

AMERICAN THORACIC SOCIETY DOCUMENTS

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

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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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<p>Introduction</p> <p>Methods</p> <p>Results</p> <p>Disparities in LCS Eligibility</p> <p>Disparities in LCS Implementation</p> <p>Proposed Strategies to Reduce LCS Disparities</p>	<p>Strategies to Ensure Equity in LCS Based on Screening Individuals with Equal Risks</p> <p>Strategies to Improve and Provide Tobacco Treatment</p> <p>Strategies to Address Barriers</p>	<p>Strategies to Reduce Geographic Barriers</p> <p>Proposed Policies to Improve Access to LCS</p> <p>Engaging Advocacy Groups and Organizations</p> <p>Conclusions</p>
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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. It is critical that we address disparities in eligibility, referral, healthcare access, and appropriate follow-up for LCS and propose 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 (PCP), reducing access to LCS.
 - Implicit bias based on sex, race, and ethnicity, and the perception of providers negatively affects 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.**

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

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

Using Mass, Small, and Social Media 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 denotes proposed strategies selected by the majority of the committee as the most impactful.

Introduction

Lung cancer is the leading cause of cancer death in the United States, and incidence and mortality rates vary by race, ethnicity, and sex. African American and Native Hawaiian individuals have the highest incidence, and white individuals have midlevel incidence, whereas Hispanic and Asian individuals have the lowest rates (1, 2). These differences in incidence are more evident by sex at low levels of smoking exposure and at younger ages (3, 4). Although the national decline in the incidence of lung cancer among men has been greater than that among women, in the 40- to 44-year-old age group, the female-to-male incidence rate ratio of lung cancer increased from 0.82 in the 1995–1999 period to 1.13 in the 2010–2014 period. The crossover in rates to higher incidence rates in younger women occurred in birth cohorts born after 1965 and was limited to white and Hispanic individuals; among white individuals, the rate rose from 0.88 in the 1995–1999 period to 1.17 in the 2010–2014 period, and among Hispanic

women, who smoke less than young Hispanic men (4), the rate rose, more notably, from 0.79 to 1.22. African American men have the highest lung cancer mortality of all groups, and lung cancer is the leading cause of mortality in Hispanic men and the second leading cause of cancer mortality in Hispanic women (1, 2, 5). Socioeconomic and racial disparities account for approximately 37% of premature cancer deaths in the United States and are a major public health concern (6). The largest socioeconomic disparity is reported for lung cancer with mortality rates five times higher in the least educated men than in the most educated men (6).

Disparities in health occur when there is an absence of health equity. Healthy People 2020 defines *health disparity* as “a particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage” (7). Disparities can occur across demographics, sex/gender identity/sexuality, race/ethnicity, SES, geography, and disability and can be compounded by intersectionality (8). A *healthcare disparity* refers to “differences between groups in health insurance coverage, access to and use of care, and quality of care [and] cannot be explained by variations in health needs, patient preferences, or treatment recommendations” (9). The World Health Organization defines equity as “the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically” (10). 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. Vulnerable populations from groups that are socially, economically, demographically, or geographically defined may need additional care or support to achieve health equity in LCS (11, 12).

A promising way to reduce disparities in lung cancer outcomes is to improve prevention and early detection. The NLST (National Lung Screening Trial) demonstrated that LCS with an annual low-dose computed tomography (LDCT) examination resulted in a 20% relative reduction in lung cancer mortality in high-risk individuals who smoke (13). In 2013, the USPSTF recommended annual LDCT

screening in individuals who currently smoke or formerly smoked (quit within the last 15 yr) aged 55–80 years with at least 30 pack-years of smoking history (14). The value of LCS has been reinforced further by findings from the NELSON (Dutch–Belgian Lung Cancer Screening) trial, which observed 24% fewer lung cancer deaths at 10 years of follow-up among individuals who smoke and those who used to smoke invited to undergo LDCT screening than among those in a group who received usual care (15). Secondary analyses of the NLST data show that African American individuals are more likely to benefit from LCS in terms of mortality reduction (hazard ratio, 0.61 in African American individuals vs. 0.86 in white individuals) (16). In addition, the reduction in lung cancer mortality after LCS is suggestive of being more favorable in women than in men (13, 17). Although smoking prevention and cessation are the most effective interventions in reducing lung cancer incidence and mortality (18), the implementation and dissemination of high-quality LCS is poised to have a significant effect on reducing lung cancer deaths. However, current USPSTF guidelines do not take into account racial, ethnic, socioeconomic, or sex-based differences in smoking patterns and lung cancer risk and may not optimally select high-risk populations such as underrepresented minorities, PLHIV, or women who have increased lung cancer risk but a lower-intensity smoking history than men (4, 19–21). A recent study used prediction models to simulate lifetime lung cancer risk and evaluated screening eligibility by USPSTF guidelines and by risk-based criteria (1.3–2.5% risk threshold) for younger (50–54 yr) and older (71–80 yr) individuals (22). About 5.4% of younger individuals who were eligible for screening by risk-based criteria were not eligible by USPSTF guidelines. In the older age group, 10.4% were ineligible for screening by guidelines. African American individuals in both age groups were more likely to be ineligible for screening by guideline criteria than white individuals (22). In July 2020, immediately before resubmitting our revised manuscript to ATS, the USPSTF released a draft recommendation statement lowering the initial age to begin screening from 55 to 50 years and lowering the smoking history from 30 pack-years to 20 pack-years (23). Although the revised

recommendations are likely to capture more eligible high-risk individuals, the disparity issues we discuss in this ATS statement remain relevant.

LCS has been underused nationally, with recent evidence indicating that few eligible individuals who smoke are being screened and indicating marked variations in rates of LCS based on race, income, and geographic location (24–27). A recent study at a safety-net institution reported an overall estimated screening rate of 16%; eligible unscreened individuals were more likely to be African American and of lower annual household income (27). Low screening rates reflect multiple barriers at the patient, provider, and healthcare-system levels (28). Although LCS is covered by private insurance and Medicare, LCS coverage by Medicaid is determined at the state level, with wide variation in coverage (29), and Medicaid programs are one of the only healthcare payer programs not required to cover LCS (29). Because the prevalence of current cigarette smoking is highest among individuals with low SES (30), the lack of coverage for Medicaid recipients in many states leaves a vulnerable portion of the population at increased risk for lung cancer without equitable access to LCS opportunities. Furthermore, racial and ethnic minorities are more likely to be uninsured (31). There is concern that inequitable eligibility guidelines and multilevel barriers to implementation of and access to LCS may exacerbate disparities in lung cancer outcomes. Herein, we expand our prior work (12) and propose strategies to reduce disparities in LCS dissemination and implementation with sufficient evidence and directed at vulnerable populations.

Methods

This ATS Thoracic Oncology Assembly project was approved by the ATS Program Review Subcommittee. A multidisciplinary panel of experts in LCS, implementation science, primary care, pulmonology, health behavior, smoking cessation, epidemiology, and disparity research was assembled to address implications of LCS eligibility criteria and barriers to LCS implementation and dissemination and propose strategies to decrease disparities in LCS. Conflicts of interest were disclosed and managed according to ATS policies and procedures.

At the initiation of the project, the Chairs (M.P.R., M.C.A., and L.M.H.) developed an overview of current knowledge and existing knowledge gaps in LCS eligibility. The major themes were further defined during a premeeting conference call with select members of the committee. An in-person meeting held on May 18, 2019, at the Annual ATS International Conference in Dallas, Texas, consisted of presentations and breakout sessions to expand discussions 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 was compiled by the Chairs and used to develop the background information on the first two overarching themes. The Chairs and the writing committee (H.A.K., N.T.T., M.T., L.C.S., R.S.W., and L.C.-H.) refined the manuscript. Proposed strategies to address the many facets of LCS disparities were developed by the Chairs and modified in conjunction with the writing committee through a series of conference calls. The manuscript was then disseminated to the entire committee for input, and revisions were made according to provided feedback. Each member of the committee was asked to identify the most impactful strategies. The strategies selected by >70% of the committee members are identified in the OVERVIEW section. The manuscript was disseminated to the entire panel for final revisions before final approval by the ATS Board of Directors.

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 intrinsic and extrinsic factors (Table 1) (32). The existing USPSTF LCS guidelines do not consider racial, ethnic, SES, and sex-based differences in smoking behaviors or lung cancer risk (3, 33, 34), and risk modeling suggests the current guidelines underselect populations such as African Americans, women, and those with low SES (Table 2) (35). The 2020 USPSTF

Table 1. Lung Cancer Risk Factors

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

Based on data from Reference 32.

draft recommendation of reduced age and smoking history (23) apply to all high-risk individuals, including white individuals and minorities, and will result in an increase in the total number of individuals eligible for screening. 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.

Racial and ethnic differences in lung cancer risk that are not accounted for in current eligibility criteria for LCS are striking. African American individuals exhibit higher smoking-adjusted risk of cancer, despite

smoking less than white individuals (3). Recent data from a large cohort study demonstrated that lung cancer cases in African American individuals were less likely to be eligible under USPSTF screening guidelines than lung cancer cases in white individuals (17% vs. 31%, respectively), primarily because of fewer pack-years smoked (36). In contrast, Hispanic and Asian American individuals have a lower smoking-adjusted risk of lung cancer (3), and thus the absolute reduction in deaths may be attenuated for these populations (37). Disparities related to LCS eligibility in Alaska Native and American Indian groups are largely unknown. Overall incidence rates of lung cancer are lower in Alaska Native and American Indian populations than in non-Hispanic white populations, despite an overall higher prevalence of tobacco use at 38.9% (38, 39). The unique impact of ceremonial tobacco is difficult to assess, given limitations in current data.

Disparities by sex. Screening eligibility also does not account for sex-based differences in lung cancer risk. Lung cancer tends to be diagnosed in women at younger ages than in men, and women start smoking at a later age and smoke less intensively than men (2, 40, 41). A recent study reported that although smoking prevalence was lower in women born after 1965, the incidence rate of lung cancer was significantly higher than in 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 (approximately 1.4- to 1.7-fold greater hazard or incidence rate ratios), which is the most common cause of malignancy-related death in PLHIV and a leading cause of mortality (42–46). Some studies suggest that advanced-stage lung cancer is commonly diagnosed in PLHIV, making early detection via screening of critical importance (46); however, PLHIV were not included in the NLST. It remains unclear whether current guidelines are optimal for PLHIV, given the average younger age at presentation of lung cancer in these individuals compared with HIV-uninfected individuals (50 vs. 54 yr, respectively) (47–49).

Other groups, such as individuals with serious mental illness (SMI), also experience increased risk of lung cancer because of higher smoking prevalence (50), are less likely to be recommended for cancer screening (51), suffer a higher risk of dying of lung cancer (52), and may similarly require a tailored approach to decrease potential disparities in LCS.

Disparities based on smoking behaviors, intensity and years since quitting. Current LCS guidelines do not accurately reflect underlying 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 and have had 15 or more years since quitting (YSQ) but averaged 45 pack-years of smoking (currently not recommended for screening) have risk similar to that of individuals who used to smoke who have a history of ≥30 pack-years and have had ≤15 YSQ (recommended for screening), all other risk factors being equal (20, 35). Moreover, these individuals who currently smoke lightly or those who used to smoke are overrepresented by women and racial and ethnic minorities (20, 35). Among individuals who used to smoke, lung cancer risk does not decrease to the level of individuals who have never smoked, and those who used to smoke heavily continue to have a substantially elevated lifetime risk for lung cancer (53). In the Framingham Heart Study, 40.8% of lung cancers in individuals who ever smoked occurred after

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 35.

*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.

more than 15 YSQ, and current LCS guidelines thus do not capture a significant portion of individuals who used to smoke who are at risk for lung cancer (54). In a retrospective study from 2005 to 2011, the proportion of patients with lung cancer who smoked ≥ 30 pack-years declined over time, whereas the proportion of individuals who used to smoke and who had quit smoking ≥ 15 years before a lung cancer diagnosis increased. The relative proportion of patients meeting USPSTF criteria for LCS decreased from 56.8% in 1990 to 43.3% in 2011 ($P < 0.001$) because of changes in smoking behaviors. When stratified by sex, a more notable decline in those meeting LCS eligibility criteria was found in women (52.3–36.6% [$P = 0.005$]) compared with men (60–49.7% [$P = 0.3$]) (55). 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 of the population, and the risk/benefit ratio for LCS across subgroups is unknown. Despite having a higher risk of lung cancer, not only are these individuals who smoke at lower intensity, who are often women and racial and ethnic minorities, denied access to LCS by current guidelines, but they are also deprived access to tobacco treatment programs incorporated into LCS programs, further exacerbating disparities. Minorities are less likely than white individuals to receive and use tobacco-cessation interventions, even after controlling for SES and healthcare factors (56). Thus, barriers to receipt of LCS and tobacco cessation may lead to downstream disparities in smoking quit attempts and lung cancer outcomes. An additional factor that may limit the benefits of LCS in minorities are well-documented disparities in lung cancer treatment (i.e., for screening to be beneficial, those with diagnosed lung cancer should undergo appropriate therapy for lung cancer).

Disparities in LCS Implementation

What are the barriers in the LCS continuum that contribute to disparities in LCS implementation? Multiple barriers at the patient, provider, and healthcare-system level (57) challenge the successful implementation and dissemination of LCS in the United States. (Table 3) This is particularly true among high-risk vulnerable populations, including racial and ethnic minorities, individuals with low SES

and/or who are living in rural areas, and PLHIV. Disparities in LCS implementation and access will increase existing disparities in lung cancer outcomes and will require critical attention at multiple intervention points for improved uptake.

Barriers to assessing smoking history and SDM. An accurate assessment of smoking history is a key factor in determining current LCS eligibility. Not only do disparities exist in tobacco screening (Hispanic individuals, Medicaid recipients, and individuals with SMI are less likely to be asked if they smoke) (50, 58), but determining smoking history from electronic health records is also challenging for all populations (59). Inaccuracies in reporting or incomplete documentation of

smoking histories can prevent eligible individuals who have access to care from being referred for LCS.

Although SDM visits inclusive of decision aids are considered a component of highly effective LCS programs and are mandated by the U.S. Centers for Medicare and Medicaid Services (CMS) (60, 61), currently available decision aids may not be appropriate for populations with limited health literacy. Most patient-facing websites with information about LCS are written above the recommended sixth-grade reading level advised by the American Medical Association and are largely written for English speakers (62, 63). To ensure informed LCS decisions that are consistent with the patient’s preference, it is crucial

Table 3. Barriers to LCS Dissemination and Implementation

Eligibility assessment	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

that patients understand numeracy concepts for informed decision-making. Yet many patients have a low understanding of numeracy and are ill prepared to make these medical decisions (64). Evaluation of Medicare recipients in 2015 and 2016 demonstrated that among enrollees undergoing LDCT screening, a mere 10% had a documented SDM visit, with lower odds among black versus white race (odds ratio, 0.76; 95% confidence interval, 0.59–0.97) (65). Furthermore, the quality of conversation for LCS currently being conducted by most providers does not meet criteria for SDM, with one study finding that none of the conversations met the minimum skill criteria for SDM (66, 67). On average these conversations lasted less than a minute and did not incorporate decision aids (67). Individuals with SMI face additional barriers to effective SDM because of difficulty with abstract thinking to consider cancer risk (68).

Healthcare system- and provider-level barriers. LCS programs require substantial capacity and coordination of services for implementation (69). In addition to personnel, management of the screening population requires technology infrastructure and alignment of resources, such as scheduling of appointments for scans, tracking scan results, and follow-up of repeat scans at different intervals that may differ across patients (70, 71). Some of the most vulnerable populations include patients who receive care at federally qualified health centers (FQHCs), which serve the nations' poor. A recent survey of 112 FQHC medical directors found significant barriers to implementation, including limited resources, adding further challenges to screening adoption among underserved populations (72).

The brief length of primary care visits also serves as a barrier to screening (73). This is particularly true among individuals who smoke and those who used to smoke heavily who have other significant comorbidities that often take priority during the primary care visit (66, 74). Furthermore, limited PCP time and resources can prevent providers from using decision aids that can be time consuming to administer, therefore preventing them from conducting effective SDM (75). Although clinician knowledge of LCS and initiation and ordering of LDCT scans improved from 2015 to 2018, provider- and system-level barriers to LCS, including cost-effectiveness and time restrictions during clinic visits, remained a significant concern

(76). In addition, implicit bias differences in trust and perception of providers based on sex, race, ethnicity, and SES negatively affect communication and patient-provider interactions (77), further contributing to disparities in LCS implementation and dissemination.

Patient-level barriers. Unlike eligibility for other cancer screenings based on age plus/minus a family history of cancer, LCS is the first to determine eligibility based on 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 compared with never-smoking counterparts (78). Smoking carries with it a stigma and a perceived self-infliction of tobacco-related disease (57). Furthermore, patients fear getting a lung cancer diagnosis because of the high mortality rates and believe there are no or few available treatments (78).

Studies have identified patient-level facilitators and barriers to LCS (79). Barriers include confusion about the risk factors for screening eligibility, lack of awareness of LCS and benefits, experience with smoking-related stigma, distrust of the healthcare system (comparing “new mechanisms to screen” to a “scam”), and nihilism (57, 80). Individuals may also be ambivalent about screening because of potential harms such as false-positive results, incidental findings, and radiation exposure (81). Perceived low value, practical barriers, knowledge avoidance, and misunderstanding regarding cost are additional reasons for opting out of screening for patients (81, 82). Time constraints can be an additional barrier for patients because LDCT scans are frequently performed during normal workday hours, preventing those with nonflexible working hours from undergoing a screening scan (57).

Perhaps one of the greatest patient-level barriers to screening is cost. In February 2015, the CMS began covering annual LCS for Medicare beneficiaries who meet the USPSTF eligibility criteria. However, 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 (30), the lack of LCS coverage for Medicaid recipients leaves a vulnerable portion of the at-risk population without equitable access to screening (28). Even among insured individuals, out-of-pocket costs associated with a positive finding on a LDCT scan are

a notable barrier to LCS. Competing healthcare demands and costs may further put individuals in a position to prioritize other care needs that are perceived as requiring more immediate attention (57).

Geographic barriers to screening centers. CMS reimbursement for LCS requires that patient data for those undergoing LDCT screening be reported to an accredited registry, with the American College of Radiology hosting the only currently accredited registry (61). Recent analyses have highlighted the inverse relationship between individuals at the utmost risk and availability of American College of Radiology-accredited screening centers (83–85). Although the number of designated LCS centers increased by more than eight times from 2014 to early 2017, variability in their geographic distribution has been reported, particularly between urban and rural areas (84, 85). Rural residents were less likely than urban residents to have access to a center within 30 miles or a 30-minute drive. Across all states, approximately 15% and 28% of adults did not have access to a designated LCS center within 30 miles or a 30-minute drive, respectively, with greater proportions in rural areas (85). The southeastern region of the United States is the poorest region, has the highest smoking prevalence, and has the highest lung cancer incidence, yet the availability of accredited LCS centers is suboptimal (84, 85). With the geographic concentration of both African Americans and individuals of low SES living in the South, underrepresented minorities and uninsured or underinsured populations are left with limited access to high-quality LCS services.

Proposed Strategies to Reduce LCS Disparities

If lung cancer risk and the expected benefit are the basis for LCS, then to achieve equity in screening, equitable management is inherently fair to everyone at risk for developing lung cancer. To ensure equitable access and use of LCS by those at highest risk for developing lung cancer who are likely to benefit from screening, multilevel strategies (outreach, education, telehealth, and patient navigators deployed simultaneously) are needed to target barriers at the patient, provider, healthcare-system and community level. Furthermore, organizations should invest in the development and deployment of health-equity performance measures to evaluate whether dissemination and implementation of LCS are equitable for all (86).

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.**

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

The benefits and harms of the strategies discussed below warrant additional investigation with regard to the number needed to screen, the false-positive results per screening-prevented lung cancer death, and mortality reductions.

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 in this population by 18.9% (87). Formal guidelines endorsing LCS in PLHIV, however, are lacking. Although screening at younger ages and in those with lower pack-years of smoking has the potential to detect a larger proportion of lung cancer cases among PLHIV (88), additional studies to prospectively evaluate the benefits and harms of screening at younger ages in healthy PLHIV are needed. Furthermore, whether screening should be stopped at younger ages in PLHIV who have decreased life expectancy compared with healthy HIV-uninfected persons also remains an open question when considering the overall balance of benefits and harms in developing tailored guidelines (88).

- **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 American individuals, women, and PLHIV at an earlier age than

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 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.

white individuals, men, and non-HIV populations, and the former populations may thus benefit from a lower minimum age for eligibility (4, 48, 54, 55). Decreasing the eligibility criteria for smoking pack-years to a minimum of 20 pack-years has been shown to increase the percentage of African Americans who smoke who would be eligible for LCS (36). Further reducing the eligible age to 50 years for African Americans in addition to allowing a minimum history of 20 pack-years resulted in a similar eligibility percentage between African American individuals and white individuals in whom lung cancer was diagnosed (36). Current USPSTF LCS

guidelines underselect women, who are more likely to smoke with low intensity or be former high-intensity smokers with ≥ 15 YSQ (35). 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 equal risk of lung cancer.

Assessing LCS eligibility on the basis of validated individualized risk calculators. The American College of Chest Physicians LCS guidelines (89) acknowledge that risk

calculators identify individuals at high risk of dying of lung cancer who do not otherwise meet screening eligibility criteria and suggest that screening may be considered on a case-by-case basis among such individuals. National Comprehensive Cancer Network guidelines (90) recommend screening high-risk individuals who meet USPSTF guidelines (up to age 77 yr) and younger (≥ 50 yr) individuals who have ever smoked (≥ 20 pack-years) with an additional risk factor (other than secondhand smoke) that increases the risk of lung cancer to $\geq 1.3\%$ using the 2012 modified Prostate, Lung, Colorectal, and Ovarian (PLCO_{M2012}) model (91). Because the effectiveness of screening depends on a person's lung cancer risk (37), all modeling studies have supported risk-based screening as an efficient alternative to current USPSTF and CMS criteria to prevent more lung cancer deaths by increasing identification of higher-risk individuals (35, 37, 91).

Risk calculator–based screening rather than current categorical eligibility guidelines could address risk-based disparities by ensuring equitable screening eligibility of all individuals who have equal risk of lung cancer (92), including African Americans; individuals who smoke with low intensity (less than half a pack/d), who are more likely to be women and African Americans; and individuals who used to smoke with high intensity but have ≥ 15 YSQ (35). That is, for choosing any fixed number of people with equal risk of lung cancer and benefit from LCS, risk-based screening will optimize the effectiveness and efficiency of screening.

Although use of risk models could greatly reduce LCS disparities induced by current USPSTF guidelines that are not specific to race and ethnicity (Table 2), additional improvements are needed. Current risk models are based on few data from minorities and generally underestimate risk by 5–25% in these patients (93). The Bach model (94) does not account for race or ethnicity, the PLCO_{M2012} risk model (91) underestimates risk in Hispanic Americans by 50%, and the Lung Cancer Risk Assessment Tool (35) generally underestimates risk in minorities. More accurate risk models that do not underestimate risk of lung cancer in minorities are needed to further reduce LCS disparities.

Using risk models in clinical practice necessitates accurately obtaining multiple risk factors and entering them into a risk calculator, which takes time and practice and may add to the existing challenges experienced with SDM. Calculating risk does not obviate the need to assess whether a patient is sufficiently healthy to tolerate complications from either follow-up of LCS-detected cancer or lung cancer treatment. Ideally, to be most useful for selecting optimal candidates for LCS in clinical practice, risk calculators should be coupled with modeling analysis that take into account competing risks and causes of death and the individual's ability to undergo invasive evaluation of screen-detected nodules or lung cancer treatment (95).

Assessing LCS eligibility LCS on the basis of individualized life-years gained from screening. Risk-based strategies tend to 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 (96). An alternative approach is selecting individuals for screening on the basis of their individualized life-years gained from screening (92). This approach considers both risk and life expectancy and can select people at medium risk but with high life expectancy, who might live decades if their life is saved by screening. Compared with risk-based screening, screening based on life-years gained prevents nearly the same number of deaths but gains the most life-years, chooses people with fewer comorbidities (who are more suitable for screening), and reduces the number of false positives (92). Although life-years gained could penalize minorities with lower life expectancy because of a lack of access to health care or historical discrimination, this is not the case for LCS eligibility. Both risk- and life gained–based screening selected similar percentages of minorities (African American individuals: 13.1% vs. 12.7%; Hispanic individuals: 3.3% vs. 2.7%; Asian individuals: 1.4% vs. 1.4%) (94). 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 (97, 98).

In summary, although our 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 LCS*, risk- or life-gained models may be the ideal way to reduce disparities in LCS eligibility by identifying additional high-benefit individuals, especially minorities and women, who are ineligible by current USPSTF criteria. Perhaps a pragmatic approach to LCS could include *both* assessment based on USPSTF guidelines and on risk and/or life gained for high-risk, high-benefit individuals who are not eligible according to the USPSTF but who have $\geq 2.19\%$ 6-year lung cancer risk according to the PLCO_{M2012} model (91, 99), $\geq 0.9\%$ 5-year lung cancer death risk according to the Lung Cancer Death Risk Assessment Tool (35), or ≥ 16.2 days of life gained according to the Life Years Gained From Screening–Computed Tomography model (92). These models have been validated and account for race and ethnicity (35, 92, 93, 99), and the risk thresholds ensure that those chosen by the models (who will be disproportionately minority and female) would have a high benefit.

- **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 and Provide Tobacco Treatment

Provide equitable access to and use of tobacco-cessation services. The importance of integrating tobacco-cessation support into the LCS process is underscored by an ancillary analysis of NLST data showing that 7 years of smoking abstinence was equally effective as LCS in reducing lung cancer mortality by 20% and that abstinence combined with LCS led to an even greater mortality reduction (100). However, integration of tobacco-cessation resources into LCS programs has been highly variable, with no best practice or standardized approach (101–103). A research agenda to identify the most effective approaches and improve integration of smoking-cessation strategies in the LCS setting has recently been published by the ATS (104).

More broadly, equitable access to and coverage of tobacco-cessation treatment is needed to serve minorities and vulnerable populations (105, 106). Although racial and ethnic minority groups are more likely than white individuals to attempt smoking cessation, they are less likely to be advised to quit smoking and to be offered behavioral counseling and pharmacotherapy and thus have lower odds of success (107). Expanding insurance coverage, particularly Medicaid coverage, of cessation treatments is one of the most important steps to increase smoking cessation in vulnerable populations (108). In addition, it is essential that tobacco treatment interventions be evidence-based and tailored to address cultural factors, language barriers, and reading level as appropriate (108, 109).

- 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. Given the substantial costs and resources needed to implement and sustain high-quality LCS programs, institutional commitment is paramount, especially for FQHCs and other systems serving vulnerable populations. A highly collaborative and coordinated infrastructure is also fundamental to optimize LCS use and effectiveness (60, 69).

Using patient navigators who are culturally and linguistically trained to serve as outreach workers and help the most vulnerable in overcoming barriers has been shown to improve cancer screening rates and decrease disparities in cancer care (110–113). A randomized trial compared the use of a patient navigation program with usual care among low-SES individuals in five community health centers among 1,200 individuals eligible for LCS (114). Navigators served as liaisons between patients and their primary care teams, introduced SDM, and helped with scheduling appointments with PCPs to decrease barriers to LCS. In the navigation study group, 23.5% underwent LDCT screening compared with 8.6% ($P < 0.001$)

in the control group (114). A recent systematic review concluded that LCS program initiatives aimed at vulnerable populations that incorporate patient-navigator programs are likely to improve LCS rates, adherence to follow-up, more rapid initiation of treatment, and quality of life (115).

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

Program coordinators, different from patient navigators, who are responsible for day-to-day administrative and operational LCS tasks can be integral in the success of LCS programs (116). This may occur through the implementation of electronic population-health-management tools and LCS tracking software to identify eligible patients, track and report LDCT results, coordinate clinical care, and communicate with patients. Indeed, LCS coordinators may increase screening adherence, particularly in vulnerable populations, after a negative baseline LDCT examination (116).

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 PCPs are needed, as providers are often unaware of recommended LCS guidelines or order chest X-rays rather than LDCT scans (117). Providers need training as well as strategies to address potential implicit bias and stigma experienced by individuals who smoke (118) and to cultivate the trust of patients (119). Communication techniques to build patient trust include discussing mistrust openly, listening with humility, and discussing structured care with the goal that gives the patient options to make choices that reflect their preferences (119). Based on successes in colorectal-cancer screening in conjunction with the American Cancer Society National Colorectal Cancer Roundtable (111, 120) and the CDC, the use of Action-Plan Toolkits that provide implementation plans and communication strategies for PCPs may be beneficial. 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 (121).

- 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 a low level of educational attainment and health literacy and those who have difficulty with abstract thinking (68). Individuals who currently smoke or formerly smoked heavily are more likely to have an average education level of a high-school graduate (30). Furthermore, SDM materials for diverse populations, using culturally appropriate language, are scarce. Training providers to use appropriate tools to engage in SDM is critical. Few providers are trained in the nuances of SDM beyond relaying factual information of benefits and harms, which can be difficult for patients with low health literacy to comprehend. Beyond information exchange, eliciting patient preferences is an integral part of the SDM process that few providers carry out because of their lack of training or lack of time during a patient visit (66). Options for improving SDM within LCS include patient and provider education (122), training program coordinators in SDM, and integrating mental health providers to conduct SDM tailored to the needs of patients with SMI and performed in mental health clinics (123). Furthermore, conducting SDM during a dedicated telephone visit with a dedicated decision counselor allows more time for SDM, with one study demonstrating similar patient satisfaction and low regret regardless of method of delivery (124). Although these strategies may be ideal for improving SDM within centralized LCS programs, more options for PCPs in busy clinical practices are needed. Incorporating patient decision aids, which are designed to promote patient understanding and often include pictographs and lay language, can increase patient knowledge, improve the accuracy of risk perceptions, clarify values, and reduce decisional conflict and regret (125). Individuals from underserved backgrounds report that decision aids are helpful to understand the risks and benefits of LCS and demonstrate improved LCS knowledge

after viewing decision aids (126, 127). There are provider-facing tools that are emerging to assist providers in better assessing when the decision to undergo LCS is more preference sensitive and whether to simplify the SDM conversation (128). It is important to note that SDM materials for all literacy levels should be updated regularly, as new data on the benefits and risks become available.

Interventions are essential to increase knowledge and awareness of LCS, particularly in high-risk vulnerable populations. These include educational efforts, addressing patient trust and engagement in screening, and improving access by addressing financial and social structures. Tailored interventions are more effective than nontailored interventions in improving knowledge, addressing health beliefs, and promoting changes toward positive health behaviors, such as undergoing preventive cancer screening among high-risk vulnerable populations (128–132). 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. Although the Community Preventive Services Task Force found insufficient data (too few studies qualified for the review) to determine whether mass-media interventions are effective in increasing screening for breast, cervical, and colorectal cancers (133), the Community Preventive Services Task Force recommends small-media interventions such as videos and printed materials (letters, brochures, pamphlets, flyers, and newsletters) to increase screening for these cancers (133). Small-media interventions may have similar effective results in LCS. For example,

sending simple letters and pamphlets inviting individuals from low-income communities to receive LCS resulted in high rates of uptake in the Lung Screening Uptake Trial (134). 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 LCDDT examinations (135). Coordinated marketing of LCS with other established screening protocols, such as mammography, could improve the uptake of LCS within healthcare systems.

Successful examples of LCS implementation in vulnerable communities using media campaigns include the Terminate Lung Cancer Study: a sequential mixed-methods approach that involved designing a screening campaign using messages developed from community focus groups followed by implementation of the campaign interventions in two high-risk regions of eastern Kentucky and one region serving as the control (136). This campaign was especially sensitive to the unique cultural attitudes and perspectives in three high-need areas burdened with significant disparities characterized by significant behavioral, educational, and economic barriers (136). 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 in regions where the campaign was deployed (132, 136).

- **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. Early studies identified that most patients are unaware of LCS guidelines in general, with further limited knowledge of what screening entails (137). In addition, PCP awareness of LCS was found to be limited (138, 139). Bringing LCS into communities requires an awareness of the local culture and beliefs that may drive acceptance of such programs.

Individuals from underserved communities typically have less access to preventive health programs and are often underresourced in ways that pose barriers, such as transportation challenges, to seeking screening at a distance (140, 141). Mobile screening units are one strategy that has shown efficacy in delivering LCS to underserved individuals in their communities and have shown promise in effectively reaching diverse and impoverished individuals who smoke, are at high risk, and qualify for LCS (142, 143). In the United States, mobile screening units can provide key components of screening largely with technology by electronic tablets for smoking cessation and SDM video aids (142, 143). In addition, the mobile-unit model employs store-and-forward (asynchronous) communication of LDCT scans by electronic transmission, with centralized interpretation of images by dedicated radiologists, using the Lung Imaging Reporting and Data System classification for nodule management and protocolized follow-up care by a multidisciplinary team (142). The Manchester Lung Health Check program, another mobile screening program, delivers LCS to low-income communities and achieves high uptake of LCS with a 90% adherence to annual LCS among eligible individuals (144, 145). Of note, 75% of individuals screened through this program indicated that location was important to their choice to be screened, and 23% reported they would be less likely to seek out LCS in a hospital-based program (146), highlighting the importance of targeted delivery of LCS to underserved communities. Although results indicate this strategy can reach underserved populations, the extent to which it is feasible to expand mobile units more broadly 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 (147) and patterns of poverty (141) and higher mortality rates from lung cancer overlay these rural areas (143, 148), telehealth is emerging as an accepted pragmatic approach to providing access to quality health services to these populations (149). Rapid advances in

technology facilitate possibilities for providing high-quality care across the LCS continuum by remote care delivery using the hub-and-spoke model of synchronous (live audio–video conferencing) and asynchronous (store-and-forward) telehealth modalities. Telehealth promises to support providers and reach high-risk patients in less-resourced regions of the country. In this model, centralized and high-quality SDM and tobacco-cessation services and follow-up care are grounded in a multidisciplinary foundation and delivered by a qualified provider (licensed coordinator or pulmonologist) via a synchronous (live) encounter through telehealth equipment (audio–video conferencing) to a remote healthcare facility or directly to the consumer on a mobile device, easing local PCP workloads (124). Telehealth also allows for qualified, local, independent diagnostic testing facilities to perform LDCT scans that are then made available by using picture archiving and communication systems and are remotely interpreted by qualified radiologists, thereby maintaining consistency in reading and maintaining the high volumes of computed tomography scans required for quality interpretation and certification. Multidisciplinary support and consultative services, including pulmonary, oncologic, surgical, and tobacco-cessation services and participation in tumor boards, are also feasible by telehealth and are thus inclusive of patients who are unable to travel to comprehensive screening programs in their communities (103).

Barriers to telehealth implementation include patient access to telehealth equipment and lack of payment parity, provider licensure, credentialing and privileging, and they inhibit the full dissemination of such services to rural areas. Healthcare providers and others in related fields are encouraged to step forward to support research and the development of evidence to inform health policy that advances the field of telehealth: the key to the broader and sustainable reach of safe and responsible LCS to those most in need. Additional research is needed to inform the implementation of effective telehealth strategies to address LCS access disparities.

- 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

Ensuring equitable implementation of LCS will require 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. Minorities and socioeconomically disadvantaged individuals are more likely to be underinsured or uninsured (31), which creates a significant barrier to paying for LCS and work-up of LCS-detected findings. Medicaid beneficiaries are disproportionately at risk for lung cancer, as evidenced by a higher smoking prevalence, compared with individuals covered by private insurance (26% vs. 11%) (30). Despite this striking disparity, as of January 2019, 12 state Medicaid programs did not cover LCS, and no information on the coverage policy was available for 7 states (29). Among the 31 states with LCS coverage, Medicaid fee-for-service programs varied in their eligibility criteria and their requirements for prior authorization and copayments (29). However, states that implemented Medicaid expansion have witnessed a decline in uninsured rates among nonelderly patients with newly diagnosed cancer and observed an increase in the percentage of early-stage cancers (150). To promote equitable LCS access in the high-risk and vulnerable populations served by Medicaid, continued action must be taken in lobbying for all state programs to cover LCS as a reimbursable service in both Medicaid fee-for-service and managed-care plans.

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

Allocation of resources and quality assurance. Several local, state, and national programs support cancer screening among uninsured and low-income groups. To improve access to breast- and cervical-cancer screening, the U.S. Congress passed the Breast and Cervical Cancer Prevention

Act in 1990 (151), which led the CDC to develop the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) to help women in medically underserved communities who are low-income, uninsured, or underinsured gain access to timely breast and cervical-cancer screening and diagnostic testing (152). Currently, the NBCCEDP funds all 50 states, 6 U.S. territories, and 13 Native American tribes or tribal organizations (153). In 2000, Congress passed the Breast and Cervical Cancer Prevention and Treatment Act, which allows states to offer women with diagnosed cancer in the NBCCEDP access to treatment through Medicaid (154). In addition to funding, the NBCCEDP focuses on personal, organizational, community, and policy factors that influence screening. Between 1991 and 2014, the NBCCEDP served over 4.8 million women, provided over 12 million screening examinations, and identified 55,264 breast and 3,553 cervical cancers (155). The Mammography Quality Standards Act, passed by Congress in 1992, requires minimum standards that ensure all women have access to quality mammography services (156). Such programs would be of benefit for improving access to and the quality of LCS. Likewise, the CDC's Colorectal Cancer Control Program funds states to implement evidence-based interventions aimed at increasing colorectal-cancer screening rates by providing screening services to uninsured or underinsured adults aged 50–64 years (157). Launching similar programs would be of benefit for improving LCS access to underserved, high-risk individuals and ensuring high-quality LCS.

- 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 for patients with lung cancer help patients and their families navigate the lung cancer landscape from screening and early detection to treatment and palliative care. These groups increase

awareness, advocate for research funding, and could leverage their resources to ensure equitable access to high-quality LCS (158–160). Organizations such as the American Lung Association and the American Cancer Society, which advocate for resources and policies in the fight against lung cancer at federal, state, and local levels (161, 162), and the National Lung Cancer Roundtable, which coordinates collective leadership, strategic planning, and advocacy among member organizations (163), can help to address disparities in LCS. Furthermore, these organizations can identify 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 populations at risk for poor lung cancer outcomes. Significant disparities across the continuum of LCS implementation—not getting screened for tobacco use, not meeting eligibility criteria, not having access to quality screening and tobacco treatment, and lack of insurance, among many—threaten to worsen disparities in lung cancer. Dedicated efforts are needed to address existing multilevel barriers to LCS that widen disparities and to respond and develop actionable plans to implement strategies using multipronged approaches

deployed simultaneously to decrease disparities. Thoughtful implementation of strategies that address racial, ethnic, socioeconomic, and sex-based differences in smoking behaviors and lung cancer risk; address inequitable distribution of LCS resources and access to health insurance coverage for LCS; and provide education and resources will be necessary to achieve equitable outcomes in LCS. 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 across the spectrum of dissemination and implementation to ensure that interventions minimize disparity gaps and positively impact health outcomes in all patients. ■

This official ATS statement was prepared by an *ad hoc* subcommittee of the ATS Assembly on Thoracic Oncology.

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