCS program initiatives aimed at vulnerable populations that incorporate patient-navigator programs can improve LCS rates, improve adherence to follow-up, result in more rapid initiation of treatment, and improve quality of life (97).

- Healthcare institutions should integrate patient navigators within LCS programs to increase the uptake and adherence among vulnerable populations.

Program coordinators responsible for day-to-day administrative and operational LCS tasks can be integral in the success of LCS programs (98) by identifying existing care gaps and disparities and may increase screening adherence, particularly in vulnerable populations (98).

**At the provider level.** Given the disproportionate impact of smoking and lung cancer in rural areas, strategies that provide education directly to rural or FQHC primary care providers are needed, as providers are often unaware of recommended LCS guidelines (99). Providers need strategies to address potential implicit bias and stigma experienced by individuals who smoke (100). On the basis of successes in colorectal-cancer screening, the use of Action-Plan Toolkits may be beneficial (101, 102). Similar toolkits could be developed for LCS and be tailored to the needs of patient subgroups. Linking LCS with the CMS Merit-based Incentive Payments System could incentivize providers to offer LCS to patients (103).

- Healthcare institutions should commit resources toward provider-level support and education to increase awareness and uptake of LCS.
- Healthcare institutions should provide training for providers on communication techniques in LCS SDM to build and improve patient trust.

**At the patient level.** SDM discussions can be difficult to understand for individuals with low levels of educational attainment and health literacy and those with difficulty with abstract thinking (52). Furthermore, SDM materials for diverse populations, using culturally appropriate language, are scarce. Training providers to use appropriate tools to engage in SDM is critical. Options for improving SDM within LCS include patient and provider education (104), training program coordinators in SDM, and integrating mental health providers to conduct SDM with individuals with SMI in mental health clinics (105). Furthermore, conducting SDM during a telephone visit with a dedicated decision counselor allows more time for SDM (106). Although these strategies may be ideal for improving SDM within centralized LCS programs, more options for providers in busy clinical practices are needed. Individuals from underserved backgrounds report that decision aids are helpful for understanding the risks and benefits of LCS and demonstrate improved LCS knowledge after viewing decision aids (107, 108). Provider-facing tools are emerging to assist in better assessing when the decision to undergo LCS is more preference sensitive and where to simplify the SDM conversation (109).

Interventions that include educational efforts, addressing patient mistrust, and improving access by addressing financial and social structures are essential to increase patient knowledge and awareness of LCS, particularly in high-risk vulnerable populations. Tailored interventions are more effective than nontailored interventions in improving knowledge, addressing health beliefs, and promoting changes toward positive health behaviors, such as undergoing cancer screening among high-risk vulnerable populations (110–113). Interventions tailored to the individual offer the opportunity to highlight information that is most meaningful to the patient, increasing the likelihood of patient engagement, follow-through, and adherence to LCS.

- Research scientists and healthcare providers should develop and test SDM tools that are culturally sensitive and understandable by those with lower literacy and numeracy and by those of differing cultural backgrounds.
- Healthcare providers should involve mental health providers in LCS implementation to facilitate SDM discussions with individuals with SMI who are eligible for LCS.

**Using mass, small, and social media to reach vulnerable populations.** The Community Preventive Services Task Force recommends small-media interventions such as videos and printed materials to increase screening for breast, cervical, and colorectal cancers (114). Small-media interventions may have similarly effective results in LCS. For example, sending simple letters and pamphlets inviting individuals from low-income communities to undergo LCS resulted in high rates of uptake (115). The use of social-media campaigns to promote LCS awareness among patients and providers has been correlated with increased online access to educational content regarding LCS and a higher volume of scheduled LDCT examinations (116). Directly disseminating knowledge and information about LCS to vulnerable communities through a multifaceted, focused, and culturally sensitive messaging campaign raised LCS awareness and resulted in significant LCS uptake (113, 117). Coordinated marketing of LCS with other established screening protocols, such as mammography, could improve uptake within healthcare systems.

- Healthcare institutions, LCS programs, public health departments, and local and state governments should launch culturally adapted LCS marketing and outreach campaigns to reach vulnerable populations.

**Strategies to Reduce Geographic Barriers**

**Bringing LCS into the community.** Individuals from underserved communities are often underresourced in ways that pose barriers, such as transportation challenges (118). Mobile screening units are one strategy that has shown efficacy in delivering LCS to individuals who smoke in areas with poor access (119). Mobile screening units can provide key components of screening, including smoking cessation and SDM (119). In addition, images are transmitted for centralized interpretation, nodule management, and protocolized follow-up care by a multidisciplinary team (119). Although results indicate this strategy can reach underserved populations, feasibility for broad expansion has not been evaluated.

- Healthcare institutions and organizations should promote research to determine the feasibility of mobile LCS units to
reach populations confronting geographic barriers. As 60 million people (19%) live in rural areas of the United States (120) and patterns of poverty (121) and higher mortality rates from lung cancer overlay these rural areas (122, 123), telehealth is emerging as an accepted pragmatic approach to providing access to quality health services to these populations (124). A hub-and-spoke model of live audio-video conferencing and telehealth modalities offers promise as a way to support less-resourced communities. Telehealth includes centralized high-quality SDM through a dedicated visit with a qualified provider that eases local primary-provider workloads (106). It also allows LDCT scans performed locally to be remotely interpreted by qualified radiologists, maintaining consistency in reading and certification.

- Healthcare institutions should incorporate telehealth, in areas where resources are available, as a pragmatic approach to facilitate access to LCS services for rural populations and should promote research into implementation of telehealth for LCS.

**Proposed Policies to Improve Access to LCS**

Equitable implementation of LCS requires coordinated efforts from policy leaders, professional societies, advocacy groups, healthcare providers, and researchers. National-level discussions of LCS among lawmakers capable of submitting and passing healthcare legislation focused on revising insurance-coverage policies will be needed.

**Medicaid coverage by state.** Medicaid beneficiaries are disproportionately at risk for lung cancer, as evidenced by their higher smoking prevalence compared with individuals covered by private insurance (26% vs. 11%) (17). Despite this striking disparity, as of January 2019, LCS was not covered by Medicaid in 12 states and no information on coverage was available for 7. Among the 31 states with LCS coverage, Medicaid programs varied in eligibility criteria and requirements for prior authorization and copayments (18). States that expanded Medicaid witnessed a decline in uninsured rates among patients with newly diagnosed cancer and an increase in the percentage of early-stage cancers (125).

- Healthcare providers, institutions, and advocacy groups should mandate expansion of Medicaid coverage of LCS in all states.

**Allocation of resources and quality assurance.** Several programs support cancer screening among uninsured and low-income groups. The Breast and Cervical Cancer Prevention Act (126) led to the development of the National Breast and Cervical Cancer Early Detection Program to help low-income, uninsured, or underinsured women gain access to timely breast- and cervical-cancer screening (127). Currently, the National Breast and Cervical Cancer Early Detection Program funds all 50 states, 6 U.S. territories, and 13 Native American tribes or tribal organizations (128). The federal Mammography Quality Standards Act requires minimum standards that ensure all women have access to quality mammography services (129). Likewise, the Colorectal Cancer Control Program funds states to implement evidence-based interventions aimed at increasing screening rates by providing services to uninsured or underinsured adults aged 50–64 years (130).

- Healthcare providers, advocacy groups, and foundations should propose federal mandates similar to the 1990 Breast and Cervical Cancer Mortality Prevention Act and the Mammography Quality Standards Act that will ensure all high-risk adults have access to high-quality LCS for the detection of lung cancer in early, more treatable stages.

**Engaging Advocacy Groups and Organizations**

Advocacy groups help patients navigate lung cancer care, increase awareness, advocate for research funding, and could leverage their resources to ensure equitable access to high-quality LCS (131–133). The American Lung Association and the American Cancer Society advocate for resources and policies for the fight against lung cancer at federal, state, and local levels (134, 135), and the National Lung Cancer Roundtable coordinates collective leadership, strategic planning, and advocacy among member organizations (136). They are poised to address disparities in LCS and promote opportunities for research and program development to improve LCS implementation and dissemination to vulnerable populations.

- Advocacy groups and organizations should leverage their resources to promote strategic planning, research funding, and advocacy to ensure equitable access to high-quality LCS in all populations.

**Conclusions**

Socially and economically disadvantaged populations are among the most vulnerable and are at risk for poor lung cancer outcomes. Significant disparities across the continuum of LCS implementation threaten to worsen disparities in lung cancer. Dedicated efforts are needed to monitor LCS disparities and to respond and develop actionable plans to implement strategies addressing existing multilevel barriers. Addressing inequities in LCS is important not only for social justice and fundamental human rights but also for the improvement of the overall health of the U.S. population and for the reduction of healthcare costs. Because LCS is a fairly new preventive service, quality metrics and ongoing research will be needed to ensure that dissemination and implementation minimize disparity gaps and positively impact health outcomes in all patients.

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