Technical Report

Evaluation of the Benefits and Harms of Lung Cancer Screening With Low-Dose Computed Tomography: A Collaborative Modeling Study for the U.S. Preventive Services Task Force

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Authors' Contributions

Authors ten Haaf, Cao, and Bastani contributed equally to this report. Likewise, authors Feuer, Plevritis, de Koning, and Kong contributed equally to this report.

Structured Abstract

Importance: The U.S. Preventive Services Task Force (USPSTF) is updating its 2013 lung cancer screening recommendations.

Objective: To inform the USPSTF by evaluating the benefits and harms of low-dose computed tomography (LDCT) screening strategies by conducting simulation modeling; comparing strategies with varying starting and stopping ages, screening frequency, and eligibility criteria (based on smoking pack-years and years since quitting smoking or based on individual lung cancer risk); and identifying efficient strategies that provide the best balance of benefits (lung cancer deaths prevented and life-years gained [LYG]) and harms for a given level of LDCT screens.

Design, Setting, and Participants: Collaborative modeling with four lung cancer natural history models for individuals from the 1950 and 1960 birth cohorts from ages 45 to 90 years with no prior lung cancer diagnosis.

Exposures: Screening with LDCT with varying starting ages (45, 50, 55 years), stopping ages (75, 77, 80 years), and screening frequency (annual, biennial). Eligibility criteria based on either age, cumulative pack-years (20, 25, 30, 40 years) and years since quitting smoking (10, 15, 20, 25 years) (*risk factor–based strategies*) or age and individual lung cancer risk estimation using three established risk prediction models (Bach, Lung Cancer Death Risk Assessment Tool, and PLCOm2012) with varying risk thresholds for eligibility (*risk model–based strategies*). A total of 1,093 (289 risk factor–based and 804 risk model–based) strategies were evaluated. Full uptake and adherence for all scenarios were assumed.

Main Outcomes and Measures: Benefits: Lung cancer deaths averted and LYG compared with no screening per 100,000 population. Harms: Lifetime number of LDCT screens, false-positive results, biopsies, overdiagnosed cases, and radiation-related lung cancer deaths per 100,000 population.

Results: We identified a set of LDCT screening programs that are efficient and result in the most lung cancer deaths averted and LYG for a given level of screening (number of LDCT screens). Most efficient risk factor–based strategies start screening at age 50 or 55 years and stop screening at the age of 80 years. Most efficient risk factor–based strategies with at least 9 percent lung cancer mortality reduction have 20 pack-years as the minimum criterion for eligibility. The 2013 USPSTF-recommended criteria, which was selected based on lung cancer deaths averted using the 1950 birth cohort, is not among the efficient strategies for the 1960 birth cohort when considering both lung cancer deaths averted and LYG. However, annual strategies with the 20 pack-years minimum criterion, starting age of 50 or 55 years and stopping age of 80 years are efficient and result in increased screening eligibility (20.6% to 23.6% eligible) and considerably more lung cancer deaths averted (469 to 558 per 100,000) and LYG (6,018 to 7,596 per 100,000) than the 2013 USPSTF-recommended strategy (14.1% eligible, 381 lung cancer deaths averted and 4,882 LYG per 100,000). However these strategies also result in more false-positive tests (1.9 to 2.5 vs. 1.9 per person screened), overdiagnosed cases (83 to 94 vs. 69 per 100,000), and radiation-related lung cancer deaths (29.0 to 42.5 vs. 20.6 per 100,000) than the 2013 USPSTF-recommended strategy. The 20 pack-year strategies result in higher relative increases vs. the 2013 USPSTF-recommended criteria in eligibility, lung cancer deaths prevented, and LYG for women than men. These strategies also result in higher relative increases compared with the 2013 USPSTF-recommended criteria in eligibility for non-Hispanic blacks, Hispanics, and American Indian/Alaska Natives than for non-Hispanic whites and Asians. Among risk model–based screening strategies, the net benefits and harms of screening strongly depend on the risk model's specific risk thresholds. Risk model–based vs. risk factor–based strategies result in higher numbers of lung cancer deaths prevented and modest additional LYGs and induce fewer radiation-related lung cancer deaths; however, they result in more overdiagnosed cases. The general patterns observed for the 1960 birth cohort for men and women combined hold for each sex and for the 1950 birth cohort.

Limitations: Simulations assumed 100 percent screening uptake and adherence. Relative performance of compared strategies might change if uptake and adherence differ by age or screening frequency. The models extrapolated results from short-term randomized trials with three LDCT annual screens to lifetime screening and followup. Simulations did not consider incidental findings and were restricted to the 1950 and 1960 U.S. birth cohorts.

Conclusions and Relevance: This collaborative modeling analysis suggests that LDCT screening could lead to important reductions of lung cancer mortality and result in significant LYG when optimally targeted. In particular, screening individuals ages 50 or 55 years through 80 years with 20 or more pack-years of smoking exposure would result in more benefits than current criteria and would reduce disparities in eligibility by sex and race/ethnicity. Risk model–based screening strategies could result in higher benefits compared with risk factor–based screening strategies; however, the analysis did not consider issues of implementation and other potential challenges of risk model–based screening strategies.

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Chapter 1. Introduction

Lung cancer remains the most common cause of cancer mortality in the United States, despite the considerable decrease in smoking and the resulting decrease in smoking-related lung cancer incidence and mortality.[1, 2] In an effort to further reduce the burden of lung cancer in the United States, in 2013 the U.S. Preventive Services Task Force (USPSTF) recommended annual screening for lung cancer with low-dose computed tomography (LDCT) in adults ages 55 through 80 years who have at least a 30 pack-year smoking history and currently smoke or have quit within the past 15 years.[3] The recommendations further stated that screening should be discontinued once a person has not smoked for 15 years or develops a health condition that substantially limits life expectancy or the ability or willingness to have curative lung surgery (Grade: B recommendation).

Important questions remain regarding the benefits and harms of lung cancer screening, particularly as it is being implemented in clinical practice in the United States. The 2013 USPSTF lung cancer screening recommendations were largely based on the results of the National Lung Screening Trial (NLST),[4-6] which found a 16 to 20 percent lung cancer mortality relative reduction for LDCT screening vs. screening with chest radiographs. Since then, lung cancer screening programs have been established across the United States, and new clinical guidelines have emerged for classifying and managing screen-detected pulmonary nodules, updating the protocols used in NLST. In particular, the American College of Radiology released the Lung Imaging Reporting and Data System (Lung-RADS™) with the goal of improving the interpretation of screening results, reducing the rate of false-positive findings, and supporting the uniform implementation of lung cancer screening across the United States.[7, 8] In addition, other randomized trials, including the Dutch–Belgian lung-cancer screening trial (NELSON) that showed a 24 percent lung cancer mortality relative reduction in men at 10 years after four rounds of LDCT screening vs. a no screening arm,[9] reported their findings.[9, 10] Nonetheless, early reports of lung cancer screening practices in different health systems have suggested that the implementation of screening with LDCT has been far from optimal. These reports have found that few eligible persons have accessed or opted for screening, while some ineligible persons with less smoking exposure than required by current guidelines and some with severe comorbidities are being screened.[11-19]

Most current LDCT screening recommendations are based on age, cumulative smoking exposure (30 pack-years), and years since quitting smoking alone and do not consider additional risk factors. However, some population groups, such as African American men or those with a family history of lung cancer, might be at high risk of lung cancer even when not meeting the 30 pack-year or other criteria.[20-22] It has been suggested that less than 45 percent of patients with lung cancer would meet the USPSTF screening eligibility criteria.[23] For these reasons, proposed alternatives are to reduce the minimum pack-year criterion or to use multivariate risk prediction models to select eligible individuals based on their estimated individual probability of being diagnosed with or dying from lung cancer.[24-27] In fact, the most recent National Comprehensive Cancer Network lung cancer screening guidelines recommend screening also for persons older than 50 years with 20 pack-years or more of smoking exposure who have additional risk factors (such as chronic obstructive pulmonary disease [COPD] or family history of lung cancer) that would increase their probability of getting lung cancer within the next 6 years (i.e., 6-year lung cancer risk) to 1.3 percent or higher according to the PLCOm2012 multivariate lung cancer risk model (level 2 recommendation, category 2a).[27] These recommendations are largely based on expert opinion, given the scarcity of studies evaluating the efficacy of screening strategies based on risk; however, evidence is starting to emerge on the potential benefits and challenges of implementing programs based on risk calculation.[25-30] Nonetheless, although much attention has been focused on evaluating the use of risk assessment to maximize the efficiency of screening, less attention has been paid to quantifying the potential resulting harms related to screening patients with comorbidities and short life expectancy who also tend to be those at the highest levels of lung cancer risk.[31-35]

This report describes a collaborative simulation modeling study or decision analysis (DA) performed for the USPSTF. The USPSTF will use this analysis to inform its updated lung cancer screening recommendations. Recognizing that simulation models provide a way to extrapolate available evidence and predict long-term outcomes,[36-39] the USPSTF commissioned this simulation modeling effort to assess the benefits and harms of various approaches to screening with LDCT. This analysis accompanies the corresponding systematic review to update the evidence on the benefits and harms of lung cancer screening.[40]

The collaborative modeling study provides an assessment of the potential benefits and harms of lung cancer screening at the population level reflecting current U.S. nodule management and followup guidelines (i.e., using Lung-RADS). The analysis evaluates the impact of screening on the lung cancer outcomes for two U.S. birth cohorts, 1950 and 1960, which are representative of the target population. In addition, this analysis, together with the systematic evidence review, provides an evaluation of screening strategies based on individual lung cancer risk (probability of incidence or death within a given period) and evaluates how strategies based on risk prediction models, termed *risk model–based strategies*, compare with strategies based on age, cumulative smoking exposure (pack-years), and years since quitting smoking, termed *risk factor–based strategies*.

Chapter 2. Methods

Key Questions

The investigators, USPSTF members, and Agency for Healthcare Research and Quality (AHRQ) Medical Officers developed the scope and key questions (KQs). Three KQs were developed for this collaborative modeling study:

1. How do the benefits and harms of screening for lung cancer with LDCT vary by (a) age to start screening; (b) age to stop screening; (c) pack-year criterion (d) years since quitting smoking; and (e) screening frequency when using screening, workup, and management protocols that are being implemented in current clinical practice?
2. What are the expected population effects of screening for lung cancer with LDCT for older vs. more recent birth cohorts of the U.S. population?
3. What are the relative benefits and harms of lung cancer screening strategies with eligibility based on individual lung cancer risk (*risk model–based)* vs. strategies with eligibility based on age, pack-years, and years since quitting smoking (*risk factor–based)*?

Lung Cancer Natural History Models

The DA was conducted by investigators of the Cancer Intervention and Surveillance Modeling Network (CISNET) Lung Group. Four CISNET lung cancer screening simulation models from different institutions were used for the analysis: the Microsimulation Screening Analysis (MISCAN)-Lung Model from Erasmus University Medical Center (Model 1), Massachusetts General Hospital–Harvard Medical School (MGH-HMS, Model 2), the Lung Cancer Outcomes Simulation (LCOS) from Stanford University (Model 3), and University of Michigan (Model 4). All of these models were part of the previous lung cancer screening DA conducted for the USPSTF.[3, 36, 41]

Overview of Decision Models

CISNET's comparative modeling approach uses multiple decision models to address common research questions. Because the models differ in terms of parameters, assumptions, model structure, and approach, comparison of results across models serves as a gauge of model specification uncertainty. Similarity of results provides greater confidence in the conclusions, whereas variation can indicate areas where more information is needed.

Although the models share common inputs, each modeling team developed its own model based on mathematical descriptions of lung cancer risk as it relates to smoking behaviors. The models explicitly consider individual factors associated with the risk of lung cancer, including the number of cigarettes smoked per day at any given age, the age of smoking initiation, duration of smoking, and the number of years since quitting.

Table 1 shows a comparison of the model characteristics. All models share the same overall structure. The central component of each model is a dose-response module that provides a quantitative description of the age-specific lung cancer incidence and mortality by detailed history of smoking. This module is used to predict age- and sex-specific lung cancer incidence and mortality risk as a function of individual smoking histories.

The models can be used to simulate the natural history of lung cancer given an individual's sex, birth year, and smoking history. A key component to all models is the Smoking History Generator (SHG), a microsimulator developed by the CISNET Lung Group that generates detailed individual smoking histories for the U.S. population.[2, 42, 43] These smoking histories serve as the main inputs for the model simulations. Multiple data sources, including the National Health Interview Survey, the Cancer Prevention Studies I and II, and the Human Mortality Database, were used to construct the input parameters for the SHG: rates of smoking initiation; cessation; cigarettes per day consumption; and other causes or all causes of death by age, birth cohort, sex, smoking status, smoking intensity, and years since quit. The SHG was used to simulate smoking and life histories of individuals from the 1950 and 1960 U.S. birth cohorts, which the four models used as inputs.

Each model can simulate the effects of lung cancer screening given an individual's smoking and lung cancer natural history. The models were calibrated to both the NLST and the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial to produce outcomes that are consistent with both trials.[41] Specifically, the models were shown to reproduce the observed annual lung cancer incidence and mortality by arm and mode of detection (screening and otherwise) in both trials, the histology and stage distributions, and the estimated benefit of three rounds of LDCT screening in NLST. Three of the models were updated to reflect current practice and nodule evaluation and management according to the Lung-RADS guidelines, modeling the Lung-RADS protocols explicitly or indirectly via the associated rates of false-positive tests (**Table 1** and appendix) and adjusting the models to reflect the expected reduction in sensitivity relative to NLST.[8] The other model uses false-positive tests, sensitivities, and screening result rates based fully on the NLST, allowing for comparison of alternative protocols and assumptions.

The models and the SHG were used to simulate the effect of different lung cancer screening scenarios for the U.S. population. Simulated outcomes included the number and percentage of persons screened given an eligibility criterion, number of lung cancer cases and deaths, number of other-cause deaths, life-years gained (LYG) relative to a no-screening scenario, number of false-positive screens, number of biopsies, overdiagnosed cases, and radiation-related lung cancer deaths. Details for each of the four models are provided in **Appendix A**.

Screening Strategies

Risk Factor–Based Strategies

The DA assessed the relative benefits and harms of alternative LDCT screening strategies. The analysis focused first on strategies using eligibility criteria similar to the prior USPSTF recommendation from 2013, which determines screening eligibility as a function of age and smoking exposure (i.e., scenarios where eligibility assessment is based on age range, pack-years, and years since quitting, henceforth called risk factor–based strategies). This primary analysis also assessed the relative performance of annual vs. biennial screening frequency. **Table 2** summarizes the LDCT screening attributes and values considered in the primary risk factor–based strategies DA. A total of 289 scenarios were considered, including a no-screening scenario as reference.

We used the four CISNET natural history models to project the benefits and harms of each strategy in the U.S. 1950 and 1960 birth cohorts. We selected these birth cohorts because they are now in the middle of their screening eligibility according to current guidelines (70 years old for 1950 and 60 years old for 1960) and are representative of different moments of the tobacco epidemic (higher smoking prevalence and average smoking intensity for the 1950 birth cohort vs. decreased smoking prevalence and lower average smoking intensity for the 1960 birth cohort) and for comparability with the 2013 DA, which focused on the 1950 birth cohort.[36, 44] Strategies also varied by starting age (45, 50, 55 years), stopping age (75, 77, 80 years), frequency (annual, biennial), minimum pack-years (20, 25, 30, 40 years), and maximum years since quitting smoking (10, 15, 20, 25 years).

Risk Model–Based Strategies

The DA also evaluated the potential population impacts of selected lung screening scenarios with eligibility criteria based on multivariate risk models that use smoking duration and intensity, sex, and age to estimate lung cancer risk (i.e., strategies where risk assessment is based on a multivariate model considering age, smoking, and sex information, henceforth called risk model–based screening strategies). For these scenarios, we focused on 6-year lung cancer risk (probability of lung cancer incidence or mortality within the next 6 years) because this was the duration of followup in the NLST trial, and one of the multivariate risk models considered has a fixed 6-year risk prediction horizon. The lung cancer risk calculation for screening eligibility considered an individual's age, sex, and more detailed smoking history than risk factor–based strategies (i.e., smoking duration, smoking intensity, years since cessation). This "unpacking" of pack-years into its components has been shown to be important because each metric has independent predictive value, and collapsing these into a single measure of cumulative exposure, such as pack-years, potentially reduces the precision to determine those most likely to be diagnosed with or die from lung cancer.[27, 45, 46] No other established risk factors for lung cancer, such as race/ethnicity, COPD, or individual and family history of lung cancer, were considered in this collaborative modeling DA. This is because it would require the joint simulation of these risk factors with smoking, sex, and age at the population level and the availability of well-calibrated and validated lung cancer natural history models incorporating all covariates. For each simulated individual, the assessment of eligibility was performed annually (or every other year for biennial strategies), from the starting age of eligibility until the stopping age or death.

Three lung cancer risk prediction models were considered to generate individual eligibility based on lung cancer risk: 1) a modified PLCOm2012 model (MPLCOm2012), 2) a modified version of the Lung Cancer Death Risk Assessment Tool (LCDRAT) model (MLCDRAT), and 3) the Bach model. The MPLCOm2012 model is a simplified version of the 6-year lung cancer incidence risk PLCOm2012[25, 27, 29] model restricted to age and smoking covariates (i.e., setting race/ethnicity, education, body mass index, COPD, personal history of cancer, and family history of lung cancer, which are in the full model, at its reference value). The MPLCOm2012 has an area under the curve (AUC) of 0.784 in the PLCO control arm compared with an AUC of 0.795 for the full model.[29] Analogously, the MLCDRAT model is a simplified version of the LCDRAT lung cancer mortality model restricted to age, sex, and smoking covariates (i.e., excluding race/ethnicity, education, COPD, and family history of lung cancer, which are in the full model).[47] The model's developer, Dr. Hormuzd Katki of the National Cancer Institute, provided the model to the DA team. The MLCDRAT model has an AUC of 0.78 in the PLCO control arm. We used the model to compute 6-year lung cancer mortality risk. The Bach model,[48] which predicts 1-year lung cancer incidence risk, was used as published but compounded to produce a 6-year incidence risk estimate. This model considers age, sex, smoking covariates, and occupational asbestos exposure. We used the model assuming no asbestos exposure (i.e., set asbestos exposure=0 in the model) because this is how it has been recently validated.[29, 47] The Bach model, with asbestos set to 0, has an AUC of 0.78 in the PLCO control arm.[29]

These three risk prediction models were selected based on two independent analyses of the performance of several risk prediction models in identifying lung cancer incidence and mortality cases in the PLCO and NLST trials and other U.S. cohorts,[29, 47] their practicality and ease of implementation, and their use as risk prediction models in current lung screening recommendations/implementations.[49] Of the risk prediction models evaluated in ten Haaf et al,[29] the PLCOm2012, Bach, and Two-Stage Clonal Expansion (TSCE) models outperformed other risk prediction models. However, the TSCE model is less straightforward to implement and is used as a dose-response model in some of the CISNET lung cancer natural history models. Hence, we did not use the TSCE model to determine screening eligibility in our risk model–based screening analyses. A recent analysis by Katki et al[47] demonstrated that the Lung Cancer Risk Assessment Tool (LCRAT) (a model that predicts lung cancer incidence) and the LCDRAT (a model that predicts lung cancer mortality) models have similar performance to the PLCOm2012 and Bach models; thus, we included the LCDRAT lung cancer mortality model to complement the two incidence models. It is worth noting, however, that currently the incidence risk prediction models are effective in identifying individuals at high risk for both lung cancer incidence and lung cancer mortality (Figures 2 through 5 in ten Haaf et al.[29]).

The evaluated risk model–based screening strategies varied then by risk prediction model (Bach, MLCDRAT, MPLCOm2012), model-specific risk threshold (i.e., the minimum level of risk required for eligibility), and lower (50, 55 years) and upper (75, 77, 80 years) age limits. We considered age limits of eligibility for two reasons: 1) to limit the extrapolation of the risk calculation to younger ages because the risk models were developed using data restricted to ages equal to or older than 50 (Bach) or 55 years (MPLCOm2012 and MLCDRAT) and 2) to avoid having people getting screened in the simulation during their 90s, more than 10 years beyond the age range for which LDCT screening has been evaluated and because of the shorter life expectancy at those ages. Model-specific risk thresholds (**Table 3**) were determined based on a previous analysis that identified threshold ranges per risk model resulting in similar percentages of screen-eligible people in the 1960 birth cohort as in the risk factor–based strategies considered in the DA.[30] Previous simulation analyses of the performance of the PLCOm2012 and Bach models to identify individuals at high risk of lung cancer in the PLCO and NLST trials suggest that using thresholds within these ranges would yield a positive net benefit from risk model–based screening relative to the NLST criteria.[29] For each risk model, we evaluated risk thresholds within the model-specific ranges at 0.1 percent increments. **Table 3** shows a summary of the resulting 804 risk model–based screening strategies evaluated. To limit the scenarios and comparisons in the risk model–based screening analysis, we focused only on the 1960 birth cohort, which, as mentioned above, is now at the beginning of its eligibility and more representative of current smoking patterns in the United States.

Scenario Simulation and Analysis

We used the SHG to simulate individual smoking and life histories of 1 million men and 1 million women from the U.S. 1950 and the 1960 birth cohorts from ages 45 to 90 years or death. The simulated individual histories were used as input by all four CISNET simulation models. Models then simulated the lung cancer screening outcomes for each individual under the different screening scenarios described above. All simulations were performed assuming that all screen-eligible individuals would choose to undergo lung cancer screening and would also adhere to ongoing screening (annual or biennial) for the duration of their screening eligibility. Smoking cessation and the risk of competing causes of disease and death were assumed to be unaffected by screening results.

Outcomes

Each model aggregated individual simulation results into counts of screening examinations and health outcomes separately for men and women. Most measures are reported as “per person in the population” rather than “per person screened” because programs defining eligibility based on smoking history may screen similar proportions of the population but screen dissimilar people, even for identical starting and stopping ages. False-positive screens, however, are reported as “per person screened.”

Table 4 lists the specific outcomes evaluated for each screening scenario by each model. These outcomes include measures of benefit such as lung cancer deaths averted, lung cancer mortality reduction and LYG vs. no-screening scenario, and measures of harm or burden such as the percentage of individuals eligible for screening, the number of LDCT screens and followup scans, the false-positive rates, biopsies following positive screens, and the rate of cancer overdiagnosis. Two models (Models 2 and 4) were used to estimate radiation-related lung cancer deaths.

We represented the trade-off between maximizing the benefits (here, lung cancer deaths averted, or LYG) due to a specific screening program and simultaneously minimizing the corresponding burden or harms (here, number of screening exams under each program) by plotting benefit vs. burden for each scenario and generating a corresponding “efficient frontier.” The efficient frontier is the line connecting the strategies that provide the largest benefit (lung cancer deaths averted or LYG) for a given number of LDCT screens. We used LDCT screens as the burden or harms metric because it is independent of other assumptions and it is measured consistently across models. However, we calculated additional measures of harm for each scenario as described above. Each model generated efficient frontiers that connected the screening programs that prevented the most lung cancer deaths or generated the most LYG for each possible value of the number of LDCT screens. Separate efficient frontiers by model were generated for both benefit measures (lung cancer deaths averted and LYG) by sex and both sexes combined and for each birth cohort (1950 and 1960).

Selection of Consensus-Efficient Scenarios

To identify efficient scenarios providing the most lung cancer deaths averted and/or LYG for a given level of screening (measured here as the number of LDCT screens per 100,000 population), we conducted a data envelopment analysis (DEA).[36, 41, 50] The DEA allows for identification of efficient scenarios accounting for a harms or burden metric (here, the number of LDCT screens) and one or several gain or benefits metrics (here, the number of lung cancer deaths averted, LYG, or both metrics simultaneously). In simple terms, for a single-benefit DEA, the approach finds programs that are near the efficient frontier of LDCT screens vs. lung cancer deaths averted or LDCT screens vs. LYG. For a two-benefit DEA, the method identifies strategies that are near the two-dimensional efficiency curve defined by the outer envelope of lung cancer deaths averted per number of LDCT screens vs. LYG per number of LDCT screens. We conducted independent DEAs for each CISNET model to identify model-specific efficient scenarios and then selected those that were efficient for at least three of the four models. This approach ensured an equal weighting of the CISNET models, preventing us from giving preference to models with higher levels of predicted benefits in the identification of efficient scenarios. Specifically, for each model's results, using the DEA we generated a rank score (decile of distance from the model's efficient frontier [or curve] for each scenario not on the frontier [or curve]). We then identified scenarios on (score 0) or closest to (first 3 deciles) the frontier of at least three CISNET models (i.e., scenarios that have efficiency scores within the top 30% for at least 3 out of the 4 models).

We performed three separate DEAs, using either lung cancer deaths averted alone, LYG alone, or both benefit metrics simultaneously (i.e., a 2-outcome metric). Main DEAs were based on the two-outcome metric with the single-metric DEAs used as sensitivity analyses.

For each consensus-efficient program, we aggregated sex-specific results to derive average (across the 4 CISNET models) predicted counts of lung cancer cases, lung cancer deaths, life years, and screening LDCT exams performed and other outcomes. We calculated the percentage of the cohort receiving at least one screening exam and the number of persons ever screened per lung cancer death averted (number needed to screen, NNS). We provide results per 100,000 individuals alive at age 45 years. As mentioned above, because the proportion and characteristics of screen-eligible individuals vary by scenario and birth cohort, the results were calculated "per 100,000 population" (including both screened and unscreened individuals) rather than "per screened population" so that outcomes are comparable across scenarios.

Sensitivity Analyses

In addition to the KQs above, additional sensitivity analyses assessed the effectiveness of different LDCT screening strategies for the effect of limiting screening to only those with more than 5 years of life expectancy assuming a perfect assessment of life expectancy. Life expectancy here is not considered an eligibility criterion. Instead, it is used as a way to operationalize in the simulation the fact that persons with significant comorbidities and short life expectancy would not be recommended for screening because they would not be eligible for curative treatment (e.g., lung resection). **Table 5** summarizes the sensitivity analyses.

Chapter 3. Results

We focus here on the results for the 1960 birth cohort because it will reach age 60 in 2020 and is more representative of current patterns of smoking and future lung cancer risk across the lung cancer screening-eligible population than the 1950 birth cohort. Results for the 1950 birth cohort are presented in the Appendices B and C and the Sensitivity Analysis section. Unless otherwise indicated, results presented here are for men and women combined. Sex-specific results are presented in the Appendices B and C.

Benefits and Harms

Efficient Frontiers for Risk Factor–Based Strategies

Figure 1 shows the number of LDCT screens and lung cancer deaths averted relative to no screening for each of the risk factor–based strategies and the 1960 birth cohort. Each panel corresponds to one of the four CISNET models, and the points in each panel represent different screening scenarios. Strategies are colored by screening frequency (annual, biennial) and screening stopping age (75, 77, 80 years). The solid line represents the efficient frontier for the corresponding model. In general, scenarios on the frontier have a screening stopping age of 80 years. Biennial strategies are concentrated on the lower/left side of each panel because they result in fewer LDCT screens and lower lung cancer deaths averted. Annual strategies tend to be on the upper/right side because they result in more LDCT screens and generally more deaths averted. Although the absolute range of predicted lung cancer deaths averted varies by CISNET model, the general patterns are consistent across models. Model 1, which predicts the largest lung cancer deaths prevented, is the model that uses false-positive tests, sensitivities, and screening result rates based fully on the NLST, allowing for comparison of alternative protocols and assumptions. Model 2, which predicts the lowest lung cancer deaths averted, uses a different smoking dose-response module (**Table 1**) and projects lower future lung cancer incidence and mortality than the other three models[51] and thus fewer lung cancer deaths that could be averted. The results for the 2013 USPSTF-recommended strategy are indicated with an ⊗. This scenario is on or among the closest to the frontier for three out of the four models.

Figure 2 shows the corresponding efficient frontier curves using LYG as the benefit metric and the 1960 birth cohort. The patterns are similar but show less variability among strategies than for lung cancer deaths averted. Although the absolute range of predicted LYG varies by CISNET model, the general patterns are consistent across models. Like with lung cancer deaths prevented, Model 1 predicts the largest LYG, while Model 2 predicts the lowest. In this case, the 2013 USPSTF-recommended strategy is only on (or among the closest to) the efficient frontier for one of the four models.

Appendix B Figures 1 through **4** show the corresponding efficient frontiers for men and women separately, and **Appendix B Figures 5** and **6** show the corresponding efficiency frontiers for the 1950 birth cohort (men and women combined). These figures demonstrate that the general patterns observed for the 1960 birth cohort for men and women combined hold for each sex and for the 1950 birth cohort. **Appendix B Figures 7** through **12** show the efficient frontiers for the 1960 birth cohort, highlighting screening scenarios by starting age, pack-years, and years since quitting.

Efficient Frontiers for Risk Factor–Based and Risk Model–Based Strategies

Figure 3 shows the simulated number of LDCT screens and the lung cancer deaths averted for all risk factor–based and risk model–based screening strategies. Strategies are colored by periodicity (annual, biennial) and type of eligibility criteria (risk factor based, risk model based). In general, risk model–based strategies tend to result in larger numbers (than risk factor–based strategies) of lung cancer deaths averted for a given number of LDCT screens (across the whole range of LDCT screens). Thus, most of the scenarios in each efficient frontier are risk model–based screening strategies. Among the scenarios considered, risk model–based screening strategies result in a wider range of LDCT screens than the risk factor–based strategies. The 2013 USPSTF-recommended strategy, marked with an ⊗, is strictly dominated by risk model–based strategies (i.e., it prevented fewer lung cancer deaths than risk model–based strategies requiring a similar number of LDCT screens) according to all the models.

Figure 4 shows the corresponding efficient frontier plots but for LYG. As when considering only risk factor–based strategies, we see less variability when using LYG as a benefit metric than when using lung cancer deaths averted. However, in this case, some of the risk factor–based strategies, particularly biennial with fewer LDCT screens, do jump to (or get close to) the frontier for some of the models. Here, the 2013 USPSTF-recommended strategy, marked with an ⊗, is strictly dominated by risk model–based strategies according to three out of the four models.

Appendix B Figures 13 through **16** show the corresponding efficient frontiers for men and women separately and demonstrate that the general patterns observed for men and women combined hold for each specific sex. **Appendix B Figures 17** and **18** show the efficient frontiers for the 1960 birth cohort highlighting the eligibility risk prediction model for each scenario.

Consensus-Efficient Scenarios

Risk Factor–Based Consensus-Efficient Scenarios

We identified 57 consensus-efficient scenarios using the DEA for the 1960 birth cohort with both outcome metrics: lung cancer deaths averted and LYG. Of these, 80.7 percent have screening stopping age of 80 years, with 61.4 percent being biennial and 38.6 percent annual strategies. The large majority of these have starting age 50 years (45.6%) or 55 years (49.1%). With regard to minimum pack-years, 26.3 percent have 20 pack-years, 26.3 percent have 25 pack-years, 12.3 percent have 30 pack-years, and 35.1 percent have 40 pack-years. The average number of minimum pack-years across consensus-efficient scenarios is 29.6, and the average maximum years since quitting is 18.9 years, both close to the 2013 USPSTF-recommended strategy. The 2013 USPSTF-recommended scenario is not one of the 57 consensus-efficient scenarios. The average number (across models) of LDCT screens per 100,000 population among the consensus scenarios ranges from 64,607 to 594,973, with the percentage of the population ever screened ranging from 9.0 to 24.1 percent. The number of lung cancer deaths averted per 100,000 population ranges from 173 to 578, corresponding to a population-level lung cancer mortality reduction ranging from 4.5 to 14.9 percent. The LYG ranges from 2,405 to 8,186 per 100,000, and the NNS (persons ever screened per lung cancer death averted) ranges from 29 to 64. **Figure 5** shows the average, across CISNET models, number of LDCT screens vs. the number of lung cancer deaths averted (left) and LYG (right) for all risk factor–based strategies, highlighting the consensus-efficient scenarios (solid color). Each panel shows the corresponding average model efficient frontier. Most of the consensus-efficient scenarios are on the frontier or among the closest to the frontier for both benefit metrics. Consensus-efficient biennial scenarios result in fewer LDCT screens, lung cancer deaths averted, and LYG than annual strategies and thus are located on the lower left side of the frontier, whereas annual consensus-efficient scenarios are located on the upper right side of the frontier. The no-screening (black dot), the 2013 USPSTF-recommended ("⊗" mark), and six selected consensus-efficient 20 pack-year annual strategies (see 20 Pack-Year Scenarios section below) are highlighted.

In terms of harms, the average number of false-positive results per screened individual ranges from 1.1 to 2.8, the number of biopsies from 241 to 922 per 100,000, and the average number of LDCT examinations per screened individual from 7.2 to 24.9. The number of overdiagnosed cancers ranges from 27 to 95 per 100,000 population, and the rate of overdiagnosis per screen-detected lung cancer varies from 4.5 to 6.3 percent. Finally, the number of radiation-related lung cancer deaths ranges from 6.8 to 55.0, increasing as a function of the number of screens and the percentage of persons screened. **Figure 6** shows the distribution of the overdiagnosis rate for all risk factor–based strategies considered by the model, gender, and stopping age, indicating that across models the proportion of overdiagnosed cases among screen-detected lung cancers increases with stopping age.

Table 6 shows the benefits of the consensus-efficient scenarios plus the 2013 USPSTF-recommended scenario restricted to those leading to at least a 9 percent lung cancer mortality reduction (a total of 26 scenarios). We concentrate on these because they provide a lung cancer mortality reduction close to or greater than that of the 2013 USPSTF-recommended strategy (9.8%). **Figure 5** shows the average, across CISNET models, number of LDCT screens vs. the number of lung cancer deaths averted (left) and LYG (right) for these selected consensus-efficient scenarios plus the 2013 USPSTF-recommended strategy. Of these, five are biennial and 21 annual; all have 80 years as the stopping age and range from 14.1 to 24.1 percent eligible individuals. In terms of minimum pack-years, 13 (50.0%) have 20 pack-years, 9 (34.6%) have 25 pack-years, 4 (15.4%) have 30 pack-years, and none has 40 pack-years. The corresponding lung cancer mortality reductions range from 9.0 to 14.9 percent and the LYG from 4,490 to 8,186. Six selected consensus-efficient 20 pack-year annual strategies are highlighted in Figure 5 (see 20 Pack-Year Scenarios section below). **Appendix C Table 1** shows the range of benefits estimates across the four CISNET models.

Table 7 shows the corresponding harms for the 25 selected consensus-efficient scenarios plus the 2013 USPSTF-recommended scenario. In this case, the average number of false-positive results per screened individual ranges from 1.2 to 2.8, the number of biopsies from 518 to 922 per 100,000 population, the average number of LDCT examinations per screened individual from 8.6 to 24.9, and the overdiagnosis rate per screen-detected lung cancer from 5.6 to 6.3 percent. The number of radiation-related lung cancer deaths ranges from 17.5 to 55.0 per 100,000 population. **Appendix C Table 2** shows the range of harm estimates across the four CISNET models.

Results for all the 57 consensus-efficient plus the 2013 USPSTF-recommended scenarios are shown in Appendix C (**Appendix C Tables 3** and **4**). Results stratified by sex for the selected consensus-efficient scenarios are also shown in Appendix C (**Appendix C Tables 5** and **6** for men and **Appendix C Tables 7** and **8** for women). **Appendix B Figures 19** and **20** show efficient frontiers for men and women, highlighting the consensus-efficient scenarios when considering risk factor–based screening strategies only.

20 Pack-Year Scenarios

Among the consensus-efficient scenarios with at least a 9 percent lung cancer mortality reduction (selected consensus-efficient scenarios), a majority (52%) have 20 pack-years as a minimum criterion for eligibility. This is in contrast with the distribution of minimum pack-years of consensus-efficient scenarios for the 1950 birth cohort in which most selected consensus scenarios have either 25 pack-years (32%) or 30 pack-years (37%) (see **Sensitivity Analysis** section) and is due in part to the lower levels of smoking in the more recent 1960 birth cohort. Various observational and modeling studies have suggested that reducing the minimum pack-year criterion for lung cancer screening to 20 pack-years would increase the number of lung cancer deaths that would be preventable by screening and also reduce sex and racial disparities in eligibility.[20, 22, 52] The recently published NELSON trial included ever smokers of ages 50 to 74 years, with a lower smoking exposure criterion than NLST (ever smokers with no more than 10 years since quitting who had smoked more than 15 cigarettes a day for more than 25 years or more than 10 cigarettes a day for more than 30 years), suggesting that expanding eligibility criteria to include smokers with fewer pack-years and starting screening at age 50 years could be beneficial.[9] Motivated by this, we further analyzed risk factor–based strategies with 20 pack-years as the minimum pack-year criterion. In particular, we focused on consensus-efficient annual 20 pack-year strategies for the 1960 birth cohort with annual frequency and stopping age of 80 years as the 2013 USPSTF-recommended strategy (A-55-80-30-15), with starting ages of 50 or 55 years, and with at least 15 years since quitting smoking. There are six such strategies: A-55-80-20-15, A-55-80-20-20, A-55-80-20-25, A-50-80-20-15, A-50-80-20-20, and A-50-80-20-25 (**Tables 6** and **7**).

Table 8 shows a comparison of the 2013 USPSTF-recommended screening eligibility criteria with these selected 20 pack-year consensus-efficient strategies. Although these 20 pack-year strategies are consensus efficient under the two-outcome metric, the 2013 USPSTF-recommended strategy is not. The table shows that expanding current screening eligibility to include individuals with 20 to 29 pack-years of exposure would result in an increase in the percentage of the population ever screened from 14.1 percent to 20.6 to 23.6 percent. The average number (across models) of LDCT screens per 100,000 population for these 20 pack-year scenarios ranges from 330,095 to 500,430, in comparison with 227,443 for the 2013 USPSTF-recommended strategy. The average age at last screen ranges from 69.0 to 72.5 years compared with 71.3 years for the 2013 USPSTF-recommended strategy. The average age at first screen ranges from 51.5 years (for all strategies with starting age of 50 years) to 55.7 years, vs. 56.2 years for the 2013 USPSTF-recommended strategy.

In terms of benefits, these are higher for risk factor–based strategies with 20 pack-years vs. the 2013 USPSTF-recommended strategy. For instance, the number of lung cancer deaths averted per 100,000 population for the 20 pack-year strategies ranges from 469 to 558, corresponding to a population lung cancer mortality reduction ranging from 12.1 to 14.4 percent. In comparison, the 2013 USPSTF-recommended strategy results in 381 lung cancer deaths averted and a 9.8 percent mortality reduction. The LYG of the selected 20 pack-year strategies ranges from 6,018 to 7,596 per 100,000, and the NNS from 42 to 45. The 2013 USPSTF-recommended strategy would result in 4,882 LYG and has an NNS of 37.

In terms of harms, these are higher in general for the 20 pack-year strategies vs. the 2013 USPSTF-recommended strategy, particularly for strategies with higher maximum years since quitting criterion or younger starting age because these result in a higher average number of LDCT screens per screened individual. The average number of false-positive results per screened individual ranges from 1.9 to 2.5 for the selected 20 pack-year strategies vs. 1.9 for the 2013 USPSTF-recommended strategy. The number of biopsies ranges from 667 to 849 per 100,000 vs. 518 per 100,000 for the 2013 USPSTF-recommended strategy. The average number of LDCT examinations per screened individual ranges from 16.0 to 21.2 vs. 16.1 for the 2013 USPSTF-recommended strategy. The number of overdiagnosed cancers ranges from 83 to 94 per 100,000 population vs. 69 per 100,000 for the 2013 USPSTF-recommended strategy. The rate of overdiagnosis per screen-detected lung cancer ranges from 6.0 to 6.3 percent vs. 6.3 for the 2013 USPSTF-recommended strategy. Finally, the number of radiation-related lung cancer deaths for the selected 20 pack-year strategies ranges from 29.0 to 42.5 per 100,000 population vs. 20.6 per 100,000 population for the 2013 USPSTF-recommended strategy.

Appendix C Tables 9 and **10** show comparisons of the 20 pack-year consensus-efficient strategies with the 2013 USPSTF-recommended strategy by sex. These show similar patterns as for the whole population, but with higher increases in eligibility and lung cancer deaths prevented and LYG for women than men. For instance, women's eligibility increases from 12.4 percent for the 2013 USPSTF-recommended strategy to 19.3 to 21.5 percent in the 20 pack-year strategies (a 56 to 73% increase), while men's eligibility increases from 15.7 percent to 21.8 to 25.6 percent (a 39 to 63% increase). In terms of lung cancer deaths prevented, these increase in women from 362 per 100,000 for the USPSTF criteria to 463 to 551 per 100,000 for the 20 pack-year strategies (a 28 to 52% increase), while in men these increase from 400 to 475 to 565 per 100,000 (a 19 to 41% increase). In terms of LYG, these increase in women from 4,685 per 100,000 for the 2013 USPSTF-recommended strategy to 6,014 to 7,496 per 100,000 for the 20 pack-year strategies (a 28 to 60% increase), while in men these increase from 5,078 to 6,022 to 7,696 per 100,000 (a 19 to 52% increase). Similarly, the increase in harms is higher in women than in men. For instance, in women the number of overdiagnosed cancers increases from 64 to 80 to 91 per 100,000 population (a 25 to 42% increase), while in men it increases from 74 to 85 to 97 per 100,000 population (a 15 to 31% increase).

In summary, expanding eligibility to include individuals with 20 to 29 pack-years results in more benefits but also in more harms and higher increases in eligibility and lung cancer deaths prevented and LYG for women than men. We thus include the selected six 20 pack-year strategies as reference scenarios from this point forward and in **Figure 5**.

Risk Factor–Based and Risk Model–Based Consensus-Efficient Scenarios

When considering all risk factor–based and risk model–based screening scenarios together, the DEA with both outcome metrics (lung cancer deaths averted and LYG) identified 267 consensus-efficient scenarios. Of these, 6.7 percent (n=18) are risk factor–based strategies, and 93.3 percent (n=249) are risk model–based strategies. Neither the 2013 USPSTF-recommended strategy nor the six selected 20 pack-year strategies are among the 267 consensus-efficient scenarios. All consensus-efficient risk factor–based strategies are biennial (n=18), all with less than 10 percent of the population eligible, whereas 48.2 percent of the risk model–based screening strategies are annual and 51.8 percent biennial. Among 267 scenarios, 59.5 and 40.5 percent have age 50 years and age 55 years as the starting age, respectively. Regarding stopping age, 74.2 percent consensus-efficient strategies stop at age 80 years, 16.9 percent at age 77 years, and only 9.0 percent at age 75 years. All 18 risk factor–based strategies have 40 minimum pack-years and, as mentioned above, are biennial. Among these strategies there are about an equal number of scenarios with 10 and 15 maximum years since quitting (about 33.3% each), but fewer with 20 and 25 maximum years since quitting (22.2% and 11.1%, respectively). Among the 249 risk model–based strategies, 43.8 percent are based on the MPLCOm2012 model, 16.1 percent on the MLCDRAT model, and 40.2 percent on the Bach model. **Figure 7** shows the average, across CISNET models, number of LDCT screens vs. the number of lung cancer deaths averted (left) and LYG (right) for all risk factor–based and risk model–based screening scenarios, highlighting the 267 consensus-efficient scenarios (solid color) and the 2013 USPSTF-recommended scenario (A-55-80-30-15). Each panel shows the corresponding efficient frontier for the average model. Most of the consensus-efficient scenarios are on the frontier or among the closest to the frontier for both benefit metrics.

The average number (across models) of LDCT screens per 100,000 population among the consensus-efficient scenarios ranges from 64,607 to 790,911, with the percentage of individuals ever screened ranging from 9.0 to 44.0 percent. Most consensus-efficient strategies with relatively lower number of LDCT screens (less than 175,000 screens) are biennial risk factor–based or risk model–based strategies because these are the least intensive strategies, whereas all strategies with a higher number of LDCT screens are annual risk-based strategies. The number of lung cancer deaths averted ranges from 173 to 728 per 100,000 population, corresponding to lung cancer mortality reductions ranging from 4.5 to 18.8 percent. The LYG ranges from 2,405 to 9,318 per 100,000, and the NNS (persons ever screened per lung cancer death averted) ranges from 37 to 73.

With regard to harms, the average number of false-positive screens per screened individual ranges from 0.8 to 2.4, the number of biopsies from 241 to 1,203 per 100,000, and the average number of LDCT examinations per screened individual from 5.0 to 20.7. The number of overdiagnosed cancers ranges from 26 to 125 per 100,000 population, and the overdiagnosis rate per screen-detected lung cancer varies from 4.5 to 7.1 percent. Finally, the number of radiation-related lung cancer deaths ranges from 5.7 to 52.3, also increasing monotonically as a function of the number of screens and the percentage of people screened.

Table 9 shows the benefits of the consensus-efficient scenarios restricted to those leading to at least 9 percent lung cancer mortality reduction per 100,000 population, as with the selected risk factor–based strategies, and requiring fewer than 600,000 LDCT screens per 100,000 (a total of 144 strategies). We concentrated on strategies resulting in fewer than 600,000 LDCT screens because all risk factor–based strategies are within this limit and one of the main goals is to assess the relative performance of risk factor–based and risk model–based screening strategies at similar levels of screening. For reference, the table also includes the reference 2013 USPSTF-recommended and the six selected 20 pack-year strategies. **Figure 7** shows the average, across CISNET models, number of LDCT screens vs. the number of lung cancer deaths averted (left) and LYG (right) for the 144 selected consensus-efficient scenarios plus the 2013 USPSTF-recommended criteria. Of these, all of the consensus-efficient scenarios are risk model–based screening with 14.3 to 39.0 percent of individuals being eligible for screening at some point during their lifetime. The corresponding mortality reduction ranges from 9.0 to 17.1 percent and the LYG from 3,940 to 8,387 per 100,000 population. **Table 10** shows the corresponding harms. In this case, the average number of false-positive screens per screened individual ranges from 1.0 to 2.2, the number of biopsies from 506 to 1,015, the average number of LDCT examinations per screened individual from 7.0 to 19.2, and the overdiagnosis rate per screen-detected lung cancer from 5.6 to 7.1 percent. The number of radiation-related lung cancer deaths ranges from 10.9 to 43.3 per 100,000 population. Results for all the 267 consensus-efficient plus the 2013 USPSTF-recommended and the six selected 20 pack-year scenarios are shown in Appendix C **(Appendix C Tables 11** and **12**). Results stratified by sex for the selected consensus-efficient scenarios are also shown in Appendix C (**Appendix C Tables 13** and **14** for men and **Appendix C Tables 15** and **16** for women). **Appendix B Figures 21** and **22** show efficient frontiers for men's and women's outcomes, highlighting the consensus-efficient scenarios when considering both risk factor–based and risk model–based screening strategies.

USPSTF and USPSTF-Like Risk Model–Based Scenarios

As an example and to further understand the differences between risk factor–based and risk model–based screening strategies, **Table 11** shows a comparison of the 2013 USPSTF-recommended screening eligibility criteria (A-55-80-30-15) with three risk model–based consensus-efficient scenarios with the same screening starting and stopping ages and frequency and that result in a similar number of LDCT screens as the 2013 USPSTF-recommended strategy: A-55-80-MPLCOm2012-0.018 (i.e., with a 1.8% MPLCOm2012 risk threshold), A-55-80-MLCDRAT-0.018 (i.e., with a 1.8% MLCDRAT risk threshold) and A-55-80-Bach-0.03 (i.e., with a 3.0% Bach risk threshold). The table shows that the percentage of eligible individuals is higher for the risk model–based screening strategies (17.0%, 18.6% and 19.0%) than for the 2013 USPSTF-recommended criteria (14.1%). In contrast, the corresponding number of screens per person screened is lower for the risk model–based strategies (13.5, 12.7, and 12.2, respectively, vs. 16.1). Together these result in 227,443 LDCT screens per 100,000 population for the 2013 USPSTF-recommended strategy vs. 228,676 and 236,483 and 231,518 for the risk model–based screening strategies, respectively.

The table shows that the ages of screening shift to older ages for the risk model–based screening strategies in comparison to the 2013 USPSTF-recommended criteria; the average ages at first screen for the risk model–based strategies are 64.0, 64.5, and 65.4 years vs. 56.2 years for the 2013 USPSTF-recommended criteria. Similarly, the average age of the last screen is 76.5 or 76.8 years for risk model–based screening strategies vs. 71.3 years for the 2013 USPSTF-recommended criteria. This results in the lower number of screens per person screened for the risk model–based screening strategies.

In terms of benefits, the risk model–based strategies led to a higher number of lung cancer deaths averted (MPLCOm2012: 444; MLCDRAT: 448; Bach: 450 vs. USPSTF: 381 deaths averted per 100,000) and lung cancer mortality reduction (MPLCOm2012: 11.5%; MLCDRAT: 11.5%; Bach: 11.6% vs. USPSTF: 9.8%). These figures correspond to a 16.5, 17.6, and 18.1 percent increase in lung cancer deaths averted by risk model–based strategies, respectively, compared with the 2013 USPSTF-recommended scenario and translate to an average number of screens per lung cancer death averted of 515 (MPLCOm2012), 528 (MLCDRAT), 514 (Bach), and 597 (USPSTF). With regard to LYG, risk model–based screening scenarios led to 2.0, 0.7, and 1.1 percent higher LYG than the 2013 USPSTF-recommended strategy, respectively (MPLCOm2012: 4,982; MLCDRAT: 4,916; and Bach: 4,936 vs. USPSTF: 4,882 LYG per 100,000). The average number of screens per LYG is about the same for all scenarios. Finally, the overdiagnosis rate per screen-detected lung cancer is slightly higher for the risk model–based screening scenarios (MPLCOm2012: 6.7%; MLCDRAT: 6.9%; and Bach: 6.9% vs. USPSTF: 6.3%). However, the number of radiation-related lung cancer deaths per 100,000 is lower for the risk model–based screening strategies (MPLCOm2012: 15.8; MLCDRAT: 15.6; and Bach: 15.5 vs. USPSTF: 20.6).

Lastly, **Table 12** shows the percentage of individuals who would ever be eligible for screening or not by the 2013 USPSTF-recommended criteria and by each of the risk model–based screening criteria. In general, more individuals are eligible by the risk model–based criteria but not by the 2013 USPSTF-recommended criteria (MPLCOm2012: 3.9%, MLCDRAT: 5.8%, and Bach: 6.4%) than those eligible by the 2013 USPSTF-recommended criteria but not by the risk model–based criteria (MPLCOm2012: 1.1%, MLCDRAT: 1.3%, and Bach: 1.6%). For example, when considering the MPLCOm2012 criteria, 3.9 percent of individuals would be eligible but not by the 2013 USPSTF-recommended criteria, but only 1.1 percent would be eligible by the 2013 USPSTF-recommended criteria but not by the MPLCOm2012 criteria. When considering the MLCDRAT criteria, 5.8 percent of individuals would be eligible but not by the 2013 USPSTF-recommended criteria, but only 1.3 percent would be eligible by the 2013 USPSTF-recommended criteria but not by the MLCDRAT criteria. Similarly, for the Bach criteria, 6.4 percent of individuals would be eligible but not by the 2013 USPSTF-recommended criteria, but only 1.6 percent would be eligible by the 2013 USPSTF-recommended criteria but not by the Bach criteria.

Similar comparisons between the six selected 20 pack-year strategies and corresponding risk model–based strategies with the same age eligibility criteria and similar number of LDCT screens are presented in the **Appendix C Tables 17** through **22**.

Sensitivity Analysis

Consensus-Efficient Scenarios and DEA Using Single Metrics and Analyses for the 1950 Birth Cohort

Risk Factor–Based Screening Scenarios

We replicated the process to identify consensus-efficient scenarios (i.e., scenarios that have efficiency scores within the top 30% for 3 out of the 4 CISNET models) using single-outcome metrics: lung cancer deaths averted or LYG. We also replicated the risk factor–based DEA using the 1950 birth cohort. In general, the DEA with lung cancer deaths averted selected a larger number of scenarios than with LYG. For example, when considering the 1960 birth cohort, the DEA identified 80 consensus-efficient risk factor–based scenarios when using lung cancer deaths averted only, 50 when using LYG only, and 57 when using both metrics simultaneously (main results). When considering the 1950 birth cohort, the DEA identified 79 consensus-efficient risk factor–based scenarios when using lung cancer deaths averted only, 58 when using LYG only, and 69 when using both metrics simultaneously.

The general features of risk factor–based consensus-efficient strategies when using both outcome metrics simultaneously remain when using a single metric, independently of the birth cohort considered, but with some minor variations. A large majority of strategies have a stopping age of 80 years independently of the metric, and very few have age 45 years as a starting age. However, most consensus-efficient strategies when using lung cancer deaths averted have a starting age of 55 years (57.5%), while most have a starting age of 50 years when using LYG (64.0%). When using both outcomes, there are about an equal number of strategies starting at age 50 or 55 years. About 61 percent of strategies are biennial when using lung cancer deaths averted, increasing to about 68 percent when using LYG. In terms of minimum pack-years, 22.5 percent have 20 pack-years, 22.5 percent have 25 pack-years, 18.7 percent 30 pack-years, and 36.3 percent have 40 pack-years when using deaths averted. When using LYG, 28.0 percent have 20 pack-years, 24.0 percent have 25 pack-years, 10.0 percent have 30 pack-years, and 38.0 percent have 40 pack-years.

Appendix C Tables 23 and **24** show the benefits and harms of the consensus-efficient scenarios when considering both benefit metrics simultaneously for the 1950 birth cohort, restricted to those strategies leading to at least a 9 percent lung cancer mortality reduction and requiring fewer than 600,000 LDCT screens per 100,000 population (a total of 41 scenarios). In this case, the 2013 USPSTF-recommended scenario and the six selected 20 pack-year strategies, except A-55-80-20-15, are among the consensus-efficient scenarios. In general, the percentage of individuals eligible for screening is higher than when considering the 1960 birth cohort (corresponding results shown in **Tables 6** and **7**), resulting in higher benefits (lung cancer deaths averted and LYG) but also in higher harms (numbers of LDCT screens and followup LDCT scans, overdiagnosed cases, and LDCT radiation-related lung cancers deaths). For example, for the 1950 birth cohort under the 2013 USPSTF-recommended strategy, 20.8 percent would be eligible, resulting in 333,300 LDCT screens, a 12.2 percent mortality reduction, 7,956 LYG, 117 overdiagnosed cases, and 28.9 radiation-related lung cancer deaths. In contrast, for the 1960 birth cohort, the 2013 USPSTF-recommended strategy would screen 14.1 percent of the population, resulting in 227,443 LDCT screens, a 9.8 percent mortality reduction, 4,882 LYG, 69 overdiagnosed cases, and 20.6 radiation-related lung cancer deaths. The selected consensus-efficient scenarios show consistent patterns with those obtained when using the 1960 birth cohort. Specifically, most are annual (61.0%) and have age 80 years as a stopping age (87.8%, the rest have 77 years as a stopping age). However, likely due to cohort differences in smoking patterns and life expectancy, the distribution of minimum pack-years differs; when using the 1950 birth cohort, 19.5 percent have 20 pack-years, 31.7 percent have 25 pack-years, 36.6 percent have 30 pack-years, and 12.2 percent have 40 pack-years, whereas the large majority of consensus-efficient scenarios have 20 pack-years (52.0%) or 25 pack-years (36.0%) when using the 1960 birth cohort, and only 12.0 percent have 30 pack-years and none have 40 pack-years. In terms of outcomes, the consensus-efficient scenarios when using the 1950 birth cohort range from 14.6 to 31.8 percent eligible individuals, from 9.0 to 15.9 percent lung cancer mortality reduction, and the LYG from 5,891 to 10,785.

Risk Factor–Based and Risk Model–Based Screening Scenarios

We replicated the process to identify risk factor–based and risk model–based consensus-efficient scenarios using single-outcome metrics in the DEA for the 1960 birth cohort. As with risk factor–based strategies only, the DEA with lung cancer deaths averted selected a larger number of scenarios than with LYG. Specifically, the DEA identified 316 consensus-efficient risk factor–based and risk model–based scenarios when using lung cancer deaths averted only vs. 211 when using LYG only and 267 when using both metrics simultaneously (main analysis).

The general features of risk factor–based and risk model–based consensus-efficient strategies when using both outcome metrics simultaneously remain when using a single metric. Most consensus-efficient scenarios are risk model–based strategies, although relatively more risk factor–based scenarios make it to the consensus-efficient list when using LYG (96.8% are risk model based when using lung cancer deaths averted, 87.7% when using LYG, and 93.3% when using both metrics), and most have age 80 years as a stopping age (78.5% with lung cancer deaths averted and 48.3% with LYG, 74.2% when using both metrics). In terms of the risk prediction model, when using lung cancer deaths averted, 29.4 percent of consensus-efficient strategies are based on the MPLCO2012 model, 29.1 percent on the MLCDRAT model, and 38.3 percent on the Bach model. When using LYG, 49.8 percent are based on the MPLCOm2012 model, 4.7 percent on the MLCDRAT model, and 33.2 percent on the Bach model.

The 2013 USPSTF-Recommended Strategy and the Selected 20 Pack-Year Strategies as Consensus Efficient

The 2013 USPSTF-recommended criterion is a consensus-efficient scenario when considering risk factor–based strategies only and using lung cancer deaths averted as a metric in the DEA for both the 1950 and the 1960 birth cohorts. This is consistent with the 2013 DA, whose DEA was based on lung cancer deaths averted in the 1950 birth cohort and identified this scenario as one of the top strategies.[36, 44] However, when considering LYG as the DEA metric, the 2013 USPSTF-recommended criterion is not identified as consensus efficient because it is not among the closest scenarios to the efficient frontier of at least three out of the four models (see **Figure**

2). When considering both metrics, the 2013 USPSTF-recommended strategy is identified as consensus efficient for the 1950 birth cohort but not for the 1960 birth cohort. In contrast, all six selected 20 pack-year strategies are consensus efficient for the 1950 birth cohort when using the lung cancer deaths averted metric only, two are so when considering LYG only, and all but one are consensus efficient when considering both metrics combined. All six selected 20 pack-year strategies are consensus efficient for the 1960 birth cohort when using either one of the metrics (lung cancer deaths averted or LYG) or combined. Finally, very few risk factor–based strategies are identified as consensus efficient when considering both risk factor–based and risk model–based strategies simultaneously. Most of these are in the lower end of the number of LDCT screens; thus, neither the 2013 USPSTF-recommended criterion nor the six selected 20 pack-year strategies are identified as consensus efficient in this case. **Table 13** shows a summary of the DEA results and the inclusion or not of the 2013 USPSTF-recommended criterion and the six selected 20 pack-year strategies as consensus efficient.

Life Expectancy Sensitivity Analysis

Appendix C Tables 25 through **26** show the benefits and harms of the selected consensus-efficient strategies when limiting screening to only those with more than 5 years of life expectancy under the assumption of perfect assessment of life expectancy. These tables show the benefits and harms of selected consensus-efficient strategies when considering risk factor–based strategies only, restricted to those strategies resulting in at least a 9 percent lung cancer mortality reduction and requiring fewer than 600,000 LDCT screens in the main analysis. **Appendix C Tables 27** and **28** show the benefits and harms of selected consensus-efficient strategies when considering risk factor–based and risk model–based screening strategies jointly, restricted to those strategies resulting in at least a 9 percent lung cancer mortality reduction and requiring fewer than 600,000 LDCT screens in the main analysis.

The tables show that, in general, limiting screening to only those with more than 5 years of life expectancy, assuming a hypothetical perfect assessment of life expectancy, would not greatly affect the resulting benefits (lung cancer mortality reduction or LYG). In contrast, excluding individuals with less than 5 years of life expectancy from screening would result in fewer harms, particularly in considerably fewer overdiagnosed cases. This is particularly true for strategies screening at older ages. For example, for the 2013 USPSTF-recommended strategy, restricting screening to those with at least 5 years of life expectancy would reduce the percentage eligible by 3.5 percent, the total number of LDCT screens by 7.2 percent, the lung cancer mortality reduction by 4.5 percent, and the number of overdiagnosed cancers by 66.7 percent. In comparison, restricting screening to those with at least 5 years of life expectancy for the "USPSTF-like" risk model–based scenario A-55-80-MPLCOm2012-0.018 would reduce the percentage eligible by 5.3 percent, the total number of LDCT screens by 10.4 percent, the lung cancer mortality reduction by 5.0 percent, and the number of overdiagnosed cancers by 68.5 percent.

Chapter 4. Discussion

This report summarizes a comparative modeling DA of the long-term benefits and harms of LDCT screening for lung cancer in the United States to inform the USPSTF lung cancer screening recommendations. The analysis extends the corresponding 2013 DA,[36, 44] which focused on the benefits and harms of screening strategies with eligibility criteria based on age, cumulative smoking exposure (pack-years), and time since quitting for former smokers by also considering strategies with eligibility based on individual lung cancer risk (probability of detection or dying from lung cancer within 6 years). Moreover, three of the CISNET lung cancer natural history models were updated to consider current practice and the management of screening results and pulmonary nodules using the Lung-RADS criteria, modeling the Lung-RADS protocols explicitly or indirectly via the associated rates of false-positive tests, and the expected changes in screening sensitivity relative to NLST (**Table 1**).[8] The other model allows for comparison with and consideration of screening outcomes based on NLST protocols. In addition, this analysis considered the long-term impacts of lung cancer screening in two U.S. birth cohorts, 1950 and 1960, further extending the previous DA that focused only on the 1950 birth cohort.

The results are consistent with the previous comparative modeling DA for risk factor–based strategies evaluated on the 1950 birth cohort. In particular, the relative ranking of risk factor–based strategies and the characteristics of consensus-efficient scenarios are consistent with the previous DA. In addition, the projected benefits and harms of the 2013 USPSTF-recommended strategy for the 1950 birth cohort are similar, although with some slight variations due to the use of one fewer CISNET model here, the updates made to the screening simulation models to reflect current practice, and the changes to the CISNET SHG and the corresponding mortality rates to reflect more current patterns of smoking and overall and tobacco-related mortality.[2, 43] For example, in 2013, the DA projected that 19.3 percent of the 1950 birth cohort would be eligible according to the 2013 USPSTF-recommended strategy, resulting in 286,813 LDCT screens per 100,000, 521 lung cancer deaths averted per 100,000 (a 14.0% mortality reduction), 5,517 LYG per 100,000, an NNS of 37, 3.5 false-positive screens per screened individual, 190 overdiagnosed cases per 100,000 (9.9% overdiagnosis rate per screen-detected lung cancer), and 24 radiation-related lung cancer deaths per 100,000.[36] In comparison, here we project that 20.8 percent of the 1950 birth cohort would be eligible, resulting in 333,300 LDCT screens per 100,000, 612 lung cancer deaths averted per 100,000 (a 12.2% mortality reduction), 7,956 LYG per 100,000, an NNS of 34, 1.9 false-positive screens per screened individual, 117 overdiagnosed cases per 100,000 (6.5% overdiagnosis rate per screen-detected lung cancer), and 28.9 radiation-related lung cancer deaths per 100,000 (**Appendix C Tables 23** and **24**). The higher absolute numbers of lung cancer deaths prevented and LYG per 100,000 population in the current DA are due to the CISNET SHG updates mentioned above, which resulted in slightly higher eligibility, lower competing mortality rates, and larger life expectancies for the simulated population. The lower percentage mortality reduction is largely due to the absence of the Fred Hutchinson Cancer Research Center CISNET model in the current DA, which had the highest percentage mortality reduction in the 2013 DA.[36] The lower overdiagnosis rate is due also to the exclusion of the Fred Hutchinson Cancer Research Center model, which had the highest overdiagnosis rate in the 2013 DA, and due to the slightly longer life expectancies in the newer version of the SHG. Finally, the lower rate of false-positive screens is due to the model updates to reflect Lung-RADS.

The current DA suggests that, if adopted by those eligible, LDCT screening could lead to reductions of lung cancer mortality and result in significant LYG in the United States. Although still present, overdiagnosis and radiation-related lung cancer deaths would be relatively limited, irrespective of age. Although the number of false-positive screens per person screened would be lower than earlier projections because of improvements in clinical practice, these would still remain a concern because each person adhering to annual screening for multiple years would be expected to receive a false-positive result at some point. However, the population impacts of screening, and its level of benefits and potential harms, are modulated by the eligibility criteria, which can greatly affect the proportion of the population that would be eligible for screening and the underlying lung cancer risk of that eligible population. Although this analysis cannot identify a single optimal scenario, it identified a set of scenarios that were determined as efficient for a level of screening (number of LDCT screens) by at least three of the four simulation models used in this analysis, providing some guidance on general features of the consensus-efficient scenarios.

When focusing only on scenarios with eligibility based on age, pack-years and time since quitting smoking for former smokers (risk factor based), most consensus-efficient strategies had stopping screening age as 80 years and starting screening age as 50 or 55 years. Annual screening strategies performed better when using lung cancer deaths averted as the benefit metric, while biennial strategies improved in their ranking when using LYG as the benefit metric. Consistent with the 2013 DA, the 2013 USPSTF-recommended eligibility criteria, annual screening of individuals between the ages of 55 and 80 years with at least 30 pack-years of smoking history and no more than 15 years since quitting smoking (A-55-80-30-15), was among the consensus-efficient strategies when using lung cancer deaths averted as the benefit metric. However, it decreased in efficiency ranking when including or considering exclusively LYG as the metric.

Recent studies have suggested that expanding eligibility to include ever smokers with 20 to 29 pack-years of exposure would increase the proportion of lung cancers preventable by screening in the United States and also reduce disparities in eligibility by race/ethnicity and gender.[20, 22, 23, 52-54] In particular, using data from the 2010 National Health Interview Survey, Pinsky et al showed that reducing the minimum pack-years to 20 would increase the percentage of women and minorities who would be eligible for screening.[20] They also used PLCO data to show that the risk of 20 to 29 pack-year current smokers is comparable to that of screening eligible former smokers based on the 2013 USPSTF-recommended criteria, providing an additional argument for considering expanding the eligibility criteria. Aldrich et al recently evaluated the percentage of lung cancers that would have been eligible for screening under the 2013 USPSTF-recommended strategy in a predominantly African American and low-income cohort.[52] They found that proportionally, fewer African Americans with lung cancer would have been eligible for screening vs. whites with lung cancer. And that expanding the criteria to include 20 to 29 pack-year ever smokers would increase considerably the screening sensitivity for African Americans.[52] This difference was attributed to the lower pack-year levels among African Americans with lung cancer vs. whites with lung cancer. The lower cumulative smoking exposure (pack-years) among African Americans vs. whites has also been observed in national data.[22] In addition, the recently published NELSON trial, which found a 24 percent lung cancer mortality relative reduction at 10 years after four rounds of LDCT screening vs. a no-screening arm, included ever smokers of ages 50 to 74 years, with lower smoking exposure criteria than the NLST and current recommendations. This study provides additional empirical evidence supporting expanding eligibility criteria to include smokers with fewer pack-years than current screening guidelines and starting screening at age 50 years.[9]

Based on these studies and on our finding that a majority of selected consensus-efficient scenarios for the 1960 birth cohort had a minimum pack-year criterion of 20, we conducted a comparison of the eligibility and the benefits and harms of selected consensus-efficient 20 pack-year scenarios vs. those of the 2013 USPSTF-recommended criteria. In particular, we focused on risk factor–based strategies with 20 pack-years and at least 15 years since quitting smoking, annual frequency, starting age of 50 or 55 years, and stopping age of 80 years. Our analysis suggests that consistent with the literature reducing the minimum pack-year criteria would result in considerable increases in eligibility with a larger increase in women vs. men. In addition, we found that including 20 to 29 pack-year smokers would result in considerable increases in the benefits of screening, but also in more harms. Although we did not consider different racial or ethnic groups in the DA, comparisons of the percentage of individuals eligible for screening in the United States under the 2013 USPSTF-recommended strategy vs. the percentage for selected 20 pack-year strategies by sex and race/ethnicity (non-Hispanic whites, non-Hispanic blacks, Hispanics, Asians, and American Indian/Alaska Natives) are presented in **Appendix C Tables 29** and **30**. These numbers are based on the nationally representative 2015 National Health Interview Survey, updating those in Pinsky et al.[20] The National Health Interview Survey data suggest that the relative increase in eligibility from reducing the pack-year criterion to 20 pack-years vs. that of the current criteria would be larger for women vs. men and for non-Hispanic blacks, Hispanics, and American Indian/Alaska Natives vs. non-Hispanic whites and Asians. For example, the percentage of eligible women would increase in the A-50-80-20-15 strategy vs. the 2013 USPSTF-recommended criteria from 2.8 percent to 5.5 percent (a 96% increase), whereas the percentage of eligible men would increase the from 4.2 percent to 7.6 percent (a 81% increase). The tables also show the distribution of 100,000 LDCT screens to the population according to the proportion of eligible ever smokers in each sex or in each racial/ethnic group. These tables suggest that the 20 pack-year strategies would distribute these LDCT screens in a more equitable manner across sex and racial/ethnic groups. In all, our findings suggest that expanding eligibility to include individuals with 20 to 29 pack-years results in considerably more benefits, but also in more harms.

Joint consideration of strategies with eligibility based on cumulative smoking exposure and time since quitting (risk factor–based strategies) and strategies with eligibility based on multivariate risk prediction models (risk model–based strategies) provided insights into the potential of more detailed risk model–based screening. In general, although restricted here to only age, smoking history, and sex covariates and thus ignoring other relevant lung cancer risk factors, risk model–based screening strategies based on multivariate models tended to result in higher numbers of lung cancer deaths averted than risk factor–based strategies for programs with a similar number of total LDCT screens. This result was also the case for LYG, although risk model–based and risk factor–based strategies were closer for this metric. This finding is consistent with other recent studies in the literature.[28, 30] The DA compared the performance of risk model–based programs relying on three different lung cancer risk prediction models: MPLCOm2012, MLCDRAT, and Bach. The analysis suggests that although the specific risk model used might be an important consideration, an even more critical aspect is to determine eligibility risk thresholds specific to the corresponding risk model.

A comparison of risk factor–based criteria with comparable risk model–based screening scenarios with the same age criteria and frequency shows that risk model–based screening strategies tend to shift the ages of screening to older ages when lung cancer risk is highest. This explains their superior performance in reducing lung cancer deaths but the more similar performance with risk factor–based strategies when considering LYG. This finding is consistent with previous analyses in ten Haaf et al.[30] In rough terms, risk factor–based (age/pack-year/time since quitting) criteria in general tend to screen people at younger ages when lung cancer risk is lower but when there are more potential life-years to be gained if a lung cancer death is prevented. In contrast, risk model–based screening strategies tend to screen older individuals when lung cancer risk is highest, preventing more lung cancer deaths but resulting in fewer LYG per lung cancer death averted. By screening older individuals, risk model–based screening strategies also result in higher numbers of overdiagnosed cases. In contrast, they result in fewer radiation-related lung cancer deaths because their numbers of LDCT screens per screened individual are lower and thus result in fewer and later-in-life radiation exposures. The life-expectancy sensitivity analysis suggests that restricting screening to only those with reasonable life expectancy and minimal comorbid conditions (i.e., to only those eligible for curative treatment) could reduce the harms and overdiagnosis rates while keeping most of the benefits from screening,[34, 35] consistently also with the previous analyses by ten Haaf et al.[30]

Our findings must be put in context relative to the NLST and other lung cancer screening trials. Here we extrapolated trial results to the general U.S. population rather than focusing only on eligible individuals, and we simulated the impact of multiple rounds of screening with an almost lifetime followup (up to age 90 years or death), rather than considering a fixed number of screens with a short-term followup as is usually done in LDCT trials (e.g., three screens as in NLST with 6 or 7 years of followup). Moreover, for each screening scenario we are estimating impact per 100,000 individuals in the overall population rather than restricting the analysis to only those eligible for screening because the proportion and risk distribution of the population eligible vary greatly across the strategies evaluated. Thus, restricting the analysis to only screen-eligible individuals would lead to noncomparable results between strategies. As such, the predicted mortality reductions per 100,000 population for all scenarios, including the 2013 USPSTF-recommended strategy, are lower than the observed mortality reduction in the NLST,[4-6] which was restricted to only those meeting the trial eligibility criteria. As discussed above, this is consistent with the results of the 2013 lung screening DA.[36, 41, 44] The estimated NNS to prevent a lung cancer death ranged from 29 to 64 among consensus-efficient risk factor–based strategies (NNS of 37 for the 2013 USPSTF-recommended strategy in the 1960 birth cohort), which is much more favorable than published estimates for only three screens, which range on average between 280 and 320,[4, 55] although with variations by risk[34] but consistent also with the 2013 DA estimates[36, 41, 44] and closer to estimates for other cancer screening programs extrapolated to the U.S. population, such as colon cancer or breast cancer screening.[56, 57] The lower NNS vs. direct-trial estimates are due to the consideration of multiple rounds of annual or biennial screening and not just three screens. The rate of overdiagnosis per screen-detected lung cancer ranged from 4.5 to 6.3 percent. This rate is lower than estimates based on the NLST with 6 to 7 years of followup[58] but consistent with more recent estimates with extended followup[6] and with estimates accounting for lifetime followup[36, 41, 44, 58] like the 2013 DA.

Strengths and Limitations of Modeling

The DA used four established lung cancer natural history models that aim to capture the complexity in smoking patterns and lung cancer risk and integrate and synthetize information from lung cancer screening randomized trials, large epidemiological prospective studies, and cancer surveillance data. The models and the CISNET SHG have been shown to reproduce the patterns of smoking and lung cancer incidence and mortality in the United States[2, 36, 41-43] and thus provide a framework to extrapolate the effects of screening into the entire U.S. population. By following a comparative modeling approach, the collaborative modeling DA was able to assess the impact of varying model structures and assumptions on the results. Although the absolute numbers of projected lung cancer deaths averted and LYG, as well as the resulting harms, such as false-positive LDCT screens and overdiagnosed cases, vary across models, the conclusions about the relative performance of different screening strategies are generally consistent across models. The models differ in structure (e.g., smoking dose-response model or histology groups modeled) in the way they incorporate screening effects and efficacy, in how they account for followup, and in their projections for future lung cancer incidence and mortality (**Appendix A**).[30, 59, 60] This results in differences in the absolute number of projected lung cancer deaths prevented and life-years gained and other outcomes between CISNET models. However, the relative performance of different scenarios according to their characteristics (starting and stopping age, minimum pack-years, maximum years since quit, risk threshold) was consistent across the models. This finding cross-validates the results and provides confidence in the conclusions. Moreover, independent DEAs by CISNET model allowed for identification of strategies that were efficient according to at least three of the four CISNET models, independently of the differences in absolute numbers between models. However, like any other modeling study, our analysis is subject to some limitations.

First, our DA assumed an idealized 100 percent screening uptake (i.e., all people eligible for screening would be identified and would choose to undergo screening after a discussion about potential benefits and harms) and 100 percent screening adherence (i.e., all recommended LDCTs would be completed) for eligible individuals. Thus, projections of the benefits and harms of screening should be interpreted as an upper bound of what the actual impact could be. Varying the uptake and adherence levels assuming a random (uniform) uptake and adherence in the population would not change the relative performance of the screening scenarios and thus our main conclusions, only the overall level of estimated benefits and harms.[61] Nonetheless it is likely that lung cancer screening uptake and adherence may vary by age, sex, race/ethnicity, socioeconomic status, smoking status, and insurance coverage.[17, 62-64] This variability could affect the relative performance of strategies that favor screening at older vs. younger ages. In addition, uptake and adherence might be likely to vary by screening frequency; for example, if uptake and adherence are greater for biennial than for annual screening strategies, then the relative performance of biennial strategies would be better than our estimates indicate. Given that lung screening implementation is still at an early stage, there is a lack of data on how uptake and adherence might vary by these and other factors. We thus restricted the analysis to a uniform 100 percent uptake and adherence. However, the potential impact of adherence heterogeneity on the relative performance of alternative strategies should be revisited in future analyses as more data on screening rates emerge, taking into account the specific meaning of uptake and adherence in this context given the shared decision-making requirements for lung screening. Relatedly, recent studies have suggested that adopting lung cancer screening has been less than optimal; only a small percentage of those eligible actually get screened.[12-17] Moreover, it has been reported that some people who do not meet the criteria are getting screened.[13] These two issues could greatly affect the actual net benefits and harms of screening at the population level. Furthermore, our analysis did not explicitly examine incidental findings, which could affect the overall benefits and harms of screening[3, 65] nor other potential harms, such as adverse events other than overdiagnosed cases, false-positive results, and radiation-related lung cancer deaths. In addition, our models were calibrated to lung screening trial outcomes; however, the effectiveness of lung cancer screening may be variable and lower in the general population than in trials because of lower accuracy of LDCT scan interpretation, nodule management protocol adherence, or higher surgical mortality. On the other hand, the models were updated to reflect improvements in nodule followup guidelines since the NLST trial was completed, which should result in lower false-positive rates and fewer followup scans than those in NLST.

Second, the DA focused only on age, smoking history, and sex, ignoring other important lung cancer risk factors, such as race/ethnicity, history of COPD, and family history of lung cancer. Including such covariates would require joint simulation of all of these at the U.S. population level, accounting for their correlation and time trends. While the CISNET group has extended the SHG to consider other covariates,[66] including all of these covariates in the DA would require validated lung cancer natural history models incorporating these risk factors. That being said, although restricted to smoking covariates, sex, and age, the DA can shed some light on the differences between risk factor–based and risk model–based screening strategies. Comparisons of representative risk factor–based strategies with risk model–based strategies with the same age range and screening frequency show that a larger proportion of individuals would be eligible by risk model–based criteria, but not by risk factor–based criteria. This difference would likely increase even further if considering other covariates. For instance, African Americans are known to smoke fewer cigarettes per day than other racial groups and thus have lower pack-years on average. Nonetheless, they have a higher risk of lung cancer on average (~1.4 relative risk vs. the risk for whites).[20-22, 27] Hence, proportionally, more African Americans with considerable lung cancer risk would be excluded by risk factor–based strategies but not by risk model–based strategies.[66] Thus, risk model–based screening strategies based on risk prediction models accounting for race/ethnicity and other sociodemographic factors could mitigate an increase in existing lung cancer disparities,[67] assuming that the benefits of screening and early treatment are consistent across race/ethnicity and sociodemographic factors.

Third, our analysis did not consider potential implementation challenges of risk model–based screening nor whether those could vary by setting or among different demographic groups. Several ongoing implementation studies and trials are evaluating the feasibility and potential of risk model–based screening in clinical settings, so far with promising results.[8, 65, 68-71] Moreover, several online calculators,[34, 46, 47, 57, 58] some embedded within screening shared decision-making tools,[34, 72] are available to facilitate the implementation of risk model–based eligibility using the risk prediction models evaluated. Our simulations assumed that the process of assessing an individual's lung cancer risk annually (or every other year for biennial strategies) using risk prediction models is equivalent and as effective as calculating risk factor exposures, but further studies are needed to determine if this is the case in clinical practice.

Fourth, our projections do not account for future improvements in lung cancer treatment and further changes in smoking trends. Recent developments in lung cancer targeted therapies and immunotherapies could affect future lung cancer death rates. These improvements could act synergistically with screening as the stage distribution of lung cancers shifts to earlier stages. The CISNET SHG projects future rates of smoking under a status quo scenario, which carries smoking initiation and cessation trends by birth cohort into the future and implicitly assumes that tobacco control practices will remain as they are today. Changes in tobacco control or shifts in tobacco use patterns due to the advent of e-cigarettes and other tobacco products could affect future smoking patterns and result in higher or lower smoking rates for the 1950 and 1960 birth cohorts. These changes could affect the screening eligibility rates and thus the population impact of screening. Furthermore, the DA did not consider the potential additional benefits of complementary smoking cessation programs within the context of lung screening.[68, 73-79]

Finally, the DA focused on two U.S. birth cohorts rather than on the whole population. Given the complex relationship between smoking and lung cancer[45, 46, 80] and the rapidly changing smoking patterns by birth cohort in the United States,[2, 81] which, as mentioned above, could greatly affect eligibility and thus the impact of screening, restricting the analyses to single cohorts reduced its complexity and dimensionality and facilitated the comparison between scenarios and the interpretation of the results. Moreover, although these two birth cohorts are separated by only 10 years, they are representative of different moments of the tobacco epidemic and provide a snapshot of how smoking rates and screening eligibility are projected to change in the near future. Our analyses show that despite their differences, the main conclusions regarding the most effective risk factor–based programs (most consensus-efficient strategies are annual, have starting age of 50 or 55 years and stopping ages of 80 years) do not vary by birth cohort.

Summary

In summary, the CISNET Lung Cancer Working Group collaborative modeling analysis identified a set of LDCT screening programs that are efficient for a given level of screening in reducing lung cancer mortality and providing important gains in life-years at the population level. Most consensus-efficient strategies have screening starting at ages 50 or 55 and stopping at the age of 80 years. Among risk factor–based strategies, starting at age 50 or 55 years results in better performance (higher number of lung cancer deaths averted and LYG for a given number of LDCT screens per 100,000 population) than age 45 years. The 2013 USPSTF-recommended criteria are not among the consensus-efficient strategies for the 1960 birth cohort. However annual risk factor–based strategies with a smoking history of at least 20 pack-years, starting ages of 50 or 55 years, and a stopping age of 80 years are consensus efficient and result in considerably more lung cancer deaths prevented and LYG than the 2013 USPSTF-recommended strategy with limited additional harms. Among risk model–based screening strategies, the net benefits and harms of screening strongly depend on the risk model's specific risk thresholds. Overall, risk model–based screening strategies result in higher numbers of lung cancer deaths prevented, modest increases in LYG and lower radiation-related lung cancer deaths than risk factor–based strategies; however, they result in higher numbers of overdiagnosed cases. But the analyses did not consider issues of implementation and other potential challenges of risk model–based strategies. Nor did they consider issues of uptake and adherence of the various modeled lung cancer screening strategies.

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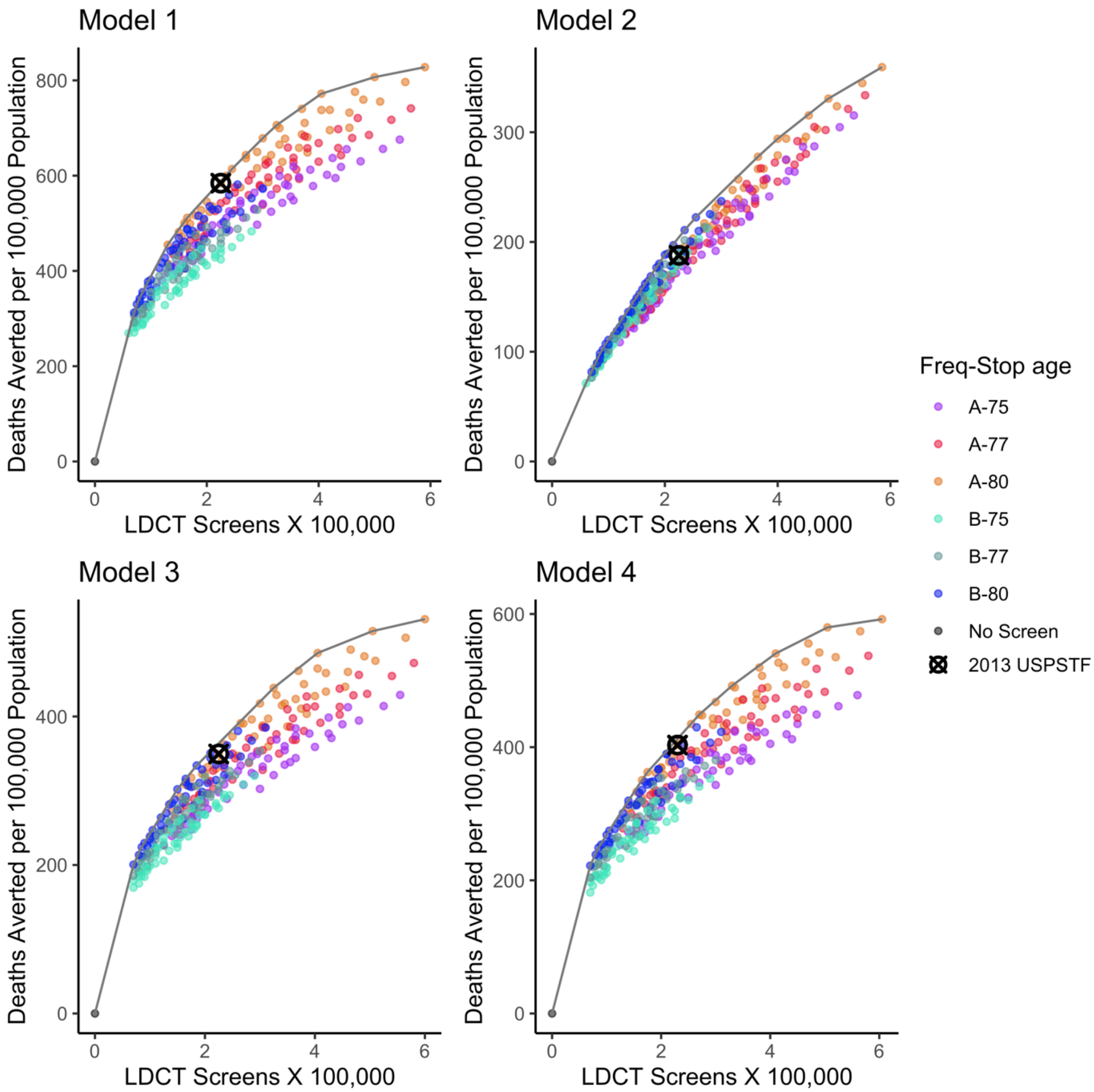
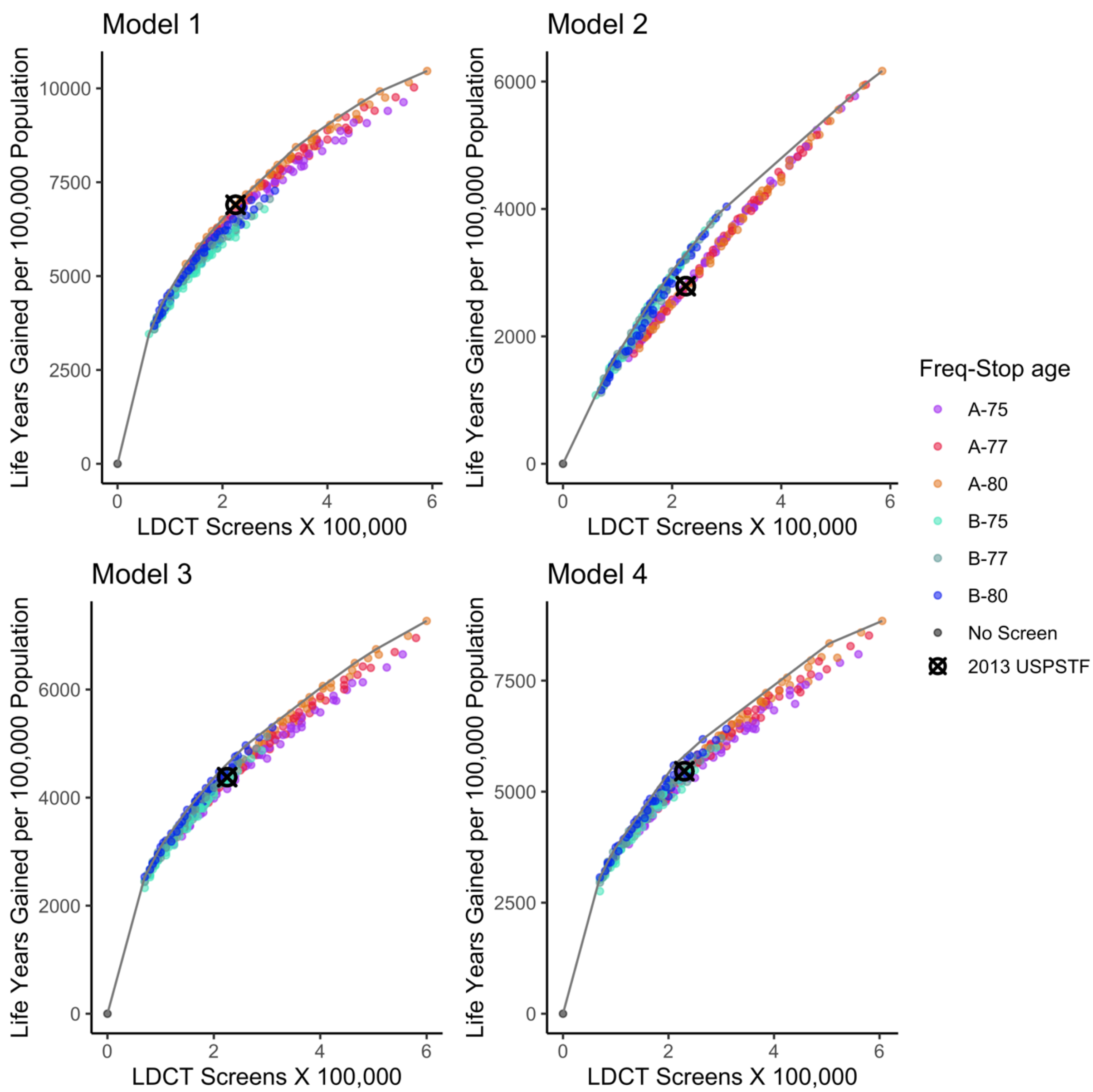
Figure 1. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force.

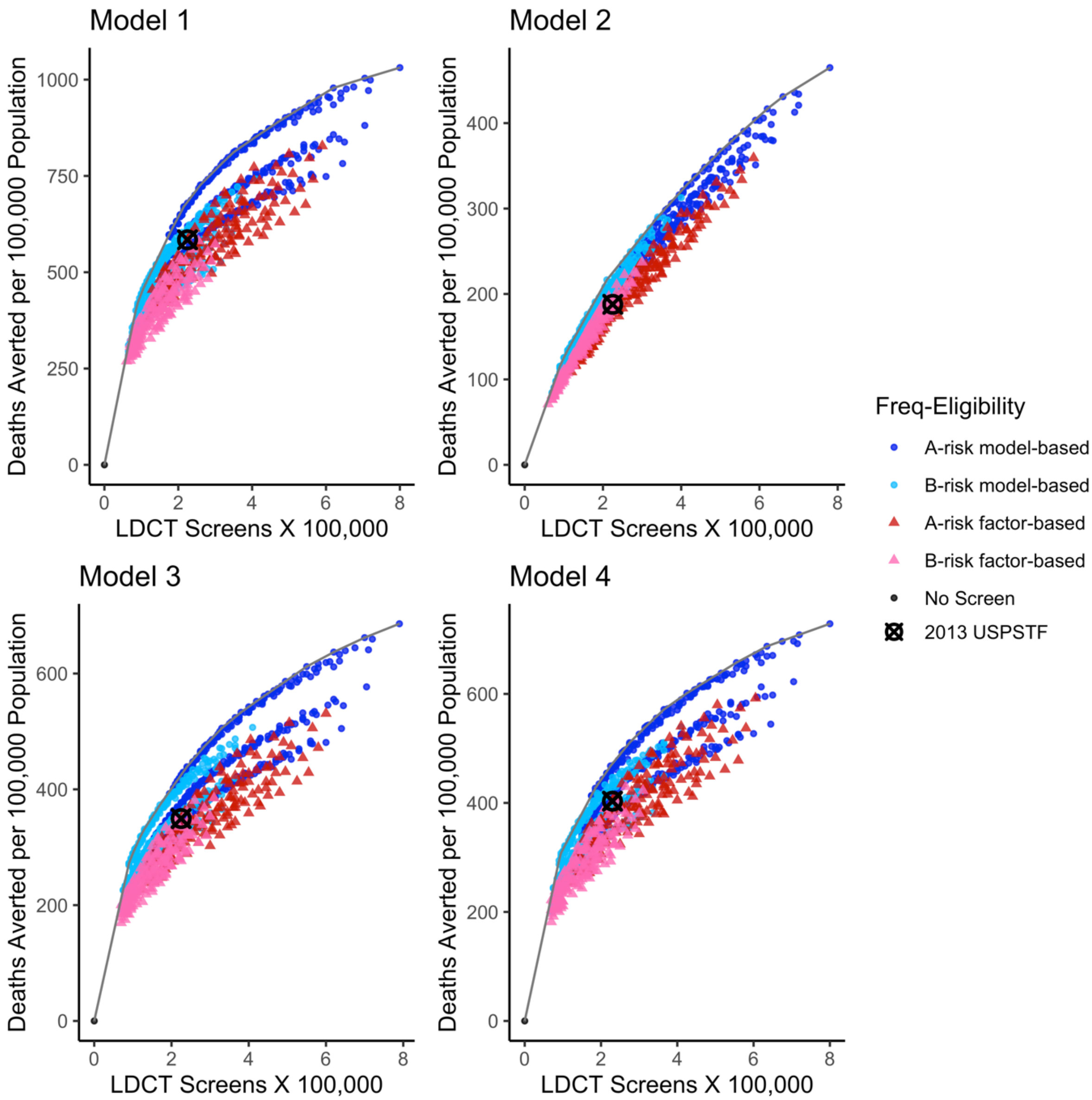
Figure 2. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force.

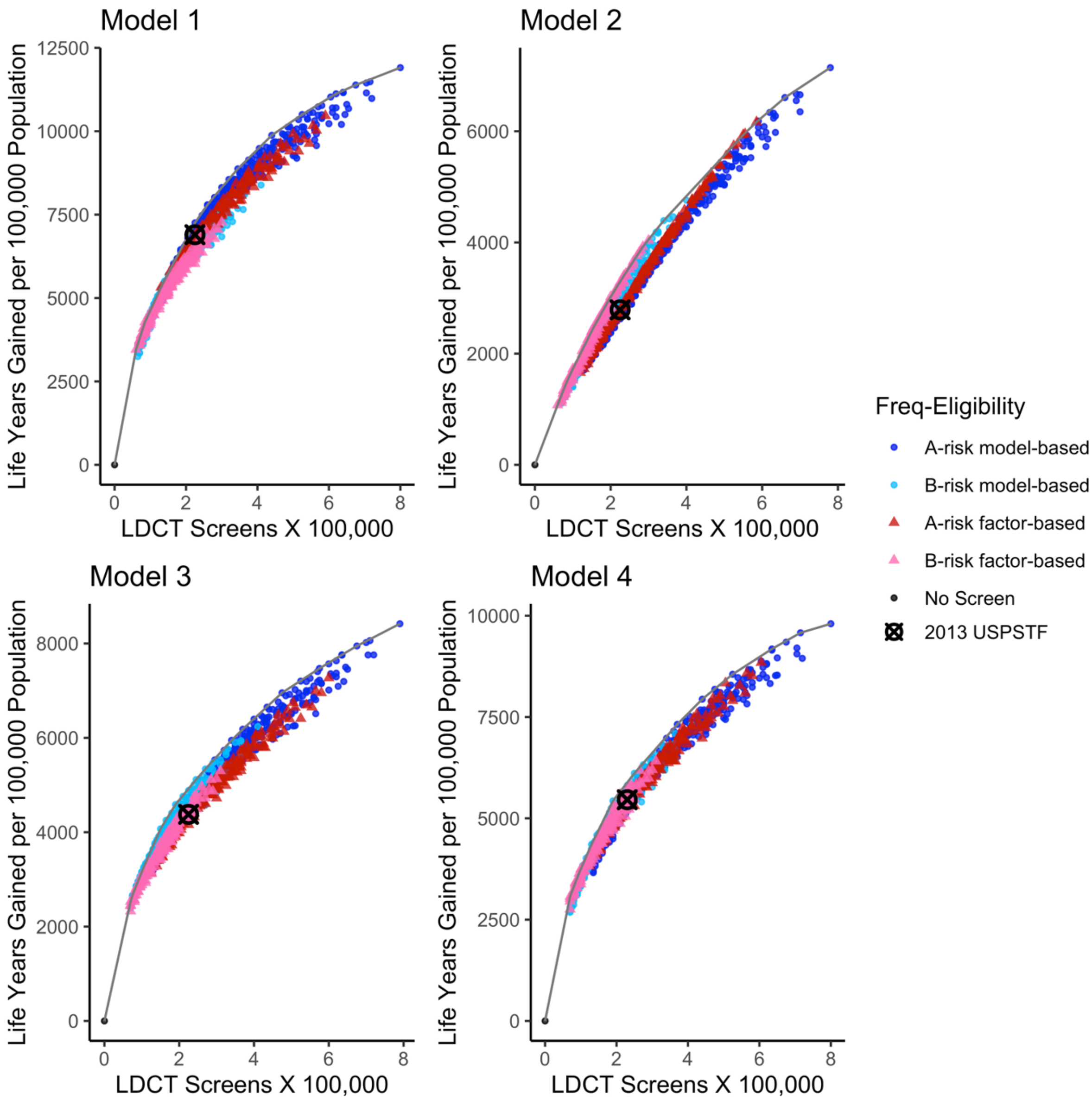
Figure 3. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) with round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

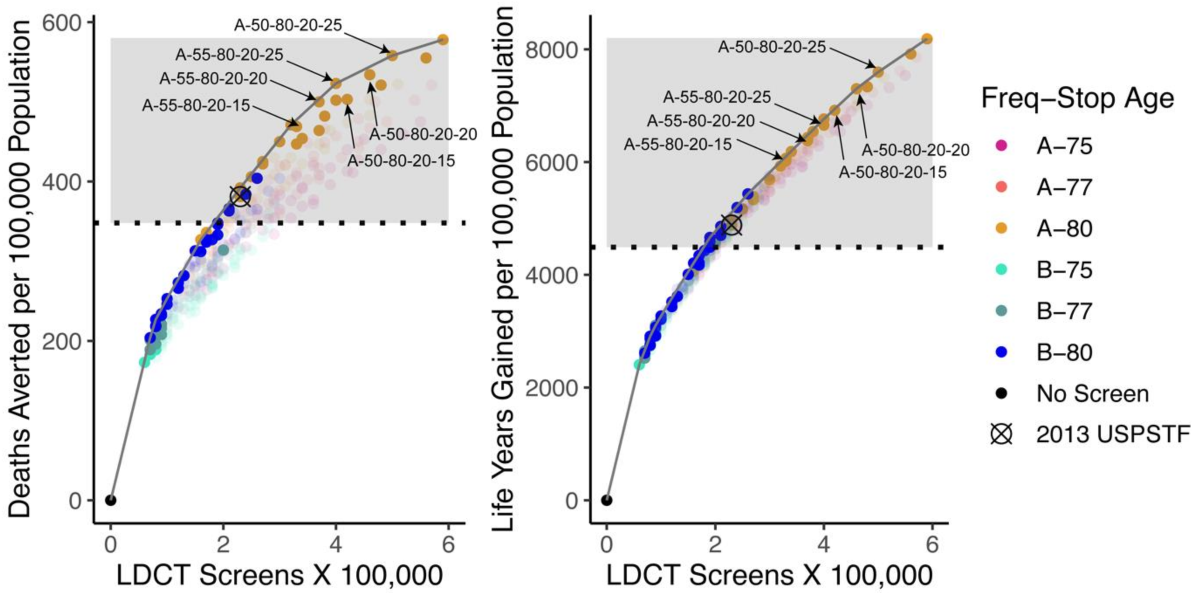
Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force.

Figure 4. Number of LDCT Screening Examinations vs. the Life-Years Gained in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) with round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.
Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force.

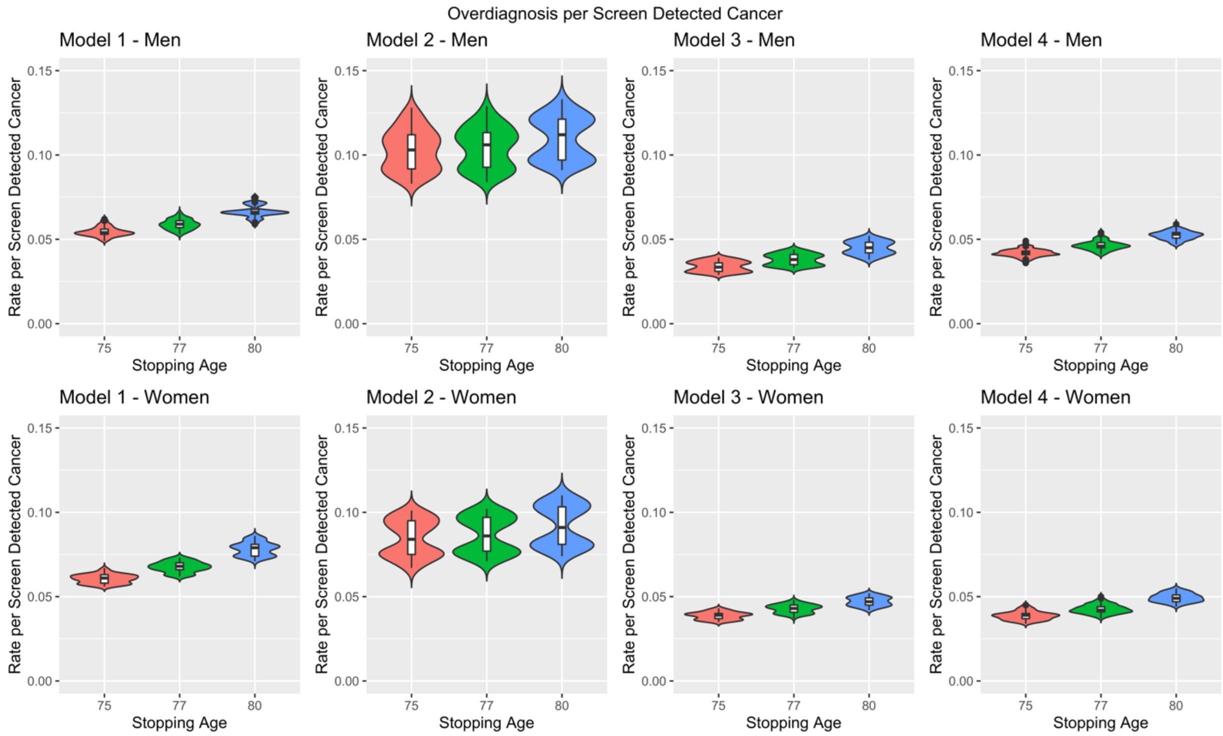
Figure 5. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort



Note: Each point represents a different scenario, and the curve represents the estimated efficient frontier for the average model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot), the 2013 USPSTF-recommended ("⊗" mark), and six selected consensus-efficient 20 pack-year scenarios are highlighted. The panels show all 288 risk factor–based strategies but highlight (solid color points) those identified as consensus efficient (listed in Appendix C Tables 3 and 4). The horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with at least a 9 percent lung cancer mortality reduction (listed in Tables 6 and 7).

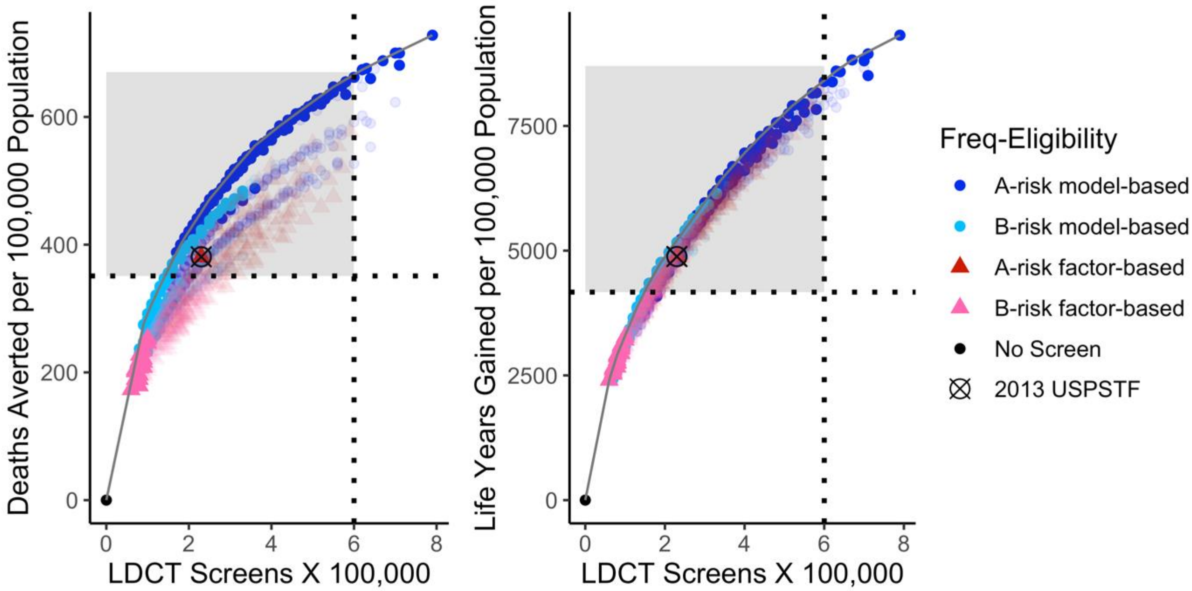
Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force.

Figure 6. Overdiagnosis Rate per Screen-Detected Lung Cancer Cases by Age at Stopping Screening and Sex for Each of the Four CISNET Models—1960 Birth Cohort



Note: Violin plots represent the distribution of the overdiagnosis rate across all the risk factor–based strategies evaluated. The boxplot inside each "violin" shows the overdiagnosis rate median, interquartile range, and 1.5 times the interquartile range across scenarios. The violin body shows the full probability density (reproduced on each side of the boxplot). For all models, the overdiagnosis rate increases as a function of age at stopping.
Abbreviation: CISNET=Cancer Intervention and Surveillance Modeling Network.

Figure 7. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based and Risk Model–Based Eligibility Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort



Note: Risk factor–based screening scenarios are represented with triangle points and risk model–based screening scenarios with round points. The curve represents the estimated overall efficient frontier for the average model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting smoking (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted. Panels show all considered strategies but highlight (solid color points) those identified as consensus efficient (listed in Appendix C Tables 11 and 12). The vertical line represents 600,000 LDCT screens, and the horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with fewer than 600,000 LDCT screens per 100,000 population and providing at least a 9 percent lung cancer mortality reduction (listed in Tables 9 and 10).

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force.

Table 1. Characteristics of the Four CISNET Lung Group Models Used in the Collaborative Modeling

Model Components	Erasmus-MISCAN Model 1	MGH-HMS Model 2	Stanford-LCOS Model 3	University of Michigan Model 4
Type of smoking dose-response model	2-stage clonal expansion model	Probabilistic by histology	2-stage clonal expansion model	2-stage clonal expansion model
Datasets used for dose-response parameter calibration	NHS/HPFS, SEER, NLST, PLCO by sex	SEER, NLST, PLCO by sex	NHS/HPFS, U.S. mortality by sex	NHS/HPFS, U.S. mortality by sex
Histological types	Adenocarcinoma+BAC+ large cell, squamous, SCLC, ONSCLC Distribution of histologies differs by sex	Adenocarcinoma, AIS, large cell, squamous, SCLC, and other	Adenocarcinoma, large cell, squamous, SCLC, BAC Distribution of histologies differs by sex	Adenocarcinoma+BAC, squamous, SCLC, other as a function of sex, smoking status, cigarettes per day, smoking duration, and years since quitting
Lung cancer stages	IA, IB, II, IIIA, IIIB, IV	IA1, IA2, IB, II, IIIA, IIIB, IV	Early (I-II), advanced (III-IV)	IA, IB, II, IIIA, IIIB, IV
Stage progression	Markov state-transition by histology and sex	Based on tumor volume and metastatic burden	Based on tumor volume and metastatic burden	Markov state-transition by histology and sex
Lung cancer survival	By sex, histology, and stage; based on SEER 18 2004-2010	Calibrated to SEER 18 2004-2013 survival	Based on SEER 17 1988-2003 survival differentiated by sex	By sex, histology, stage, and age at diagnosis; based on SEER 18 2005-2012
Other-cause mortality	U.S. rates (NCI Smoking History Generator) by sex	Cox model of OC mortality calibrated to NLST/PLCO	Gompertz model of OC mortality based on NLST calibrated model by sex	Gompertz model of OC mortality calibrated to each trial by sex
Screening sensitivity model	By stage and histology	By size (mm) and location in lung (central/peripheral)	By size (mm), histology, and sex	By stage, histology and sex
Screening effectiveness	Cure model*	Stage-shift model†	Cure model*	Stage-shift model†
Positive nodule followup algorithm	Implicit based on the NLST	Explicitly modeled using Fleischner and Lung-RADS guidelines; lung cancers diagnosed on followup are categorized as “non-screened-detected”	Explicit model of Lung-RADS guidelines	Implicit based on Lung-RADS

*The benefit of screening is based on a stage-specific cure rate.

†The benefit of screening is based on an earlier stage at detection relative to clinical detection.

Abbreviations: AIS=adenocarcinoma in situ; BAC=bronchioloalveolar carcinoma; CISNET=Cancer Intervention and Surveillance Modeling Network; LCOS=Lung Cancer Outcomes Simulator; Lung-RADS=Lung Imaging Reporting and Data System; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MISCAN=Microsimulation Screening Analysis; NCI=National Cancer Institute; NHS/HPFS=Nurses’ Health Study/Health Professionals’ Followup Study; NLST=National Lung Screening Trial; OC=other-cause; ONSCLC=other non-small cell lung cancers; PLCO=Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial; SCLC=small-cell lung cancer; SEER=Surveillance, Epidemiology, and End Results.

Table 2. Risk Factor–Based Eligibility Screening Strategies

Screening/Modeling Parameter	Values/Ranges	Number of Options
Eligibility starting age	45, 50, 55	3
Eligibility stopping age	75, 77, 80	3
Screening frequency	annual, biennial	2
Minimum pack-years criterion	20, 25, 30, 40	4
Maximum years since quitting	10, 15, 20, 25	4
Followup protocol	Lung-RADS or NLST	1
Birth cohort	1950, 1960	2
Horizon	Lifetime	
Total # of strategies per cohort*	289	

*Reference scenario: No screening.

[†]Models 2, 3 and 4 use Lung-RADS protocol/rates while Model 1 uses NLST protocol/rates.

Abbreviation: Lung-RADS=Lung Imaging Reporting and Data System.

Table 3. Risk Model–Based Eligibility Screening Strategies (1960 Birth Cohort)

Parameter	Values	Number of Options
Risk model	MPLCOm2012, MLCDRAT, Bach	3
*MPLCOm2012 risk model thresholds**	*0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1.0%, 1.1%, 1.2%, 1.3%, 1.4%, 1.5%, 1.6%, 1.7%, 1.8%, 1.9%, 2.0%, 2.1%, 2.2%, 2.3%*	20
*MLCDRAT risk model thresholds**	*0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1.0%, 1.1%, 1.2%, 1.3%, 1.4%,1.5%, 1.6%, 1.7%, 1.8%, 1.9 %, 2.0%, 2.1%, 2.2%, 2.3%*	20
*Bach risk model thresholds**	*0.8%, 0.9%, 1.0%, 1.1%, 1.2%, 1.3%, 1.4%, 1.5%, 1.6%, 1.7%, 1.8%, 1.9%, 2.0%, 2.1%, 2.2%, 2.3%, 2.4%, 2.5%, 2.6%, 2.7%, 2.8%, 2.9%, 3.0%, 3.1 %, 3.2%, 3.3%, 3.4%*	27
Screening frequency	annual, biennial	2
Lower age limit	50, 55	2
Upper age limit	75,77, 80	3
Birth cohort	1960	1
Total # of strategies	804	

*Because the risk models produce different absolute risks, we considered a range of model-specific risk thresholds based on sensitivity in the PLCO control arm and the percentage eligible for screening under each threshold in the 1960 birth cohort.

Abbreviations: MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; PLCO=Prostate, Lung, Colorectal, and Ovarian.

Table 4. Modeled Outcomes

Outcomes per Screening Scenario	Value
Eligible persons	Number per 100,000 and percentage
LDCT screens and followup scans	Number per 100,000
False-positive screens	Per person screened
Biopsies*	Number per 100,000
Lung cancer incidence	Cases and rate per 100,000
Lung cancer mortality	Deaths, deaths averted and rate per 100,000
LYG vs. no screening	Per 100,000
Overdiagnosed cases	Number per 100,000 and percentage per screen detected cancers
Radiation-related lung cancer deaths†	Number per 100,000

*Based on the number of screen-detected lung cancers and false-positive LDCT screens.
†Only two models (Models 2 and 4) estimate radiation-related lung cancer deaths. For this reason, these are reported as a separate column and not included in the average lung cancer deaths and deaths averted counts in the result tables.
Abbreviations: LDCT=low-dose computed tomography; LYG=life-years gained.

Table 5. Parameters Varied in Main Sensitivity Analyses*

Sensitivity Analyses	Description
Life expectancy	Evaluate the impact of limiting screening to only those with more than 5 years of life expectancy (assuming a perfect assessment of life expectancy)
DEA metric	Lung cancer deaths averted, LYG

* Restricted to scenarios of interest identified in the primary DAs.

Abbreviations: DA=decision analysis; DEA=data envelope analysis; LYG=life-years gained.

Table 6. Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
B-55-80-20-20	22.0	189,587	1,134	9.0	348	4,490	12.9	42	545	63
B-55-80-20-25	22.7	207,010	1,189	9.5	366	4,701	12.8	44	566	62
B-50-80-25-25	19.0	208,753	1,169	9.4	363	4,859	13.4	43	575	52
A-55-80-30-15	**14.1**	**227,443**	**1,102**	**9.8**	**381**	**4,882**	**12.8**	**47**	**597**	**37**
A-55-80-25-10	16.0	234,030	1,131	10.1	392	4,969	12.7	47	597	41
B-50-80-20-20	23.3	239,223	1,226	9.9	384	5,194	13.5	46	623	61
A-55-80-30-20	14.5	250,592	1,169	10.5	406	5,170	12.7	48	617	36
B-50-80-20-25	23.6	258,024	1,288	10.4	404	5,436	13.5	47	639	58
A-55-80-25-15	17.2	267,471	1,219	11.0	425	5,387	12.7	50	629	40
A-55-80-30-25	14.8	269,096	1,218	10.9	422	5,333	12.6	50	638	35
A-55-80-25-20	18.0	298,016	1,295	11.6	450	5,690	12.6	52	662	40
A-55-80-25-25	18.3	324,008	1,354	12.2	471	5,930	12.6	55	688	39
A-55-80-20-15	**20.6**	**330,095**	**1,334**	**12.1**	**469**	**6,018**	**12.8**	**55**	**704**	**44**
A-50-80-30-25	15.3	334,396	1,273	11.5	447	6,066	13.6	55	748	34
A-50-80-25-15	18.5	344,294	1,282	11.7	454	6,187	13.6	56	758	41
A-55-80-20-20	**22.0**	**369,610**	**1,423**	**12.9**	**500**	**6,379**	**12.8**	**58**	**739**	**44**
A-50-80-20-10	21.2	369,742	1,295	12.0	464	6,435	13.9	57	797	46
A-50-80-25-20	18.9	377,405	1,357	12.5	482	6,542	13.6	58	783	39
A-50-80-25-25	19.0	404,469	1,417	13.0	502	6,764	13.5	60	806	38
A-55-80-20-25	**22.7**	**404,596**	**1,492**	**13.5**	**523**	**6,654**	**12.7**	**61**	**774**	**43**
A-50-80-20-15	**22.6**	**419,030**	**1,401**	**13.0**	**503**	**6,918**	**13.8**	**61**	**833**	**45**
A-50-80-20-20	**23.3**	**463,457**	**1,487**	**13.8**	**534**	**7,301**	**13.7**	**63**	**868**	**44**
A-45-80-25-25	19.4	482,601	1,448	13.5	521	7,336	14.1	66	926	37
A-50-80-20-25	**23.6**	**500,430**	**1,560**	**14.4**	**558**	**7,596**	**13.6**	**66**	**897**	**42**
A-45-80-20-20	24.0	557,453	1,523	14.4	555	7,919	14.3	70	1,004	43
A-45-80-20-25	24.1	594,973	1,592	14.9	578	8,186	14.2	73	1,029	42

*Strategies with at least 9.0 percent lung cancer mortality reduction.

Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and six selected consensus-efficient 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Table 7. Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-20-20	189,587	209,334	8.6	1.2	526	64	1.3	5.6	17.5
B-55-80-20-25	207,010	227,740	9.1	1.3	557	67	1.4	5.6	18.2
B-50-80-25-25	208,753	228,965	11.0	1.5	546	68	1.4	5.8	19.3
A-55-80-30-15	**227,443**	**247,644**	**16.1**	**1.9**	**518**	**69**	**1.4**	**6.3**	**20.6**
A-55-80-25-10	234,030	254,870	14.6	1.8	536	71	1.4	6.3	21.5
B-50-80-20-20	239,223	261,627	10.3	1.4	593	70	1.4	5.7	22.8
A-55-80-30-20	250,592	272,008	17.3	2.0	554	73	1.5	6.2	21.5
B-50-80-20-25	258,024	281,421	10.9	1.5	626	74	1.5	5.7	23.6
A-55-80-25-15	267,471	290,163	15.6	1.9	586	77	1.5	6.3	23.4
A-55-80-30-25	269,096	291,461	18.2	2.1	580	76	1.5	6.2	22.1
A-55-80-25-20	298,016	322,330	16.6	2.0	630	82	1.6	6.3	24.7
A-55-80-25-25	324,008	349,657	17.7	2.1	664	84	1.7	6.2	25.6
A-55-80-20-15	**330,095**	**356,390**	**16.0**	**1.9**	**667**	**83**	**1.7**	**6.2**	**29.0**
A-50-80-30-25	334,396	359,972	21.9	2.5	639	76	1.5	6.0	29.9
A-50-80-25-15	344,294	370,892	18.6	2.2	658	77	1.6	6.0	32.1
A-55-80-20-20	**369,610**	**398,094**	**16.8**	**2.0**	**722**	**89**	**1.8**	**6.3**	**30.6**
A-50-80-20-10	369,742	397,994	17.4	2.1	684	77	1.5	5.9	36.5
A-50-80-25-20	377,405	405,682	20.0	2.3	701	82	1.6	6.0	33.5
A-50-80-25-25	404,469	434,104	21.3	2.5	735	85	1.7	6.0	34.9
A-55-80-20-25	**404,596**	**434,892**	**17.8**	**2.1**	**765**	**94**	**1.9**	**6.3**	**31.9**
A-50-80-20-15	**419,030**	**449,947**	**18.5**	**2.2**	**750**	**84**	**1.7**	**6.0**	**38.6**
A-50-80-20-20	**463,457**	**496,698**	**19.9**	**2.3**	**804**	**89**	**1.8**	**6.0**	**40.6**
A-45-80-25-25	482,601	515,967	24.9	2.8	797	86	1.7	5.9	45.8
A-50-80-20-25	**500,430**	**535,519**	**21.2**	**2.5**	**849**	**94**	**1.9**	**6.0**	**42.5**
A-45-80-20-20	557,453	595,203	23.2	2.7	879	91	1.8	6.0	53.1
A-45-80-20-25	594,973	634,568	24.7	2.8	922	95	1.9	6.0	55.0

*Strategies with at least 9.0 percent lung cancer mortality reduction. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected consensus-efficient 20-pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; USPSTF=U.S. Preventive Services Task Force.

Table 8. Comparison of 2013 USPSTF-Recommended (A-55-80-30-15) and Selected Risk Factor–Based Screening (20 Pack-Year Consensus-Efficient) Scenarios—1960 Birth Cohort

	A-55-80-30-15	A-55-80-20-15	A-55-80-20-20	A-55-80-20-25	A-50-80-20-15	A-50-80-20-20	A-50-80-20-25
% eligible	14.1%	20.6%	22.0%	22.7%	22.6%	23.3%	23.6%
# LDCT screens*	227,443	330,095	369,610	404,596	419,030	463,457	500,430
Avg. # of LDCT screens per person screened	16.1	16.0	16.8	17.8	18.5	19.9	21.2
Avg. age at first screen	56.2	55.7	55.6	55.6	51.5	51.5	51.5
Avg. age at last screen	71.3	70.7	71.4	72.5	69.0	70.3	71.6
Avg. age at screening	65.1	65.1	65.3	65.5	59.0	59.4	59.9
LC deaths averted*	381	469	500	523	503	534	558
Mortality reduction	9.8%	12.1%	12.9%	13.5%	13.0%	13.8%	14.4%
Difference in LC deaths averted vs. USPSTF strategy	NA	23.1%	31.2%	37.3%	32.0%	40.2%	46.5%
Avg. # screens per LC death averted	597	704	739	774	833	868	897
LYG*	4,882	6,018	6,379	6,654	6,918	7,301	7,596
Difference in LYG vs. USPSTF strategy	NA	23.3%	30.7%	36.3%	41.7%	49.5%	55.6%
Avg. # screens per LYG	47	55	58	61	61	63	66
NNS	37	44	44	43	45	44	42
False-positive screens per person screened	1.9	1.9	2.0	2.1	2.2	2.3	2.5
Biopsies	518	667	722	765	750	804	849
Overdiagnosed cases*	69	83	89	94	84	89	94
Overdiagnosis rate per screen-detected cancers	6.3%	6.2%	6.3%	6.3%	6.0%	6.0%	6.0%
Radiation-related lung cancer deaths*	20.6	29.0	30.6	31.9	38.6	40.6	42.5

* Per 100,000 individuals. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Table 9. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Death Averted	NNS
B-50-80-MLCDRAT-0.015	20.7	148,360	1,174	9.0	348	3,940	11.3	38	426	59
B-50-80-Bach-0.025	21.6	150,601	1,197	9.2	355	4,017	11.3	37	424	61
B-50-80-MPLCOm2012-0.014	19.7	153,324	1,187	9.2	356	4,147	11.6	37	431	55
B-55-80-Bach-0.024	22.0	154,299	1,190	9.1	354	4,056	11.5	38	436	62
B-50-80-Bach-0.024	22.2	157,520	1,222	9.4	362	4,125	11.4	38	435	61
B-55-80-MPLCOm2012-0.013	20.4	158,123	1,181	9.1	354	4,177	11.8	38	447	58
B-50-80-MLCDRAT-0.014	21.6	158,658	1,206	9.3	361	4,106	11.4	39	439	60
B-50-80-MPLCOm2012-0.013	20.6	164,259	1,218	9.5	367	4,348	11.8	38	448	56
B-50-80-Bach-0.023	22.7	164,603	1,242	9.5	370	4,239	11.5	39	445	61
B-50-80-Bach-0.022	23.3	172,049	1,262	9.7	377	4,365	11.6	39	456	62
A-55-80-MPLCOm2012-0.023	14.3	174,860	1,177	10.0	388	4,161	10.7	42	451	37
A-50-80-MPLCOm2012-0.023	14.3	174,911	1,178	10.0	388	4,187	10.8	42	451	37
B-55-80-Bach-0.021	23.8	175,310	1,245	9.6	372	4,325	11.6	41	471	64
B-50-80-MPLCOm2012-0.012	21.6	176,755	1,253	9.7	378	4,527	12.0	39	468	57
A-55-80-MLCDRAT-0.023	15.6	179,310	1,178	10.0	388	4,087	10.5	44	462	40
B-50-80-Bach-0.021	23.9	180,105	1,280	9.9	384	4,457	11.6	40	469	62
B-55-80-Bach-0.02	24.4	182,833	1,264	9.8	381	4,439	11.7	41	480	64
A-55-80-MPLCOm2012-0.022	14.7	184,176	1,204	10.3	400	4,334	10.8	42	460	37
A-50-80-MPLCOm2012-0.022	14.7	184,284	1,205	10.3	399	4,336	10.9	43	462	37
B-50-80-Bach-0.02	24.6	188,573	1,301	10.2	394	4,596	11.7	41	479	62
B-55-80-Bach-0.019	25.0	190,612	1,282	10.0	387	4,547	11.7	42	493	65
B-50-80-MPLCOm2012-0.011	22.7	191,379	1,290	10.1	393	4,766	12.1	40	487	58
A-55-80-MPLCOm2012-0.021	15.3	193,965	1,232	10.6	411	4,515	11.0	43	472	37
A-55-80-Bach-0.034	17.1	194,099	1,247	10.6	409	4,404	10.8	44	475	42
A-50-80-MPLCOm2012-0.021	15.3	194,193	1,235	10.6	410	4,502	11.0	43	474	37
A-50-80-Bach-0.034	17.1	194,261	1,248	10.6	411	4,417	10.7	44	473	42
B-50-80-Bach-0.019	25.2	197,209	1,323	10.3	400	4,727	11.8	42	493	63
A-55-80-Bach-0.033	17.5	202,943	1,272	10.8	420	4,539	10.8	45	483	42
A-50-80-Bach-0.033	17.5	203,167	1,271	10.8	419	4,526	10.8	45	485	42
A-55-80-MPLCOm2012-0.02	15.8	204,612	1,262	10.9	421	4,645	11.0	44	486	38
A-50-80-MPLCOm2012-0.02	15.8	205,020	1,262	10.8	419	4,662	11.1	44	489	38
B-50-80-Bach-0.018	25.8	206,581	1,343	10.5	408	4,830	11.8	43	506	63
B-50-80-MPLCOm2012-0.01	23.8	206,957	1,323	10.4	404	4,967	12.3	42	512	59
A-50-80-MLCDRAT-0.02	17.4	210,560	1,273	10.9	423	4,566	10.8	46	498	41
A-55-80-Bach-0.032	18.0	212,181	1,296	11.1	431	4,655	10.8	46	492	42
A-50-80-Bach-0.032	18.0	212,490	1,298	11.1	430	4,668	10.9	46	494	42

Table 9. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Death Averted	NNS
A-55-80-MPLCOm2012-0.019	16.3	216,291	1,293	11.2	434	4,833	11.1	45	498	38
A-50-80-MPLCOm2012-0.019	16.4	217,030	1,293	11.2	435	4,859	11.2	45	499	38
A-55-80-Bach-0.031	18.5	221,421	1,321	11.3	439	4,791	10.9	46	504	42
A-50-80-Bach-0.031	18.5	221,847	1,321	11.4	441	4,831	11.0	46	503	42
B-50-80-MPLCOm2012-0.009	25.0	225,054	1,357	10.8	417	5,169	12.4	44	540	60
A-50-80-MLCDRAT-0.019	18.1	225,292	1,310	11.3	437	4,774	10.9	47	516	41
B-50-80-Bach-0.016	27.3	227,395	1,388	10.9	423	5,099	12.1	45	538	65
A-55-80-30-15	**14.1**	**227,443**	**1,102**	**9.8**	**381**	**4,882**	**12.8**	**47**	**597**	**37**
A-55-80-MPLCOm2012-0.018	17.0	228,676	1,320	11.5	444	4,982	11.2	46	515	38
A-50-80-MPLCOm2012-0.018	17.0	229,944	1,327	11.5	445	5,021	11.3	46	517	38
A-55-80-Bach-0.03	19.0	231,518	1,347	11.6	450	4,936	11.0	47	514	42
A-50-80-Bach-0.03	19.0	232,092	1,350	11.6	450	4,969	11.0	47	516	42
A-50-80-MLCDRAT-0.018	18.6	236,479	1,339	11.6	450	4,942	11.0	48	526	41
A-55-80-MLCDRAT-0.018	18.6	236,483	1,340	11.5	448	4,916	11.0	48	528	42
A-55-80-Bach-0.029	19.5	241,484	1,370	11.8	459	5,063	11.0	48	526	42
A-50-80-Bach-0.029	19.5	242,278	1,374	11.8	459	5,084	11.1	48	528	42
A-55-80-MPLCOm2012-0.017	17.6	242,329	1,352	11.8	455	5,163	11.3	47	533	39
A-50-80-MPLCOm2012-0.017	17.6	244,349	1,359	11.8	457	5,227	11.4	47	535	39
B-50-80-MPLCOm2012-0.008	26.5	245,777	1,399	11.2	432	5,407	12.5	45	569	61
B-50-80-Bach-0.014	28.8	250,390	1,430	11.3	438	5,358	12.2	47	572	66
A-55-80-Bach-0.028	20.0	252,590	1,396	12.1	468	5,199	11.1	49	540	43
A-50-80-Bach-0.028	20.0	253,613	1,399	12.1	471	5,225	11.1	49	538	42
A-50-80-MLCDRAT-0.017	19.3	253,620	1,376	12.0	463	5,153	11.1	49	548	42
A-55-80-MPLCOm2012-0.016	18.3	256,724	1,383	12.1	468	5,341	11.4	48	549	39
A-50-80-MPLCOm2012-0.016	18.3	259,832	1,394	12.3	475	5,502	11.6	47	547	39
B-50-80-Bach-0.013	29.6	263,135	1,451	11.5	445	5,498	12.4	48	591	67
A-55-80-Bach-0.027	20.6	263,986	1,420	12.3	478	5,328	11.1	50	552	43
A-50-80-Bach-0.027	20.6	265,411	1,424	12.3	478	5,353	11.2	50	555	43
A-50-80-MLCDRAT-0.016	20.0	267,426	1,409	12.3	478	5,355	11.2	50	559	42
B-50-80-MPLCOm2012-0.007	28.1	270,148	1,442	11.6	449	5,644	12.6	48	602	63
A-55-80-MPLCOm2012-0.015	19.0	272,809	1,415	12.4	481	5,533	11.5	49	567	40
A-55-80-Bach-0.026	21.1	275,329	1,444	12.6	489	5,463	11.2	50	563	43
B-50-80-Bach-0.012	30.5	277,033	1,476	11.8	456	5,639	12.4	49	608	67
A-50-80-Bach-0.026	21.1	277,066	1,447	12.6	489	5,495	11.2	50	567	43
A-50-80-MPLCOm2012-0.015	19.0	277,426	1,429	12.6	488	5,685	11.6	49	568	39
A-50-77-MPLCOm2012-0.013	19.7	280,113	1,260	11.4	441	5,712	13.0	49	635	45
A-50-80-MLCDRAT-0.015	20.8	286,154	1,451	12.7	491	5,562	11.3	51	583	42
A-55-80-Bach-0.025	21.7	287,935	1,470	12.8	495	5,572	11.3	52	582	44

Table 9. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Death Averted	NNS
A-50-80-Bach-0.025	21.7	290,340	1,475	12.9	498	5,657	11.4	51	583	44
A-55-80-MPLCOm2012-0.014	19.8	290,431	1,452	12.7	494	5,717	11.6	51	588	40
B-50-80-Bach-0.011	31.5	292,128	1,499	12.0	465	5,800	12.5	50	628	68
B-50-80-MPLCOm2012-0.006	29.9	296,680	1,482	11.9	461	5,867	12.7	51	644	65
A-50-80-MPLCOm2012-0.014	19.8	297,009	1,466	13.0	503	5,925	11.8	50	590	39
A-55-80-Bach-0.024	22.2	300,842	1,494	13.1	507	5,735	11.3	52	593	44
A-50-77-MPLCOm2012-0.012	20.6	303,023	1,296	11.7	455	5,960	13.1	51	666	45
A-55-80-MLCDRAT-0.014	21.7	303,286	1,480	13.0	504	5,722	11.4	53	602	43
A-50-80-Bach-0.024	22.3	303,778	1,502	13.2	510	5,840	11.5	52	596	44
A-50-80-MLCDRAT-0.014	21.7	306,138	1,487	13.1	507	5,808	11.5	53	604	43
B-50-80-Bach-0.01	32.6	308,091	1,527	12.2	472	5,924	12.6	52	653	69
A-55-80-MPLCOm2012-0.013	20.6	309,284	1,482	13.1	508	5,933	11.7	52	609	41
A-55-80-Bach-0.023	22.8	313,914	1,520	13.4	518	5,898	11.4	53	606	44
A-50-80-Bach-0.023	22.9	317,678	1,530	13.4	521	5,999	11.5	53	610	44
A-50-80-MPLCOm2012-0.013	20.7	318,502	1,502	13.3	514	6,136	11.9	52	620	40
A-55-80-MLCDRAT-0.013	22.6	320,862	1,516	13.4	520	5,935	11.4	54	617	43
A-50-80-MLCDRAT-0.013	22.7	325,175	1,524	13.5	522	6,033	11.6	54	623	43
B-50-80-Bach-0.009	33.8	325,901	1,554	12.5	484	6,136	12.7	53	673	70
B-50-80-MPLCOm2012-0.005	31.9	327,272	1,522	12.3	477	6,149	12.9	53	686	67
A-55-80-Bach-0.022	23.4	327,719	1,542	13.6	527	6,024	11.4	54	622	44
A-50-77-MPLCOm2012-0.011	21.6	328,622	1,331	12.1	469	6,212	13.2	53	701	46
A-55-80-20-15	**20.6**	**330,095**	**1,334**	**12.1**	**469**	**6,018**	**12.8**	**55**	**704**	**44**
A-55-80-MPLCOm2012-0.012	21.6	330,347	1,519	13.4	520	6,146	11.8	54	635	42
A-50-80-Bach-0.022	23.4	332,451	1,550	13.7	531	6,167	11.6	54	626	44
A-55-80-Bach-0.021	24.0	342,337	1,566	13.9	538	6,197	11.5	55	636	45
A-50-80-MPLCOm2012-0.012	21.7	343,293	1,543	13.7	532	6,409	12.0	54	645	41
A-55-80-MLCDRAT-0.012	23.8	343,713	1,551	13.7	532	6,126	11.5	56	646	45
A-50-80-Bach-0.021	24.1	348,282	1,577	14.0	541	6,340	11.7	55	644	45
A-50-80-MLCDRAT-0.012	23.9	350,286	1,564	13.9	537	6,271	11.7	56	652	45
A-55-80-MPLCOm2012-0.011	22.6	352,002	1,552	13.8	535	6,348	11.9	55	658	42
A-55-80-Bach-0.02	24.6	357,203	1,586	14.1	545	6,319	11.6	57	655	45
A-50-77-MPLCOm2012-0.01	22.7	357,345	1,369	12.6	488	6,529	13.4	55	732	47
A-50-80-Bach-0.02	24.7	364,767	1,603	14.3	555	6,545	11.8	56	657	45
A-55-80-MLCDRAT-0.011	25.5	369,025	1,595	14.2	549	6,384	11.6	58	672	46
A-55-80-20-20	**22.0**	**369,610**	**1,423**	**12.9**	**500**	**6,379**	**12.8**	**58**	**739**	**44**
A-50-80-MPLCOm2012-0.011	22.8	370,909	1,582	14.2	550	6,686	12.2	55	674	41
A-55-80-Bach-0.019	25.2	372,598	1,611	14.3	554	6,458	11.7	58	673	45
A-55-80-MPLCOm2012-0.01	23.7	375,484	1,586	14.1	548	6,519	11.9	58	685	43

Table 9. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Death Averted	NNS
A-50-80-MLCDRAT-0.011	25.5	377,864	1,613	14.4	558	6,607	11.8	57	677	46
A-50-80-Bach-0.019	25.3	381,778	1,624	14.4	559	6,652	11.9	57	683	45
A-55-80-Bach-0.018	25.8	389,243	1,632	14.5	563	6,589	11.7	59	691	46
A-55-80-MLCDRAT-0.01	27.7	398,180	1,641	14.6	564	6,605	11.7	60	706	49
A-50-80-Bach-0.018	26.0	400,457	1,653	14.8	572	6,846	12.0	58	700	45
A-50-80-MPLCOm2012-0.01	23.9	401,856	1,622	14.6	564	6,957	12.3	58	713	42
A-55-80-20-25	**22.7**	**404,596**	**1,492**	**13.5**	**523**	**6,654**	**12.7**	**61**	**774**	**43**
A-55-80-Bach-0.017	26.5	406,323	1,657	14.9	575	6,774	11.8	60	707	46
A-50-80-MLCDRAT-0.01	27.9	409,804	1,662	14.8	575	6,871	11.9	60	713	49
A-50-80-20-15	**22.6**	**419,030**	**1,401**	**13.0**	**503**	**6,918**	**13.8**	**61**	**833**	**45**
A-50-80-Bach-0.017	26.6	420,352	1,678	15.1	586	7,039	12.0	60	717	45
A-55-80-Bach-0.016	27.2	423,929	1,677	15.0	582	6,908	11.9	61	728	47
A-55-80-MPLCOm2012-0.008	26.2	432,557	1,662	14.9	579	6,975	12.0	62	747	45
A-55-80-MLCDRAT-0.009	30.4	433,597	1,696	15.0	583	6,869	11.8	63	744	52
A-50-80-MPLCOm2012-0.009	25.1	437,273	1,665	15.0	582	7,291	12.5	60	751	43
A-50-80-Bach-0.016	27.4	441,294	1,704	15.4	595	7,190	12.1	61	742	46
A-55-80-Bach-0.015	27.9	442,384	1,700	15.3	592	7,034	11.9	63	747	47
A-50-80-MLCDRAT-0.009	30.6	449,030	1,717	15.4	596	7,168	12.0	63	753	51
A-55-80-Bach-0.014	28.7	461,609	1,723	15.5	602	7,179	11.9	64	767	48
A-50-80-Bach-0.015	28.1	463,301	1,727	15.6	605	7,391	12.2	63	766	46
A-50-80-20-20	**23.3**	**463,457**	**1,487**	**13.8**	**534**	**7,301**	**13.7**	**63**	**868**	**44**
A-55-80-MLCDRAT-0.008	33.3	474,060	1,749	15.6	606	7,147	11.8	66	782	55
A-50-80-MPLCOm2012-0.008	26.6	478,349	1,710	15.5	601	7,564	12.6	63	796	44
A-55-80-Bach-0.013	29.5	482,093	1,744	15.8	610	7,330	12.0	66	790	48
A-50-80-Bach-0.014	28.9	486,484	1,752	15.9	616	7,582	12.3	64	790	47
A-50-80-MLCDRAT-0.008	33.5	495,424	1,779	16.0	619	7,508	12.1	66	800	54
A-50-80-20-25	**23.6**	**500,430**	**1,560**	**14.4**	**558**	**7,596**	**13.6**	**66**	**897**	**42**
A-55-80-Bach-0.012	30.3	503,871	1,768	16.0	617	7,467	12.1	67	817	49
A-50-80-Bach-0.013	29.7	511,462	1,778	16.2	627	7,746	12.4	66	816	47
A-55-80-MLCDRAT-0.007	36.3	520,869	1,805	16.2	629	7,496	11.9	69	828	58
A-50-80-MPLCOm2012-0.007	28.2	524,392	1,754	16.0	620	7,904	12.7	66	846	45
A-55-80-Bach-0.011	31.3	527,263	1,793	16.2	628	7,606	12.1	69	840	50
A-50-80-Bach-0.012	30.6	538,488	1,806	16.4	635	7,914	12.5	68	848	48
A-50-80-MLCDRAT-0.007	36.5	550,777	1,843	16.7	647	7,943	12.3	69	851	56
A-55-80-Bach-0.01	32.3	551,762	1,816	16.5	639	7,773	12.2	71	863	51
A-50-80-Bach-0.011	31.6	568,005	1,834	16.7	648	8,156	12.6	70	877	49
A-50-80-MPLCOm2012-0.006	30.0	575,496	1,797	16.4	635	8,164	12.9	70	906	47
A-55-80-MLCDRAT-0.006	39.0	577,420	1,865	16.9	655	7,830	12.0	74	882	60

Table 9. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Death Averted	NNS
A-50-80-Bach-0.01	32.7	599,143	1,862	17.1	662	8,387	12.7	71	905	49

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs.

Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The risk model–based screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The risk factor–based screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force

Table 10. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiag-nosis: % of All LC Cases	Overdiag-nosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-50-80-MLCDRAT-0.015	148,360	165,827	7.2	1.0	506	76	1.5	6.5	11.1
B-50-80-Bach-0.025	150,601	168,292	7.0	1.0	516	76	1.5	6.3	11.0
B-50-80-MPLCOm2012-0.014	153,324	170,855	7.8	1.1	512	73	1.5	6.1	11.9
B-55-80-Bach-0.024	154,299	172,167	7.0	1.0	516	74	1.5	6.2	11.5
B-50-80-Bach-0.024	157,520	175,651	7.1	1.0	529	77	1.5	6.3	11.8
B-55-80-MPLCOm2012-0.013	158,123	175,963	7.8	1.1	514	71	1.4	6.0	12.5
B-50-80-MLCDRAT-0.014	158,658	176,788	7.3	1.0	524	77	1.6	6.4	12.0
B-50-80-MPLCOm2012-0.013	164,259	182,478	8.0	1.1	531	74	1.5	6.1	13.4
B-50-80-Bach-0.023	164,603	183,169	7.3	1.0	541	78	1.6	6.3	12.3
B-50-80-Bach-0.022	172,049	191,083	7.4	1.0	553	79	1.6	6.3	12.8
A-55-80-MPLCOm2012-0.023	174,860	192,554	12.2	1.5	508	80	1.6	6.8	11.2
A-50-80-MPLCOm2012-0.023	174,911	192,601	12.2	1.5	508	80	1.6	6.8	11.2
B-55-80-Bach-0.021	175,310	194,510	7.4	1.0	550	75	1.5	6.0	13.1
B-50-80-MPLCOm2012-0.012	176,755	195,746	8.2	1.1	552	76	1.5	6.1	13.7
A-55-80-MLCDRAT-0.023	179,310	197,439	11.5	1.4	513	84	1.7	7.1	10.9
B-50-80-Bach-0.021	180,105	199,649	7.5	1.1	565	79	1.6	6.2	13.7
B-55-80-Bach-0.02	182,833	202,516	7.5	1.1	562	76	1.5	6.0	13.9
A-55-80-MPLCOm2012-0.022	184,176	202,396	12.5	1.5	523	82	1.6	6.8	12.1
A-50-80-MPLCOm2012-0.022	184,284	202,513	12.5	1.5	523	82	1.6	6.8	12.1
B-50-80-Bach-0.02	188,573	208,640	7.7	1.1	579	80	1.6	6.1	14.6
B-55-80-Bach-0.019	190,612	210,780	7.6	1.1	574	77	1.5	6.0	14.5
B-50-80-MPLCOm2012-0.011	191,379	211,271	8.4	1.2	575	77	1.6	6.0	15.3
A-55-80-MPLCOm2012-0.021	193,965	212,755	12.7	1.5	539	84	1.7	6.8	13.2
A-55-80-Bach-0.034	194,099	213,177	11.4	1.4	546	88	1.8	7.1	12.8
A-50-80-MPLCOm2012-0.021	194,193	212,990	12.7	1.5	540	84	1.7	6.8	13.2
A-50-80-Bach-0.034	194,261	213,338	11.4	1.4	546	87	1.7	7.0	12.8
B-50-80-Bach-0.019	197,209	217,812	7.8	1.1	593	81	1.6	6.1	15.2
A-55-80-Bach-0.033	202,943	222,529	11.6	1.4	560	88	1.8	6.9	13.5
A-50-80-Bach-0.033	203,167	222,759	11.6	1.4	560	88	1.8	6.9	13.6
A-55-80-MPLCOm2012-0.02	204,612	224,001	13.0	1.6	555	86	1.7	6.8	14.1
A-50-80-MPLCOm2012-0.02	205,020	224,420	13.0	1.6	555	85	1.7	6.7	14.2
B-50-80-Bach-0.018	206,581	227,744	8.0	1.1	606	82	1.7	6.1	16.0
B-50-80-MPLCOm2012-0.01	206,957	227,804	8.7	1.2	598	79	1.6	6.0	16.9
A-50-80-MLCDRAT-0.02	210,560	230,513	12.1	1.5	565	89	1.8	7.0	13.3
A-55-80-Bach-0.032	212,181	232,294	11.8	1.4	574	90	1.8	6.9	14.1
A-50-80-Bach-0.032	212,490	232,621	11.8	1.4	575	89	1.8	6.9	14.1

Table 10. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiag-nosis: % of All LC Cases	Overdiag-nosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-MPLCOm2012-0.019	216,291	236,355	13.3	1.6	573	87	1.7	6.7	15.1
A-50-80-MPLCOm2012-0.019	217,030	237,128	13.2	1.6	574	87	1.7	6.7	15.2
A-55-80-Bach-0.031	221,421	242,072	12.0	1.5	589	91	1.8	6.9	14.8
A-50-80-Bach-0.031	221,847	242,513	12.0	1.5	589	90	1.8	6.8	14.9
B-50-80-MPLCOm2012-0.009	225,054	247,007	9.0	1.2	623	80	1.6	5.9	18.5
A-50-80-MLCDRAT-0.019	225,292	246,094	12.4	1.5	587	91	1.8	6.9	14.6
B-50-80-Bach-0.016	227,395	249,832	8.3	1.2	637	84	1.7	6.1	18.2
A-55-80-30-15	**227,443**	**247,644**	**16.1**	**1.9**	**518**	**69**	**1.4**	**6.3**	**20.6**
A-55-80-MPLCOm2012-0.018	228,676	249,442	13.5	1.6	591	89	1.8	6.7	15.8
A-50-80-MPLCOm2012-0.018	229,944	250,782	13.5	1.6	594	90	1.8	6.8	15.9
A-55-80-Bach-0.03	231,518	252,744	12.2	1.5	604	93	1.9	6.9	15.5
A-50-80-Bach-0.03	232,092	253,350	12.2	1.5	605	93	1.9	6.9	15.6
A-50-80-MLCDRAT-0.018	236,479	257,928	12.7	1.5	604	92	1.8	6.9	15.6
A-55-80-MLCDRAT-0.018	236,483	257,918	12.7	1.5	604	92	1.8	6.9	15.6
A-55-80-Bach-0.029	241,484	263,290	12.4	1.5	618	94	1.9	6.9	16.2
A-50-80-Bach-0.029	242,278	264,120	12.4	1.5	620	94	1.9	6.8	16.3
A-55-80-MPLCOm2012-0.017	242,329	263,878	13.8	1.6	610	90	1.8	6.7	17.1
A-50-80-MPLCOm2012-0.017	244,349	265,995	13.9	1.7	614	92	1.8	6.8	17.4
B-50-80-MPLCOm2012-0.008	245,777	268,980	9.3	1.3	653	83	1.7	5.9	20.0
B-50-80-Bach-0.014	250,390	274,208	8.7	1.2	668	86	1.7	6.0	19.6
A-55-80-Bach-0.028	252,590	275,022	12.6	1.5	634	96	1.9	6.9	16.8
A-50-80-Bach-0.028	253,613	276,110	12.7	1.5	636	95	1.9	6.8	17.0
A-50-80-MLCDRAT-0.017	253,620	276,030	13.1	1.6	628	95	1.9	6.9	17.0
A-55-80-MPLCOm2012-0.016	256,724	279,088	14.0	1.7	630	92	1.8	6.7	18.3
A-50-80-MPLCOm2012-0.016	259,832	282,347	14.2	1.7	635	94	1.9	6.7	18.9
B-50-80-Bach-0.013	263,135	287,720	8.9	1.2	685	86	1.7	5.9	20.8
A-55-80-Bach-0.027	263,986	287,083	12.8	1.5	650	97	1.9	6.8	17.9
A-50-80-Bach-0.027	265,411	288,573	12.9	1.6	652	97	1.9	6.8	18.1
A-50-80-MLCDRAT-0.016	267,426	290,613	13.4	1.6	648	97	1.9	6.9	18.1
B-50-80-MPLCOm2012-0.007	270,148	294,837	9.6	1.3	685	85	1.7	5.9	21.9
A-55-80-MPLCOm2012-0.015	272,809	296,092	14.4	1.7	651	93	1.9	6.6	19.5
A-55-80-Bach-0.026	275,329	299,073	13.0	1.6	665	99	2.0	6.9	18.7
B-50-80-Bach-0.012	277,033	302,448	9.1	1.2	704	87	1.8	5.9	22.1
A-50-80-Bach-0.026	277,066	300,897	13.1	1.6	667	98	2.0	6.8	18.9
A-50-80-MPLCOm2012-0.015	277,426	300,937	14.6	1.7	659	94	1.9	6.6	20.2
A-50-77-MPLCOm2012-0.013	280,113	303,848	14.2	1.7	609	72	1.4	5.7	22.0
A-50-80-MLCDRAT-0.015	286,154	310,413	13.8	1.6	674	99	2.0	6.8	19.2
A-55-80-Bach-0.025	287,935	312,383	13.3	1.6	682	99	2.0	6.7	19.6

Table 10. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiag-nosis: % of All LC Cases	Overdiag-nosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-Bach-0.025	290,340	314,916	13.4	1.6	685	99	2.0	6.7	20.0
A-55-80-MPLCOm2012-0.014	290,431	314,704	14.7	1.7	675	95	1.9	6.5	20.5
B-50-80-Bach-0.011	292,128	318,447	9.3	1.3	723	89	1.8	5.9	23.0
B-50-80-MPLCOm2012-0.006	296,680	322,996	9.9	1.3	719	88	1.8	5.9	23.8
A-50-80-MPLCOm2012-0.014	297,009	321,624	15.0	1.8	684	96	1.9	6.5	21.3
A-55-80-Bach-0.024	300,842	326,030	13.6	1.6	698	101	2.0	6.8	20.3
A-50-77-MPLCOm2012-0.012	303,023	328,035	14.7	1.8	637	73	1.5	5.6	24.1
A-55-80-MLCDRAT-0.014	303,286	328,536	14.0	1.7	695	100	2.0	6.8	20.4
A-50-80-Bach-0.024	303,778	329,091	13.6	1.6	703	100	2.0	6.7	20.6
A-50-80-MLCDRAT-0.014	306,138	331,531	14.1	1.7	699	100	2.0	6.7	20.7
B-50-80-Bach-0.01	308,091	335,373	9.5	1.3	744	90	1.8	5.9	24.4
A-55-80-MPLCOm2012-0.013	309,284	334,629	15.0	1.8	697	96	1.9	6.5	21.8
A-55-80-Bach-0.023	313,914	339,831	13.8	1.6	716	102	2.0	6.7	21.0
A-50-80-Bach-0.023	317,678	343,778	13.9	1.7	721	101	2.0	6.6	21.5
A-50-80-MPLCOm2012-0.013	318,502	344,299	15.4	1.8	709	98	2.0	6.5	23.1
A-55-80-MLCDRAT-0.013	320,862	347,108	14.2	1.7	718	102	2.0	6.7	21.3
A-50-80-MLCDRAT-0.013	325,175	351,637	14.3	1.7	724	102	2.0	6.7	21.9
B-50-80-Bach-0.009	325,901	354,263	9.6	1.3	767	91	1.8	5.9	25.7
B-50-80-MPLCOm2012-0.005	327,272	355,416	10.3	1.4	756	89	1.8	5.8	25.3
A-55-80-Bach-0.022	327,719	354,413	14.0	1.7	732	103	2.1	6.7	22.3
A-50-77-MPLCOm2012-0.011	328,622	355,052	15.2	1.8	665	74	1.5	5.6	26.0
A-55-80-20-15	**330,095**	**356,390**	**16.0**	**1.9**	**667**	**83**	**1.7**	**6.2**	**29.0**
A-55-80-MPLCOm2012-0.012	330,347	356,878	15.3	1.8	723	98	2.0	6.5	23.3
A-50-80-Bach-0.022	332,451	359,385	14.2	1.7	738	103	2.1	6.6	22.9
A-55-80-Bach-0.021	342,337	369,858	14.3	1.7	750	105	2.1	6.7	23.1
A-50-80-MPLCOm2012-0.012	343,293	370,477	15.8	1.9	740	99	2.0	6.4	25.2
A-55-80-MLCDRAT-0.012	343,713	371,269	14.4	1.7	745	104	2.1	6.7	23.0
A-50-80-Bach-0.021	348,282	376,097	14.5	1.7	757	104	2.1	6.6	24.0
A-50-80-MLCDRAT-0.012	350,286	378,187	14.7	1.7	754	103	2.1	6.6	23.9
A-55-80-MPLCOm2012-0.011	352,002	379,754	15.6	1.8	749	100	2.0	6.4	24.7
A-55-80-Bach-0.02	357,203	385,566	14.5	1.7	766	105	2.1	6.6	24.1
A-50-77-MPLCOm2012-0.01	357,345	385,345	15.7	1.9	697	76	1.5	5.6	28.7
A-50-80-Bach-0.02	364,767	393,511	14.8	1.7	776	105	2.1	6.6	25.1
A-55-80-MLCDRAT-0.011	369,025	398,078	14.5	1.7	777	105	2.1	6.6	24.6
A-55-80-20-20	**369,610**	**398,094**	**16.8**	**2.0**	**722**	**89**	**1.8**	**6.3**	**30.6**
A-50-80-MPLCOm2012-0.011	370,909	399,603	16.3	1.9	770	101	2.0	6.4	27.2
A-55-80-Bach-0.019	372,598	401,805	14.8	1.7	784	106	2.1	6.6	25.2
A-55-80-MPLCOm2012-0.01	375,484	404,571	15.8	1.9	776	102	2.0	6.4	26.5

Table 10. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiag-nosis: % of All LC Cases	Overdiag-nosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-MLCDRAT-0.011	377,864	407,366	14.8	1.7	789	105	2.1	6.5	25.8
A-50-80-Bach-0.019	381,778	411,439	15.1	1.8	794	106	2.1	6.5	26.4
A-55-80-Bach-0.018	389,243	419,367	15.1	1.8	802	107	2.2	6.6	26.5
A-55-80-MLCDRAT-0.01	398,180	429,019	14.4	1.7	813	108	2.2	6.6	26.5
A-50-80-Bach-0.018	400,457	431,163	15.4	1.8	816	107	2.1	6.5	28.0
A-50-80-MPLCOm2012-0.01	401,856	432,251	16.8	2.0	804	104	2.1	6.4	29.8
A-55-80-20-25	**404,596**	**434,892**	**17.8**	**2.1**	**765**	**94**	**1.9**	**6.3**	**31.9**
A-55-80-Bach-0.017	406,323	437,409	15.3	1.8	822	109	2.2	6.6	28.0
A-50-80-MLCDRAT-0.01	409,804	441,216	14.7	1.7	827	108	2.2	6.5	28.2
A-50-80-20-15	**419,030**	**449,947**	**18.5**	**2.2**	**750**	**84**	**1.7**	**6.0**	**38.6**
A-50-80-Bach-0.017	420,352	452,129	15.8	1.8	837	108	2.2	6.4	30.1
A-55-80-Bach-0.016	423,929	455,993	15.6	1.8	840	110	2.2	6.6	29.2
A-55-80-MPLCOm2012-0.008	432,557	464,850	16.5	1.9	839	106	2.1	6.4	30.0
A-55-80-MLCDRAT-0.009	433,597	466,571	14.3	1.7	856	112	2.2	6.6	29.3
A-50-80-MPLCOm2012-0.009	437,273	469,612	17.4	2.0	841	105	2.1	6.3	32.3
A-50-80-Bach-0.016	441,294	474,232	16.1	1.9	860	110	2.2	6.5	31.6
A-55-80-Bach-0.015	442,384	475,479	15.9	1.9	860	111	2.2	6.5	30.4
A-50-80-MLCDRAT-0.009	449,030	482,762	14.7	1.7	872	111	2.2	6.5	31.4
A-55-80-Bach-0.014	461,609	495,768	16.1	1.9	880	112	2.2	6.5	31.8
A-50-80-Bach-0.015	463,301	497,449	16.5	1.9	882	110	2.2	6.4	33.3
A-50-80-20-20	**463,457**	**496,698**	**19.9**	**2.3**	**804**	**89**	**1.8**	**6.0**	**40.6**
A-55-80-MLCDRAT-0.008	474,060	509,474	14.2	1.7	902	114	2.3	6.5	31.5
A-50-80-MPLCOm2012-0.008	478,349	512,920	18.0	2.1	883	108	2.2	6.3	35.4
A-55-80-Bach-0.013	482,093	517,364	16.3	1.9	900	113	2.3	6.5	33.3
A-50-80-Bach-0.014	486,484	521,881	16.8	2.0	905	111	2.2	6.3	35.0
A-50-80-MLCDRAT-0.008	495,424	531,893	14.8	1.7	925	114	2.3	6.4	34.2
A-50-80-20-25	**500,430**	**535,519**	**21.2**	**2.5**	**849**	**94**	**1.9**	**6.0**	**42.5**
A-55-80-Bach-0.012	503,871	540,363	16.6	1.9	922	114	2.3	6.4	34.6
A-50-80-Bach-0.013	511,462	548,218	17.2	2.0	930	112	2.2	6.3	37.1
A-55-80-MLCDRAT-0.007	520,869	559,024	14.3	1.7	953	117	2.3	6.5	34.0
A-50-80-MPLCOm2012-0.007	524,392	561,495	18.6	2.1	928	110	2.2	6.3	38.6
A-55-80-Bach-0.011	527,263	565,051	16.8	2.0	946	115	2.3	6.4	36.0
A-50-80-Bach-0.012	538,488	576,709	17.6	2.0	957	113	2.3	6.3	39.1
A-50-80-MLCDRAT-0.007	550,777	590,414	15.1	1.8	984	117	2.3	6.3	37.6
A-55-80-Bach-0.01	551,762	590,917	17.1	2.0	970	116	2.3	6.4	37.5
A-50-80-Bach-0.011	568,005	607,834	18.0	2.1	985	115	2.3	6.3	41.1
A-50-80-MPLCOm2012-0.006	575,496	615,371	19.2	2.2	976	112	2.2	6.2	42.0
A-55-80-MLCDRAT-0.006	577,420	618,778	14.8	1.7	1,011	120	2.4	6.4	37.3

Table 10. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiag-nosis: % of All LC Cases	Overdiag-nosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-Bach-0.01	599,143	640,649	18.3	2.1	1,015	117	2.3	6.3	43.3

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Table 11. Comparison of the 2013 USPSTF-Recommended (A-55-80-30-15) and Risk Model–Based USPSTF-Like Scenarios

	A-55-80-30-15	A-55-80-MPLCOm2012-0.018	A-55-80-MLCDRAT-0.018	A-55-80-Bach-0.03
% eligible	14.1%	17.0%	18.6%	19.0%
# LDCT screens*	227,443	228,676	236,483	231,518
Avg. # of LDCT screens per person screened	16.1	13.5	12.7	12.2
Avg. age at first screen	56.2	64.0	64.5	65.4
Avg. age at last screen	71.3	76.5	76.5	76.8
Avg. age at screening	65.1	69.6	70.1	70.3
LC deaths averted*	381	444	448	450
Mortality reduction	9.8%	11.5%	11.5%	11.6%
Difference in LC deaths averted vs. USPSTF strategy	NA	16.5%	17.6%	18.1%
Avg. # screens per LC death averted	597	515	528	514
LYG*	4,882	4,982	4,916	4,936
Difference in LYG vs. USPSTF strategy	NA	2.0%	0.7%	1.1%
Avg. # screens per LYG	47	46	48	47
NNS	37	38	42	42
False-positive screens per person screened	1.9	1.6	1.5	1.5
Biopsies	518	591	604	604
Overdiagnosed cases*	69	89	92	93
Overdiagnosis rate per screen-detected cancers	6.3%	6.7%	6.9%	6.9%
Radiation-related lung cancer deaths*	20.6	15.8	15.6	15.5

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Table 12. Cross-Screening Eligibility of the 2013 USPSTF-Recommended (A-55-80-30-15) and Risk Model–Based USPSTF-Like Scenarios

	vs. MPLCOm2012-0.018		vs. MLCDRAT-0.018		vs. Bach-0.03	
	Noneligible	**Eligible**	**Noneligible**	**Eligible**	**Noneligible**	**Eligible**
2013 USPSTF Noneligible	81.8%	3.9%	79.9%	5.8%	79.3%	6.4%
2013 USPSTF Eligible	1.1%	13.2%	1.3%	13.0%	1.6%	12.7%

Abbreviations: MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Table 13. 2013 USPSTF-Recommended Criteria (A-55-80-30-15) and Six Selected Risk Factor–Based Scenarios with 20 Pack-Year Criterion as Consensus Efficient

Group Analysis	LC Deaths Averted*	LYG*	LC Deaths Averted and LYG*
1950 Birth Cohort: Risk Factor–Based Strategies Only			
Number of consensus-efficient scenarios	79	58	69
2013 USPSTF criteria as consensus efficient	Yes	No	Yes
A-55-80-20-15 scenario as consensus efficient	Yes	No	No
A-55-80-20-20 scenario as consensus efficient	Yes	No	Yes
A-55-80-20-25 scenario as consensus efficient	Yes	No	Yes
A-50-80-20-15 scenario as consensus efficient	Yes	No	Yes
A-50-80-20-20 scenario as consensus efficient	Yes	Yes	Yes
A-50-80-20-25 scenario as consensus efficient	Yes	Yes	Yes
1960 Birth Cohort: Risk Factor–Based Strategies Only			
Number of consensus-efficient scenarios	80	50	57
2013 USPSTF criteria as consensus efficient	Yes	No	No
A-55-80-20-15 scenario as consensus efficient	Yes	Yes	Yes
A-55-80-20-20 scenario as consensus efficient	Yes	Yes	Yes
A-55-80-20-25 scenario as consensus efficient	Yes	Yes	Yes
A-50-80-20-15 scenario as consensus efficient	Yes	Yes	Yes
A-50-80-20-20 scenario as consensus efficient	Yes	Yes	Yes
A-50-80-20-25 scenario as consensus efficient	Yes	Yes	Yes
1960 Birth Cohort: Risk Factor–Based and Risk Model–Based Strategies			
Number of consensus-efficient scenarios	316	211	267
2013 USPSTF criteria as consensus efficient	No	No	No
A-55-80-20-15 scenario as consensus efficient	No	No	No
A-55-80-20-20 scenario as consensus efficient	No	No	No
A-55-80-20-25 scenario as consensus efficient	No	No	No
A-50-80-20-15 scenario as consensus efficient	No	No	No
A-50-80-20-20 scenario as consensus efficient	No	No	No
A-50-80-20-25 scenario as consensus efficient	No	No	No

*DEA metric.

Abbreviations: LC=lung cancer; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force.

Model 1: Erasmus-MISCAN

The Erasmus-Microsimulation Screening Analysis (MISCAN)-Lung Model is a microsimulation model that simulates a population of individual life histories. For each individual, a smoking history (including never smoking) is generated using the Smoking History Generator (SHG).[1] Lung cancer is modeled through a multistep procedure. Once a person's age at death from causes other than lung cancer is generated by the SHG, which is influenced by the person's smoking history, the integrated Two-Stage Clonal Expansion (TSCE) model is used to determine whether lung cancer develops in that individual.[2, 3] MISCAN-Lung distinguishes four histological types of lung cancer: squamous cell carcinoma, adenocarcinoma, other non-small cell carcinoma, and small-cell carcinoma.

Once lung cancer has developed, it progresses to more advanced preclinical stages until it is detected. Lung cancers can be detected either clinically (due to symptoms) or by screening. The incidence of clinically detected lung cancers depends on the preclinical duration and the probability of clinical detection, which both vary by cancer stage and histology (and sex for the preclinical durations). Data from the National Lung Screening Trial (NLST) and the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial (PLCO) were used to calibrate MISCAN-Lung, from which information on the natural history and screen detectability of lung cancer was derived.[4-7] Through incorporating information on the preclinical duration, probability of clinical detection, and screen detectability of lung cancer, as well as a person's death from causes other than lung cancer, MISCAN-Lung can account for the effects of lead time and overdiagnosis.

If screening does not occur, lung cancers can only be clinically detected. If persons die of lung cancer before dying from other causes, their ages of death are adjusted accordingly. Upon activating the screening component, preclinical lung cancers may be detected by screening, which may cure patients, allowing them to resume their normal (cancer-free) life history. The probability of cure differs by the stage of cancer at detection and was based on data from the NLST. Upon clinical or screen detection (if no curation occurs) of lung cancer, the patient is assigned a histological type-, stage- and sex-specific survival time, which follows a piecewise uniform distribution.

In the decision analysis, the model evaluated different properties of the screening test (such as sensitivity), and various screening policies (e.g., starting/stopping age, screening frequency, smoking eligibility criteria) can be specified. For each of these properties and screening policies, the model can evaluate various simulated events in the presence and absence of screening, such as the mortality due to lung cancer and other causes, life-years gained, and overdiagnosis.

MISCAN-Lung has previously been used to evaluate the effect of tobacco control on U.S. lung cancer mortality.[8] MISCAN-Lung contributed to the analyses of the CISNET Lung Group, which were used to inform the U.S. Preventive Services Task Force (USPSTF) for their 2013 recommendations for lung cancer screening.[4, 9-11] The model was used to evaluate the cost-effectiveness of lung cancer screening in Ontario, Canada.[12] The model was also used in recent comparative modeling studies by the CISNET Lung Group: 1) evaluation of the effects of risk-stratified screening[13] and 2) analysis of the cost-effectiveness of lung cancer screening in the United States.[14]

Model 2: MGH-HMS

The Massachusetts General Hospital–Harvard Medical School (MGH-HMS) group's model is a comprehensive state-transition microsimulation model that simulates a patient's lung cancer development, progression, detection, followup, treatment, and survival.[9, 10, 15-22] The MGH-HMS model was originally developed to evaluate the clinical effectiveness and cost-effectiveness of low-dose computed tomography (LDCT) screening for lung cancer.[17, 18, 20] The model has been extended to estimate the effect of reduced tobacco smoking on lung cancer mortality in the United States,[21] the number of radiation-induced cancers from lung cancer screening,[9, 16] cost-effectiveness of followup of incidentally detected pulmonary nodules,[15] and effectiveness of treatment strategies for stage IA/IB non-small cell carcinoma patients who were nonoperative candidates.[22] The model was used in the 2013 CISNET lung cancer decision analysis for the USPSTF.[4, 9, 10]

The MGH-HMS model is a Monte Carlo microsimulation model coded in C++. The model initially populates with disease-free persons who then go through different health states according to monthly transition probabilities. In each monthly cycle, an individual may develop lung cancer, have an existing cancer grow, or develop symptoms or metastases. The risk of lung cancer is related to persons' smoking history, which is updated monthly (the model also includes cancers in nonsmokers). Smoking exposure history is supplied by the SHG. Lung cancers can be detected by an evaluation of symptoms through incidental imaging or by LDCT screening (with different tumor behavior for screen-detected cases). Persons with suspected lung cancer receive diagnostic and staging tests and then may undergo treatment. The screening module can be turned on and off to allow for analyses of treatment effectiveness for screen-detected vs. nonscreen-detected cases.

Each simulated individual in the MGH-HMS model can develop up to three cancers from any of five lung cancer cell types (adenocarcinoma, large cell, squamous cell, small cell, and other non-small cell carcinoma). For each cell type, the monthly probability of cancer development is described by a logistic equation with seven natural history parameters: a type-specific intercept, type-specific coefficients for age, age squared, years of cigarette exposure (pack-years), an interaction term between pack-years and age squared, the average number of cigarettes smoked per day (cigarettes per day), and the years since quitting smoking. The MGH-HMS model also explicitly simulates the followup schedule of small incidentally detected or screen-detected lung nodules, which allows the model to examine the effectiveness of followup recommendations by the Fleischner Society or the Lung Imaging Reporting and Data System (Lung-RADS). In the MGH-HMS model, the levels of simulated disease characteristics allow the staging of patients according to the Tumor Node Metastasis classification,[23] permitting the model to simulate the most up-to-date treatment options according to current clinical practices. The natural history parameters related to unobservable events (i.e., the initiation of the first cancer cell) were estimated by calibrating the model using Surveillance, Epidemiology, and End Results (SEER) registry data (cancer incidence by cell type, stage distribution at diagnosis, and stage-specific survival), published cohort studies, and clinical trial data. The details of model calibration and validation of the original natural history parameters have been described in our previous publications.[4, 24]

The MGH-HMS model's flexibility allows for evaluation of multiple components in a lung cancer screening program, including screening eligibility, smoking cessation, followup, staging, and treatment. Improvements in any of these components may affect patient outcomes and may influence the effectiveness of interventions in other areas. The MGH-HMS model does not rely on data from a single trial to inform the parameter estimates but rather incorporates data from multiple sources and can incorporate new data as they emerge. The MGH-HMS model can thus be used to evaluate screening in populations not included in ongoing trials and can address the "moving target" problem of improved test performance or treatment effectiveness.

Model 3: Stanford

The Lung Cancer Outcomes Simulator (LCOS) Model (Stanford University) is based on a natural history model of lung cancer that assumes exponential growth for the primary tumor and growth of metastasis proportional to the primary tumor growth.[4, 25] The natural history model simulates the individual's tumor growth in the absence of any intervention, based on sex and histologic subtype, providing outcomes such as tumor volume doubling time, time for onset of metastasis, tumor size at clinical detection, and survival time. The parameters of the natural history model are estimated using SEER survival data.

In the natural history model, the primary tumor grows exponentially with growth rate r, and its corresponding tumor volume doubling time is given as (log2)/r. When the tumor reaches a certain size (Vp), it prompts symptoms that lead to a clinical detection of the primary tumor. The tumor volume and the growth rate parameter are modeled as a bivariate log-normal distribution. Fatal metastases start growing at a certain time, and we assume that the volume of the primary tumor at this time (Vc) is a threshold for cure (cure threshold) so that only if the primary tumor is detected and treated earlier than this point is the patient cured. The metastatic burden grows proportionally to the primary tumor size with fraction "f" until it reaches a maximum burden size (BD). The time at which BD is reached is a survival time if the primary tumor is not detected and treated before reaching the cure threshold. If this metastatic burden grows to a certain size (c1BD, where $0<c1<1$), it becomes an observable metastasis; thus, if detection (either clinical or screen detection) occurs earlier than this point, the tumor is staged as early stage. Otherwise, the tumor is staged as advanced. When the metastatic burden grows to a certain size (c2BD, where $0<c2<1$), it becomes clinically symptomatic; hence, detection is due to either the primary tumor or metastasis, depending on which becomes symptomatic first.

The LCOS superimposes a specific screening intervention to each individual and estimates individual-level outcomes, which can be aggregated for evaluating population-level outcomes. Key inputs for the LCOS include sex, individual-level smoking history (e.g., pack-years and age for starting/quitting smoking), and age of entry to the screening program. The LCOS uses the TSCE model to predict annual hazards for lung cancer incidence in the absence of screening given smoking history, sex, and age.[3] The parameters of the TSCE model were estimated based on data from Nurses' Health Study (NHS)/Health Professionals' Followup Study (HPFS) with further adjustments.[26]

For each lung cancer, a histologic subtype (adenocarcinoma, squamous, large cell, or small cell) is assigned by sampling from the observed proportions from SEER data. The lung cancer cases with indeterminate diagnosis follow the Lung-RADS guidelines,[4] which are explicitly incorporated in the LCOS.[26] The LCOS compares the performance of the screening program of interest against the no-screen scenario estimating the benefit of screening. It can estimate sex-specific benefits and harms of screening strategies with various starting and stopping screening ages, smoking exposure levels, screening frequencies, and followup protocols. Outcome measures include lung cancer deaths avoided, all-cause and lung cancer–specific mortality reduction, number of detected cases by mode of detection, number of screening examinations, number of false-positive results, and number of overdiagnosed cases, among others.

Model 4: University of Michigan

The University of Michigan Lung Cancer Screening Model is a combination of a multistage carcinogenesis model and a discrete-state microsimulation model. The model was developed to evaluate the effect of screening on lung cancer incidence and mortality, survival outcomes, overdiagnosis, and quality of life. This model consists of two components: natural history and screening. It was used for the 2013 USPSTF lung cancer screening decision analyses[4, 9] but has been updated considerably to simplify its use and enhance its applicability. The model was recently used to assess the cost-effectiveness of LDCT in the United States[14] and the effect of risk-based screening strategies in collaboration with the other CISNET Lung groups.[13]

The natural history component simulates individual lung cancer–oriented life events in the absence of screening given the individual's smoking history. The age at clinical detection of lung cancer (dose-response) is simulated through a TSCE model.[2, 3] The TSCE model assumes that two mutation (rate-limiting) events are required for the initiation of premalignant lung tumors, and it explicitly models the dynamics of premalignant and malignant tumors. The TSCE model was fitted to lung cancer incidence in the NHS and the HPFS using a likelihood-based approach. If an individual develops clinically diagnosed lung cancer, the natural history model also simulates the age at lung cancer onset, histology, stage at diagnosis, preclinical sojourn time for each stage, and age at lung cancer death. Lung cancer histology is classified into four main groups: small cell, adenocarcinoma, squamous, and other. Histology is simulated using a multinomial logistic regression accounting for sex, age, and smoking exposure model based on the PLCO. Preclinical sojourn times for each stage follow a Weibull distribution with shape and scale parameters depending on sex, stage, and histology.[5] The preclinical sojourn times are simulated for all stages for each clinically diagnosed lung cancer case and used in the screening component to model the effect of screening. Lung cancer–specific survival time conditioned on sex, age at diagnosis, histology, and stage are estimated by using cure models with lognormal survival distributions, which were fitted to lung cancer survival data in SEER 18.

The outputs from the natural history component serve as inputs for the screening component to simulate the effect of screening on lung cancer incidence, stage, and survival. The model uses sensitivity and specificity rates to simulate screening results: true positive, false positive, or negative. Sensitivity estimates were obtained from ten Haaf et al[5] and vary by screening round, lung cancer histology, and stage. These estimates, originally based on NLST, were adjusted to conform to Lung-RADS criteria by multiplying them by a scaling factor, given by the ratio of the overall sensitivity from Lung-RADS over that from NLST.[27] Specificity rates by screening round were also based on a retrospective analysis of NLST outcomes using the Lung-RADS criteria.[27]

The model simulates additional screening outcomes such as the number of followup tests and potential complications based on NLST rates.[6, 28] The rates of specificity and sensitivity for screening simulation were chosen based on other published literature.[5, 6, 28] For true-positive cases, lung cancer–specific survival time and stage burden were updated given the stage and age at diagnosis.

A version of this model using an alternative dose-response model (Bach's lung cancer risk model[29]) was recently used to evaluate the preference-sensitivity of LDCT at different levels of underlying risk.[30]

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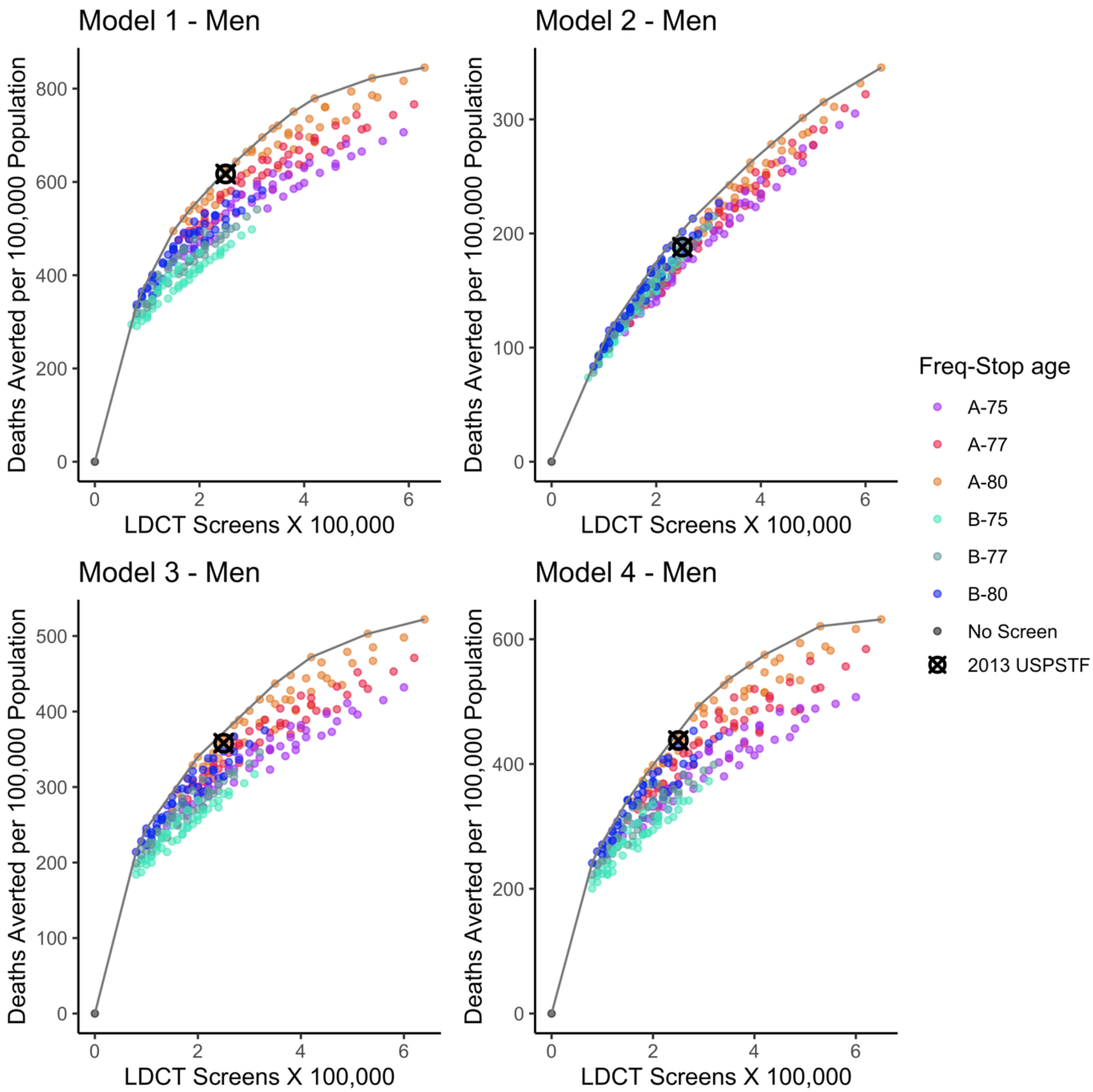
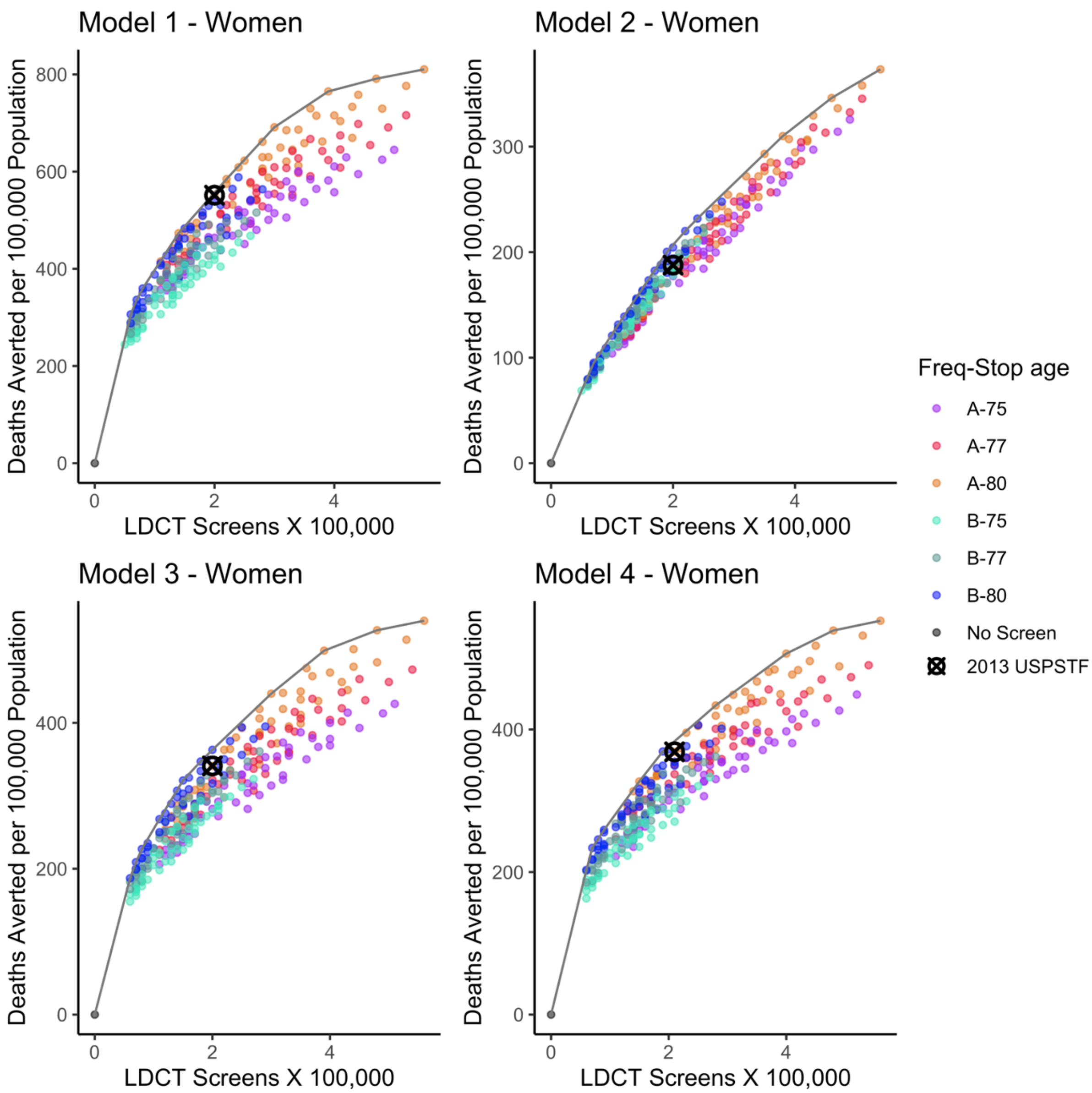
Appendix B Figure 1. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Men



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs=versus.

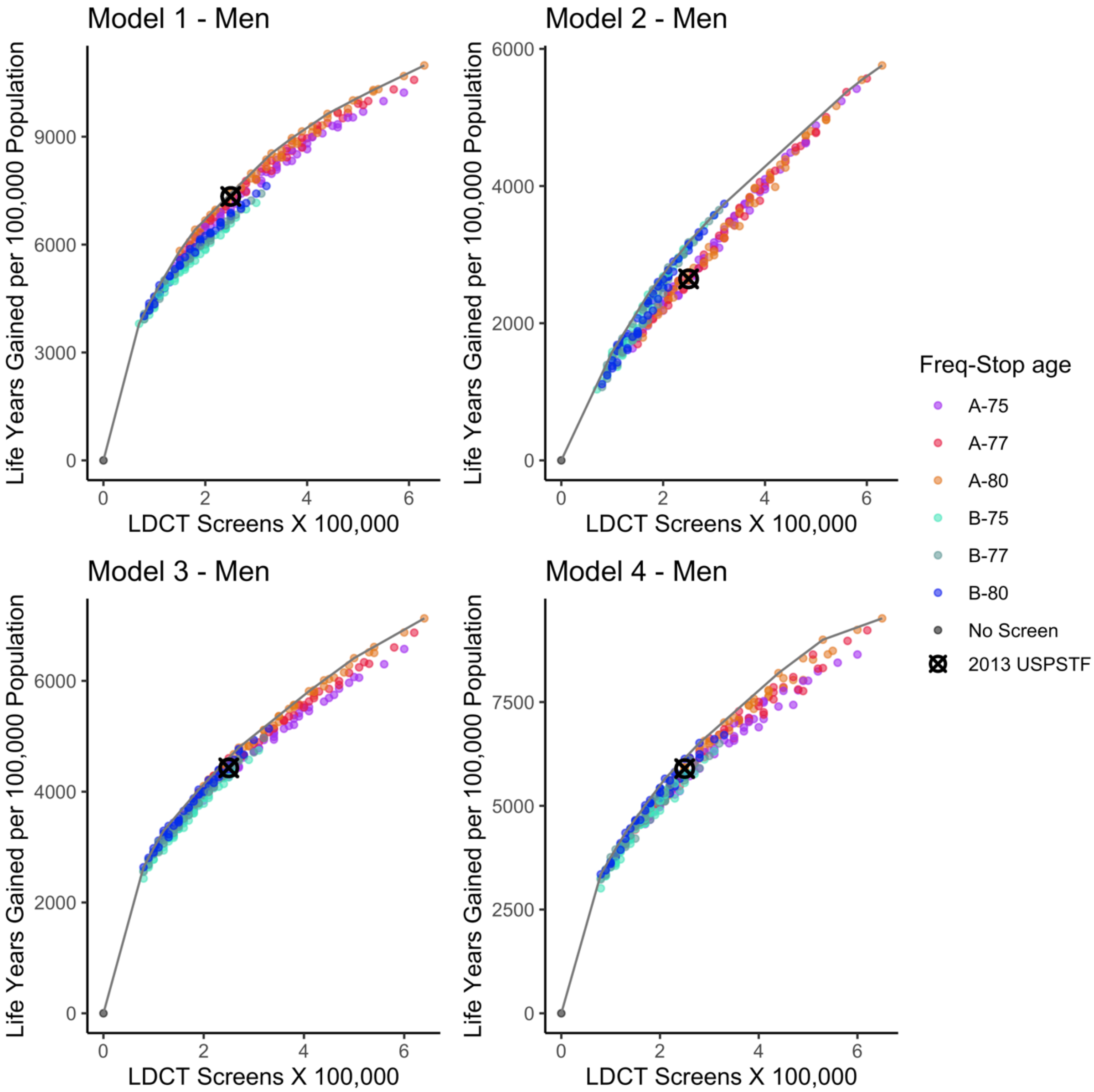
Appendix B Figure 2. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Women



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs=versus.

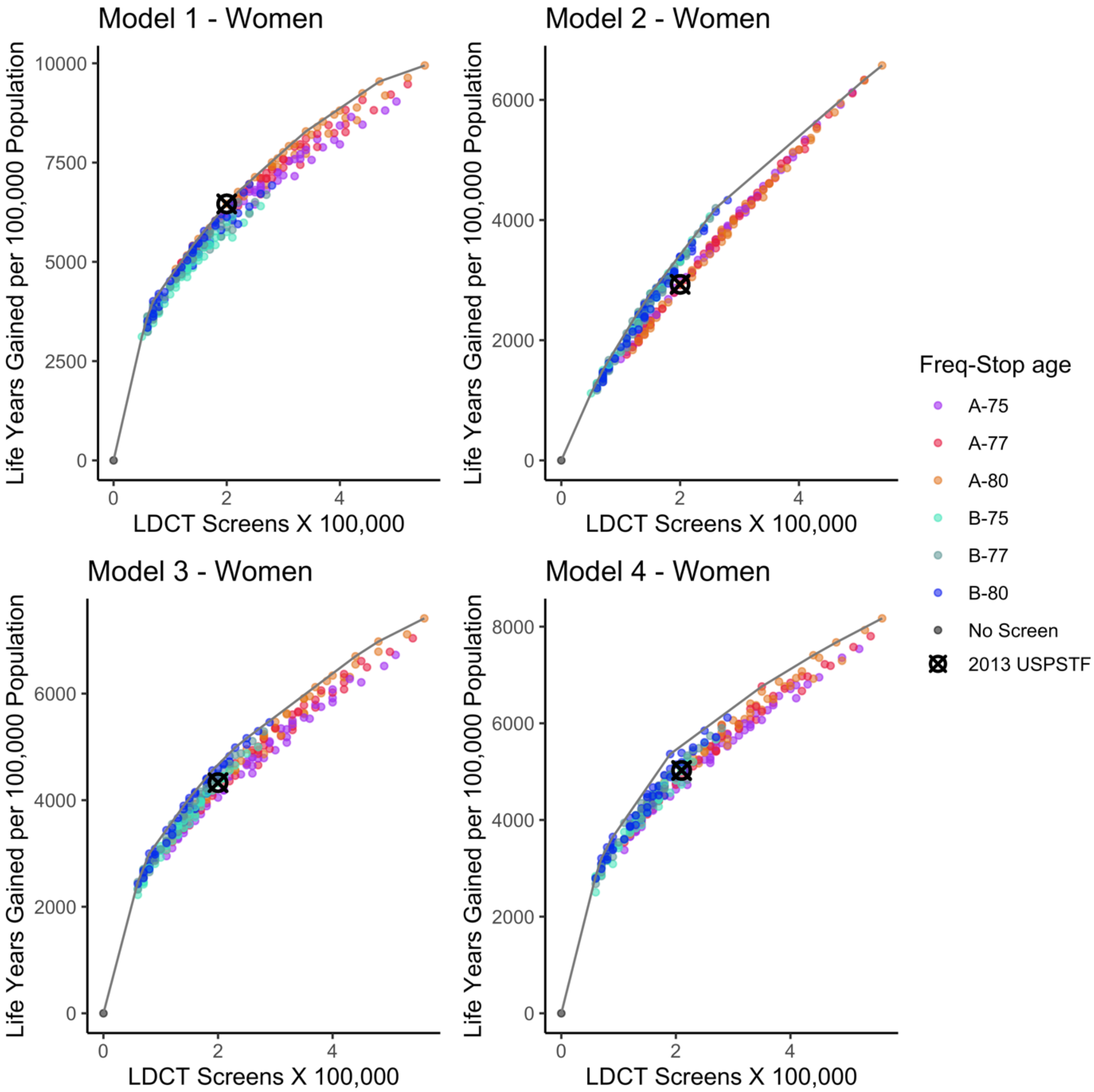
Appendix B Figure 3. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Men



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs=versus.

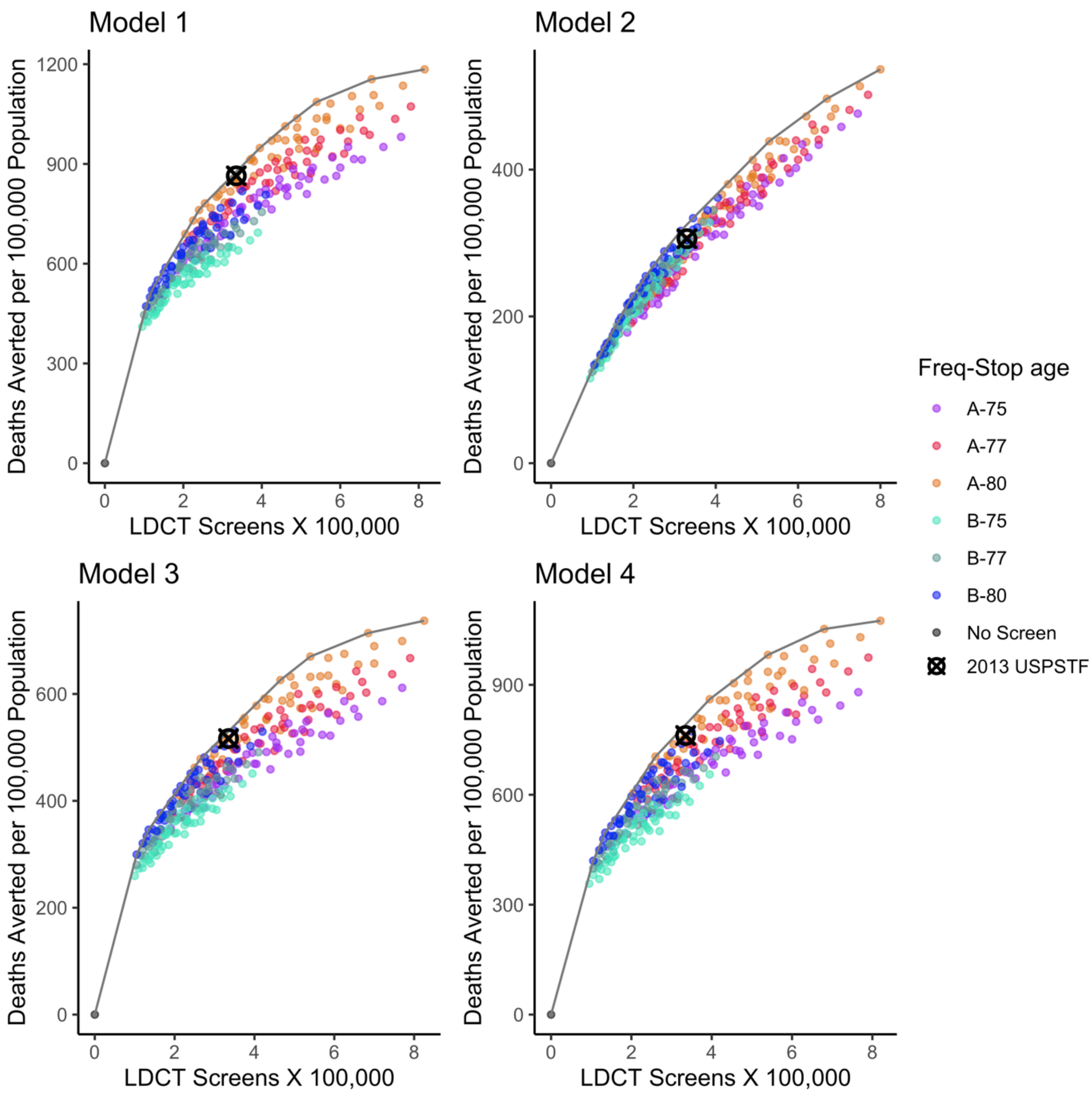
Appendix B Figure 4. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Women



Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs=versus.

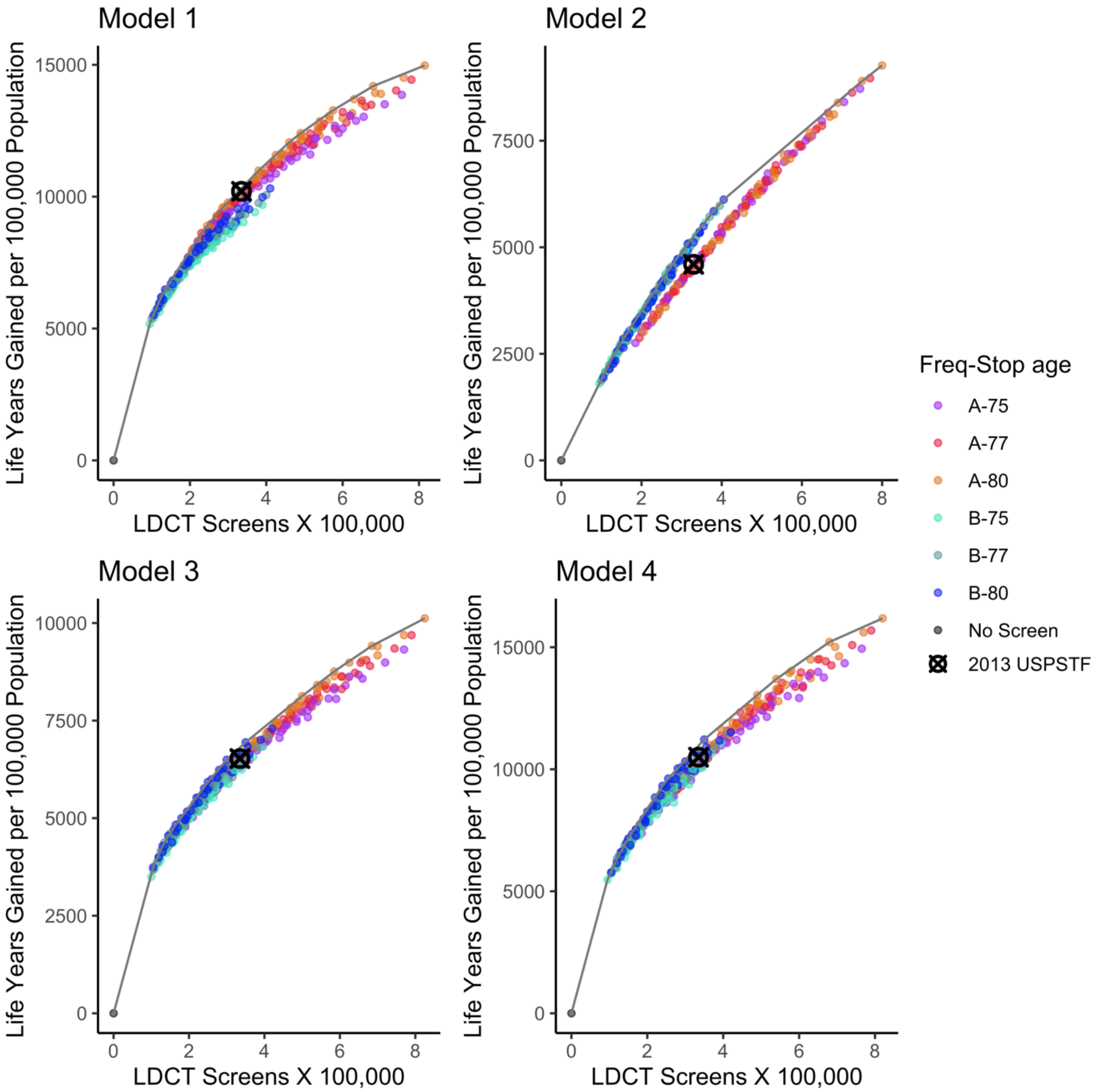
Appendix B Figure 5. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1950 Birth Cohort



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs=versus.

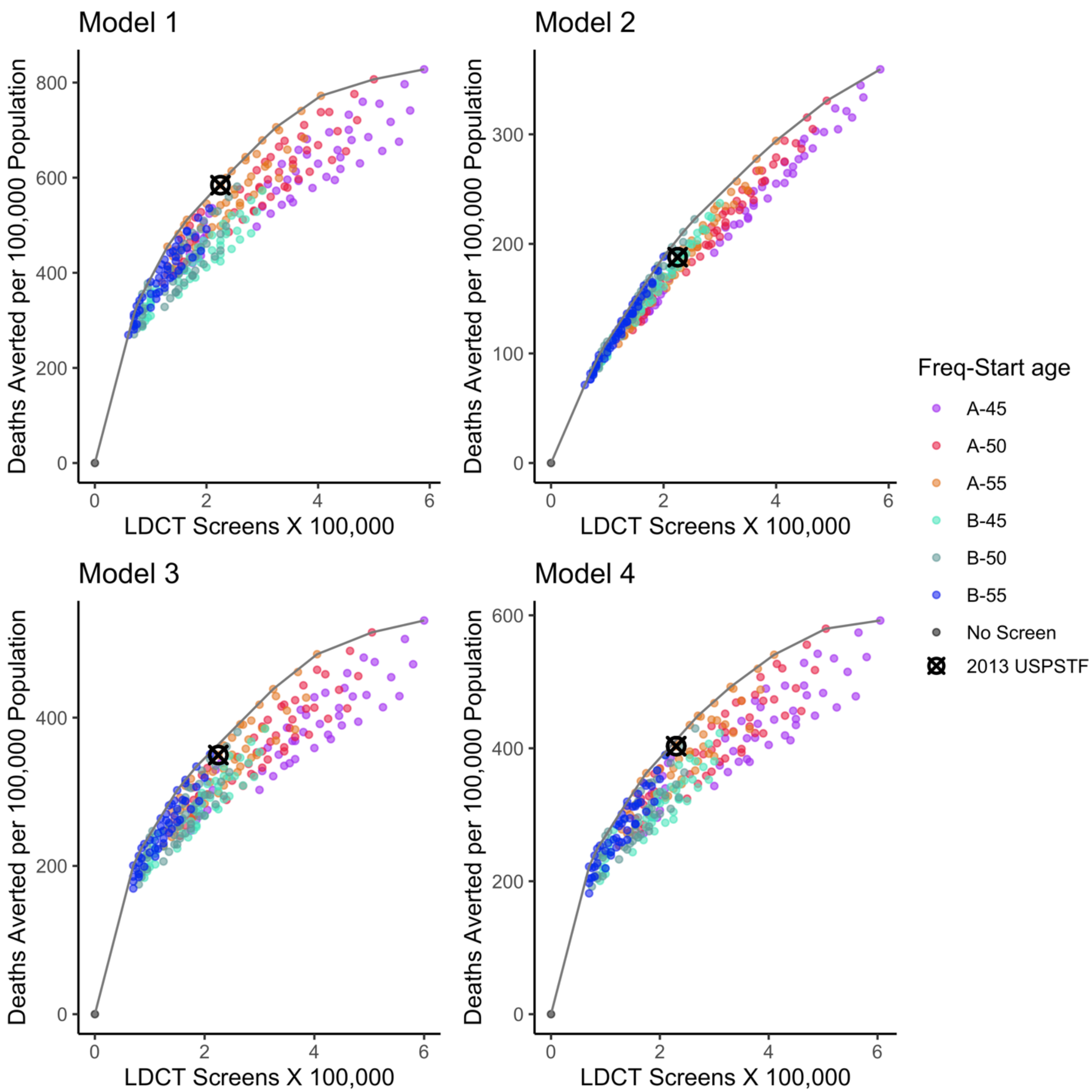
Appendix B Figure 6. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1950 Birth Cohort



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

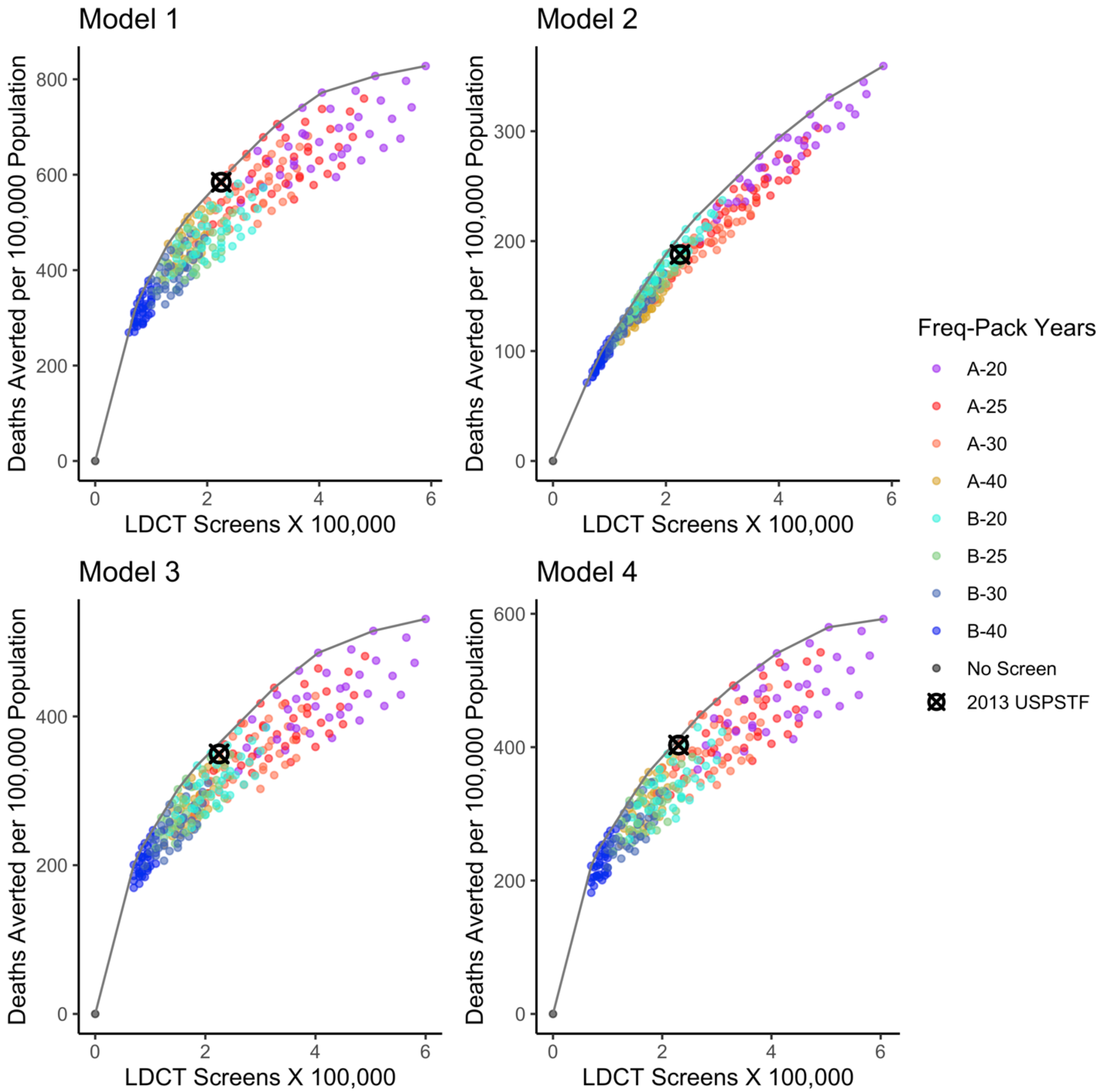
Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix B Figure 7. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Age at Starting Screening)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at starting screening (45, 50, 55). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.
Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

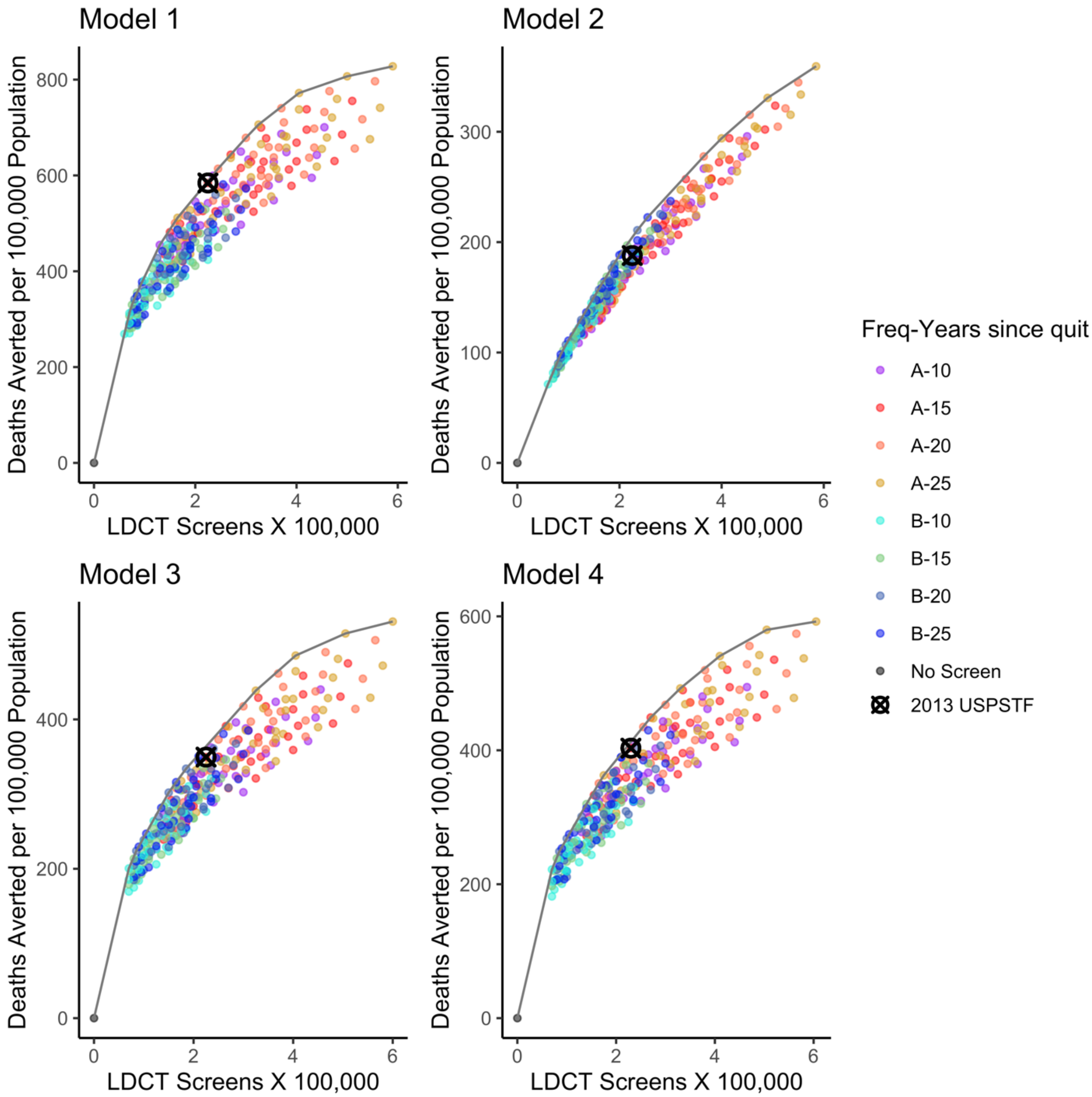
Appendix B Figure 8. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Pack-Years Criterion)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the pack-years criterion (20, 25, 30, 40). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

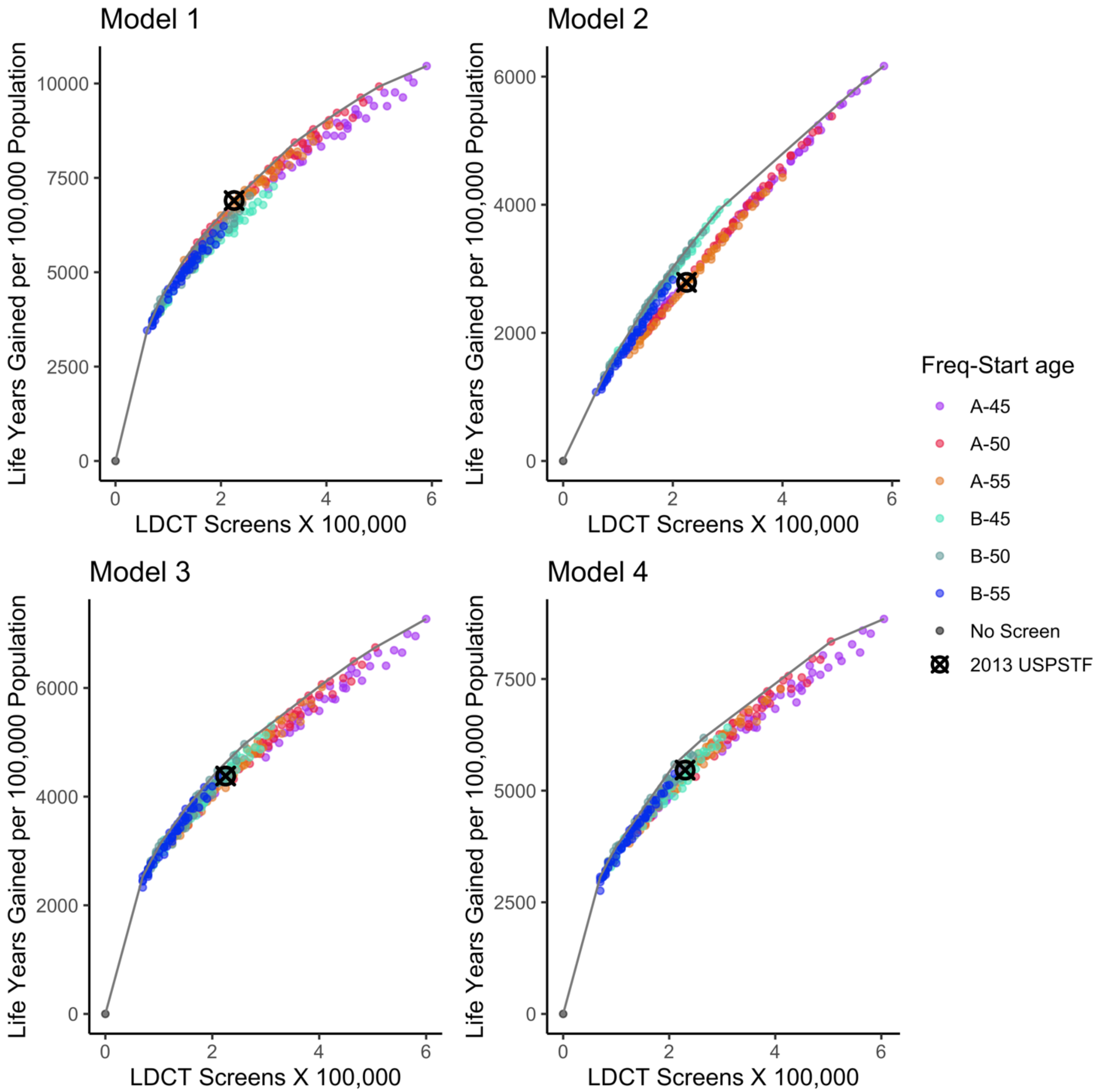
Appendix B Figure 9. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Years Since Quitting)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the years since quitting (10, 15, 20, 25). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

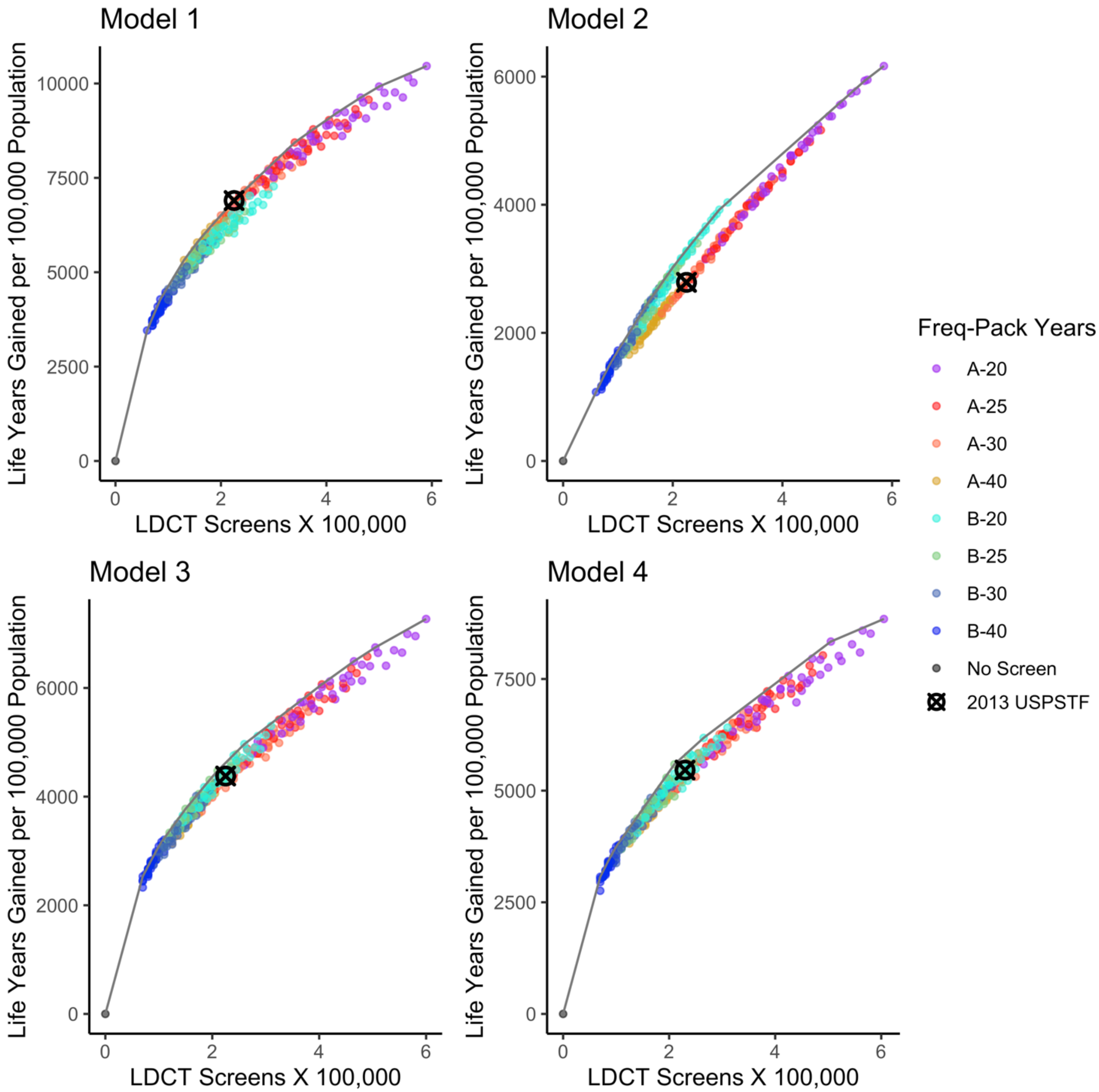
Appendix B Figure 10. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Age at Starting Screening)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at starting screening (45, 50, 55). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

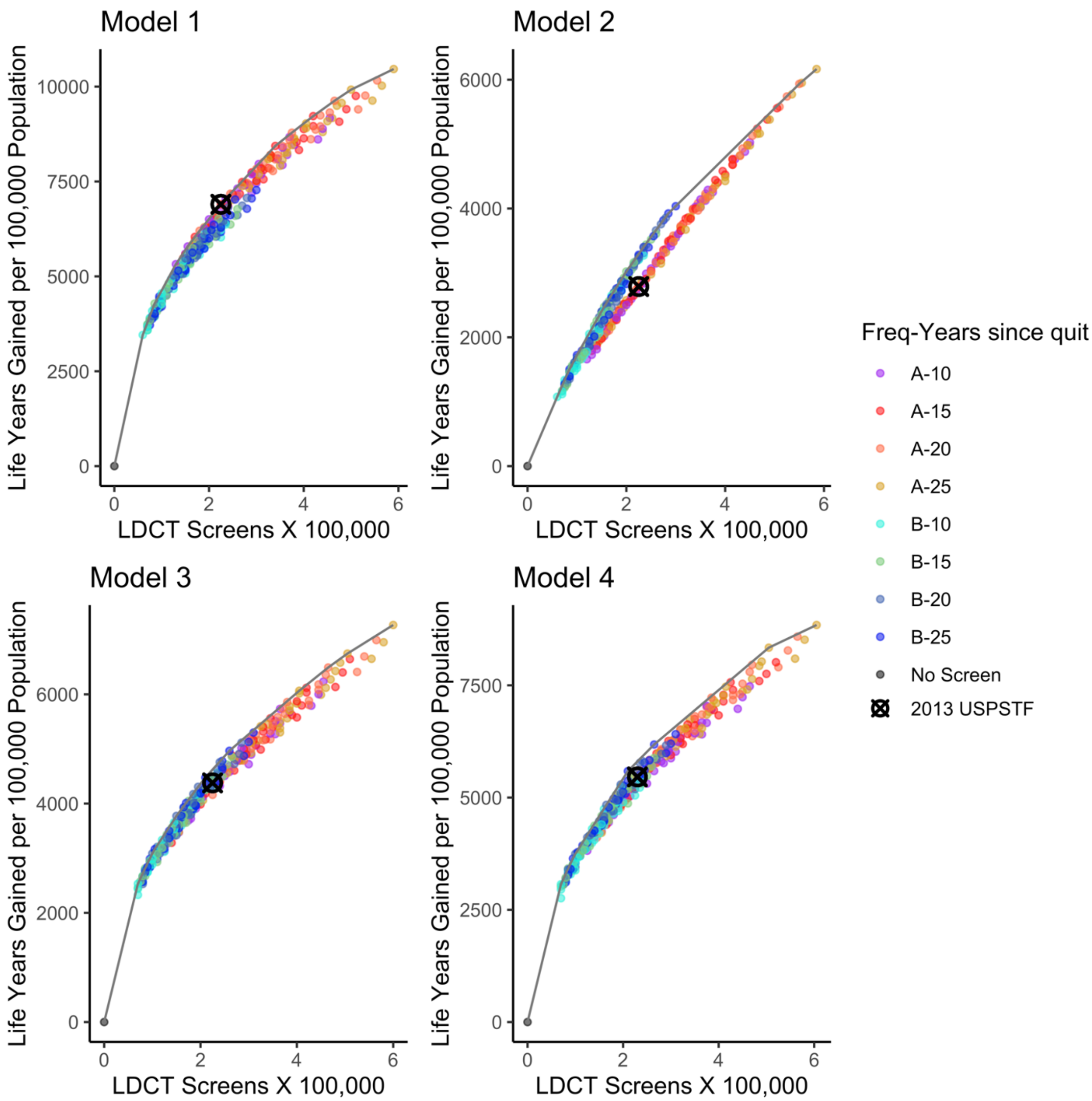
Appendix B Figure 11. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Pack-Years Criterion)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the pack-years criterion (20, 25, 30, 40). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

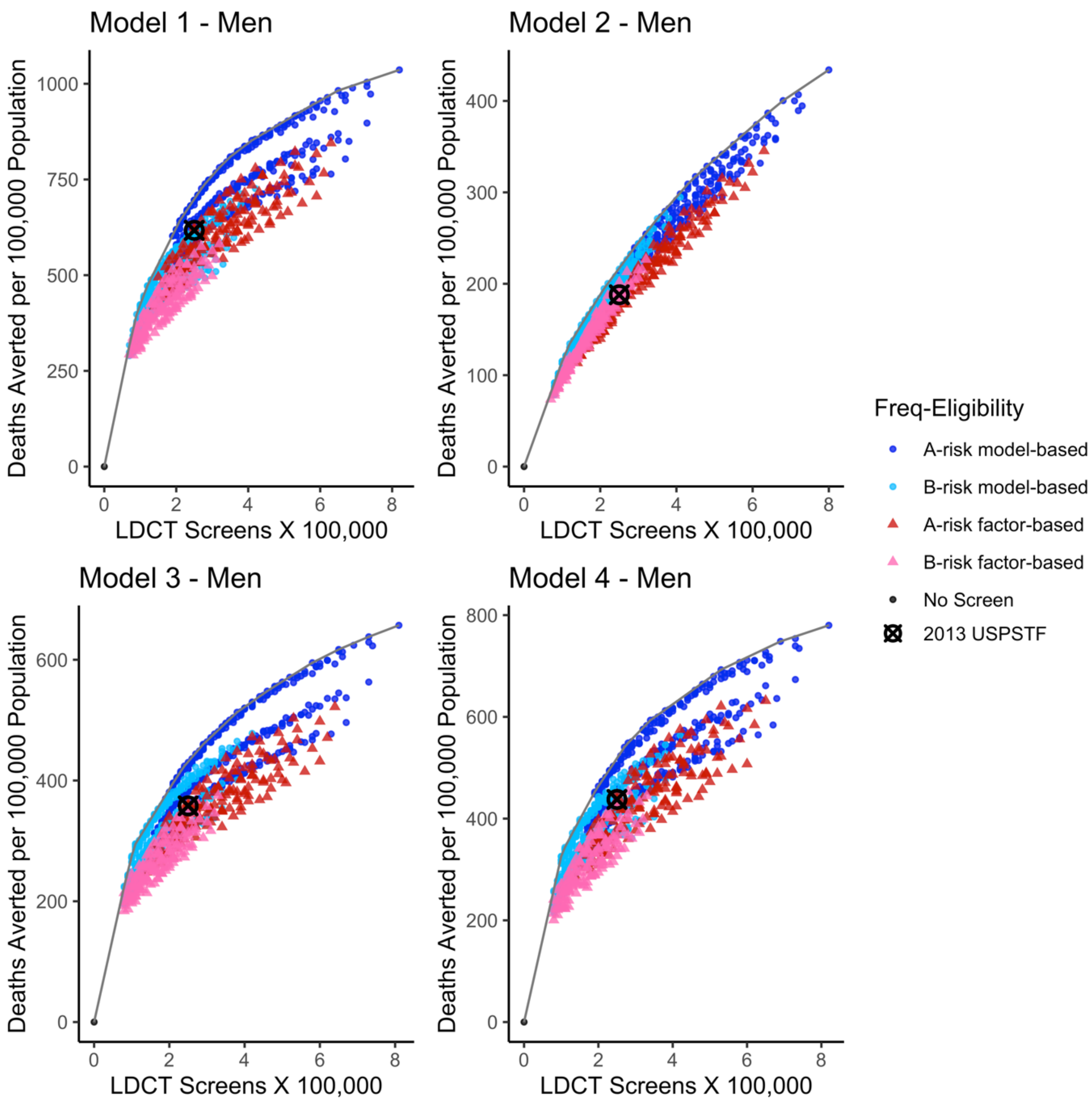
Appendix B Figure 12. Number of LDCT Screening Examinations vs. Life-Years Gained in Each of the 289 Risk Factor–Based Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort (by Frequency and Years Since Quitting)



Note: Each point represents a different scenario, and the line represents the estimated efficient frontier per model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the years since quitting (10, 15, 20, 25). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

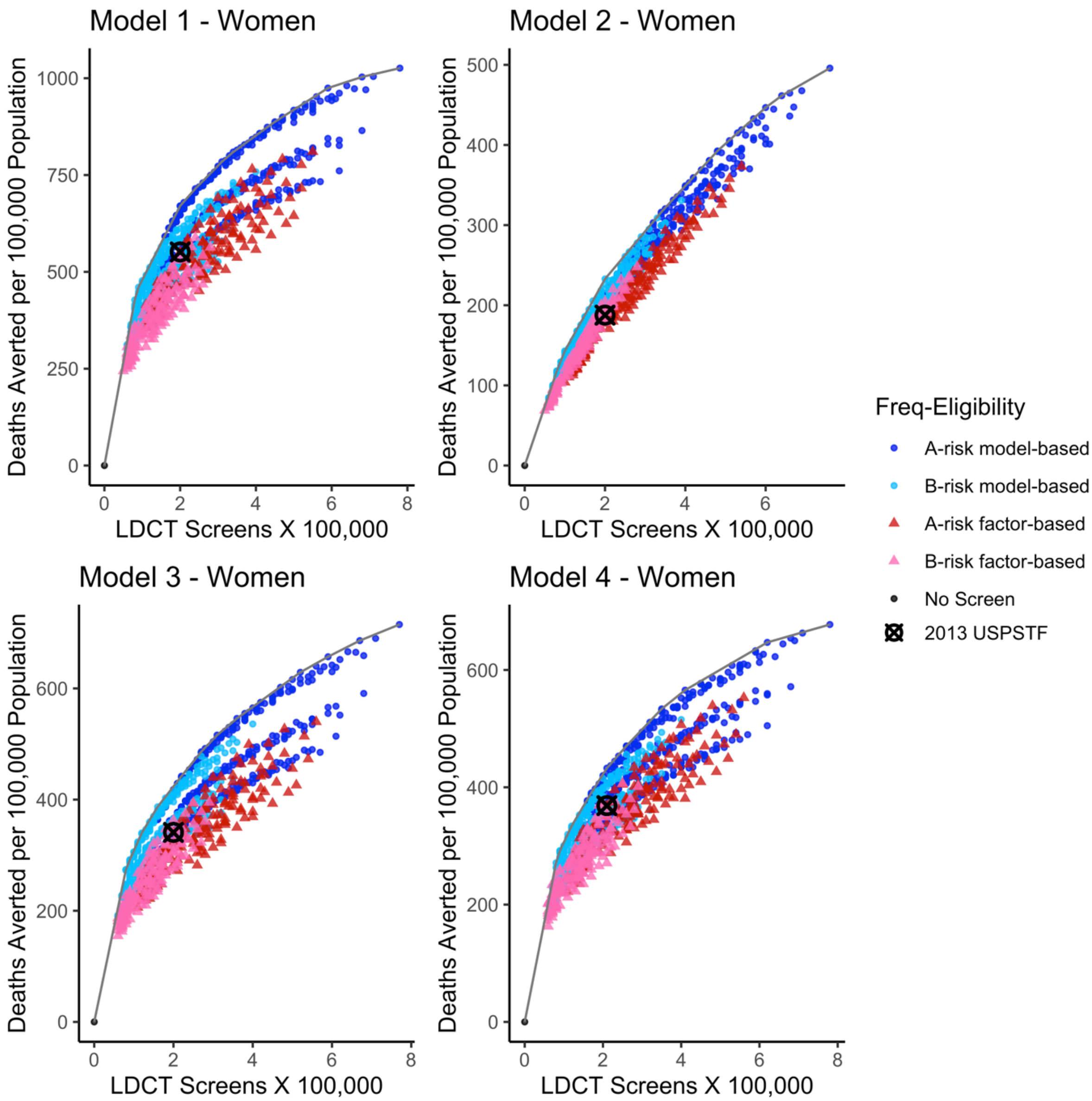
Appendix B Figure 13. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Men



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) by round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

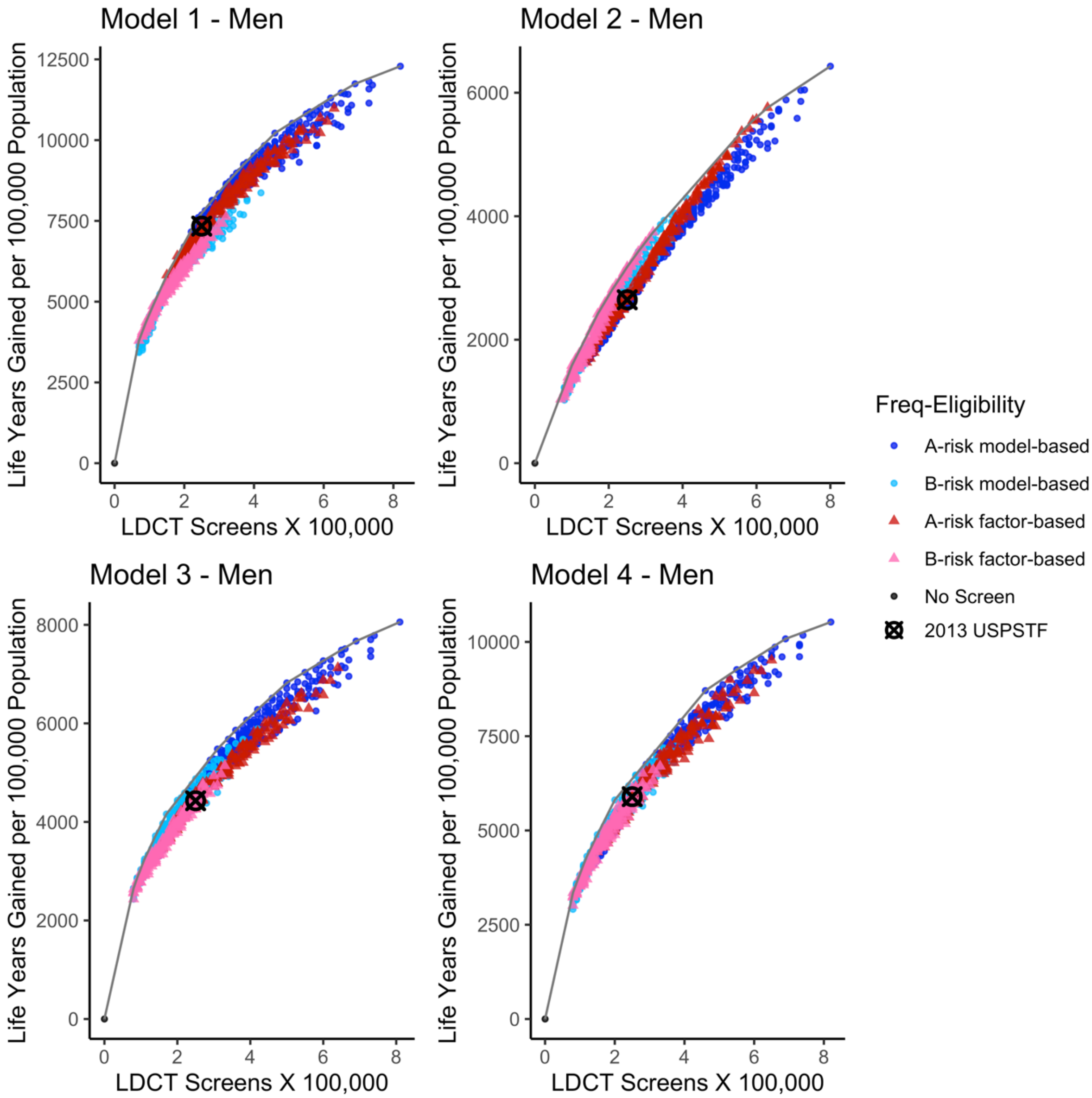
Appendix B Figure 14. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Women



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) by round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

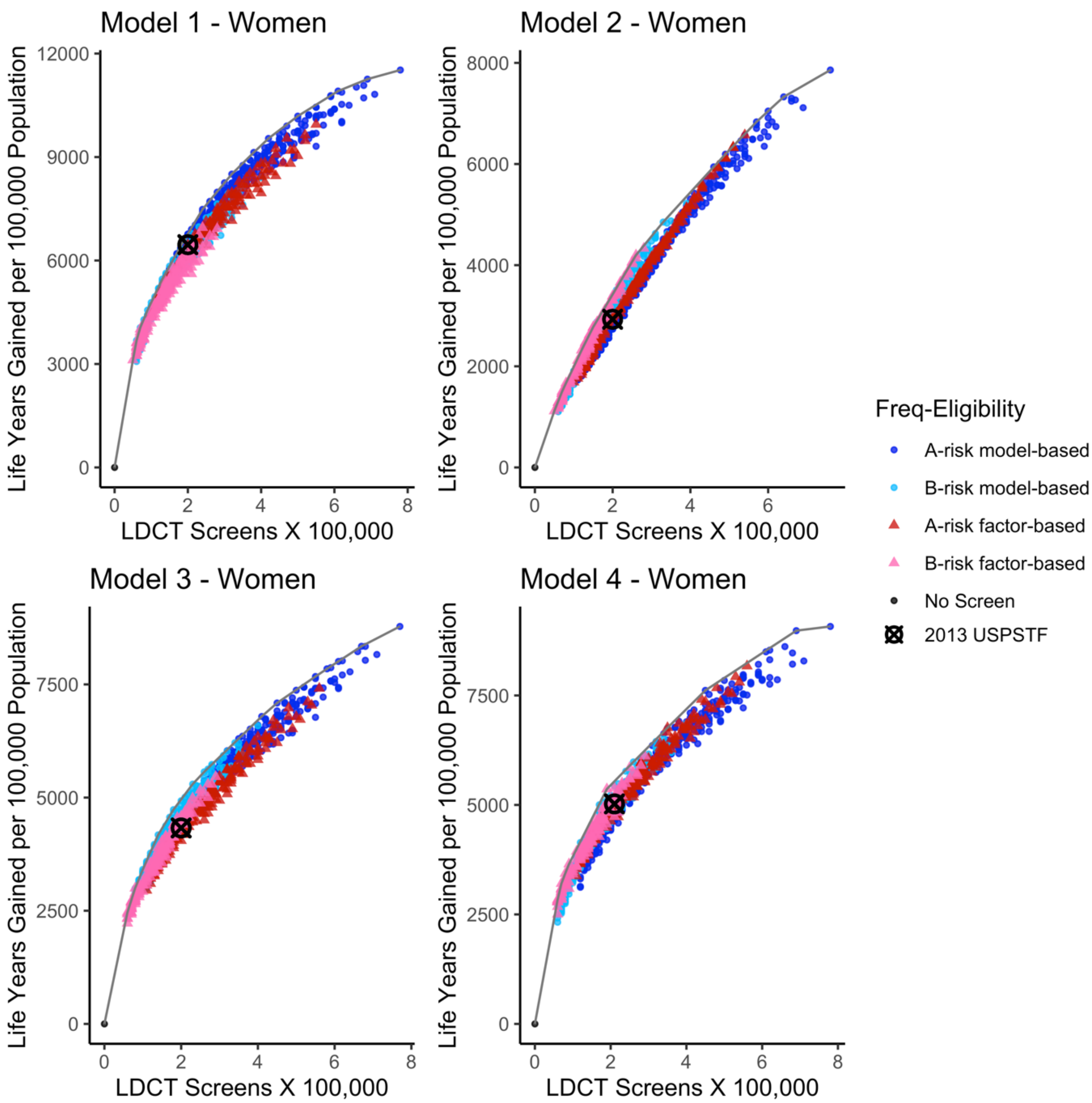
Appendix B Figure 15. Number of LDCT Screening Examinations vs. the Life-Years Gained in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Men



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) by round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

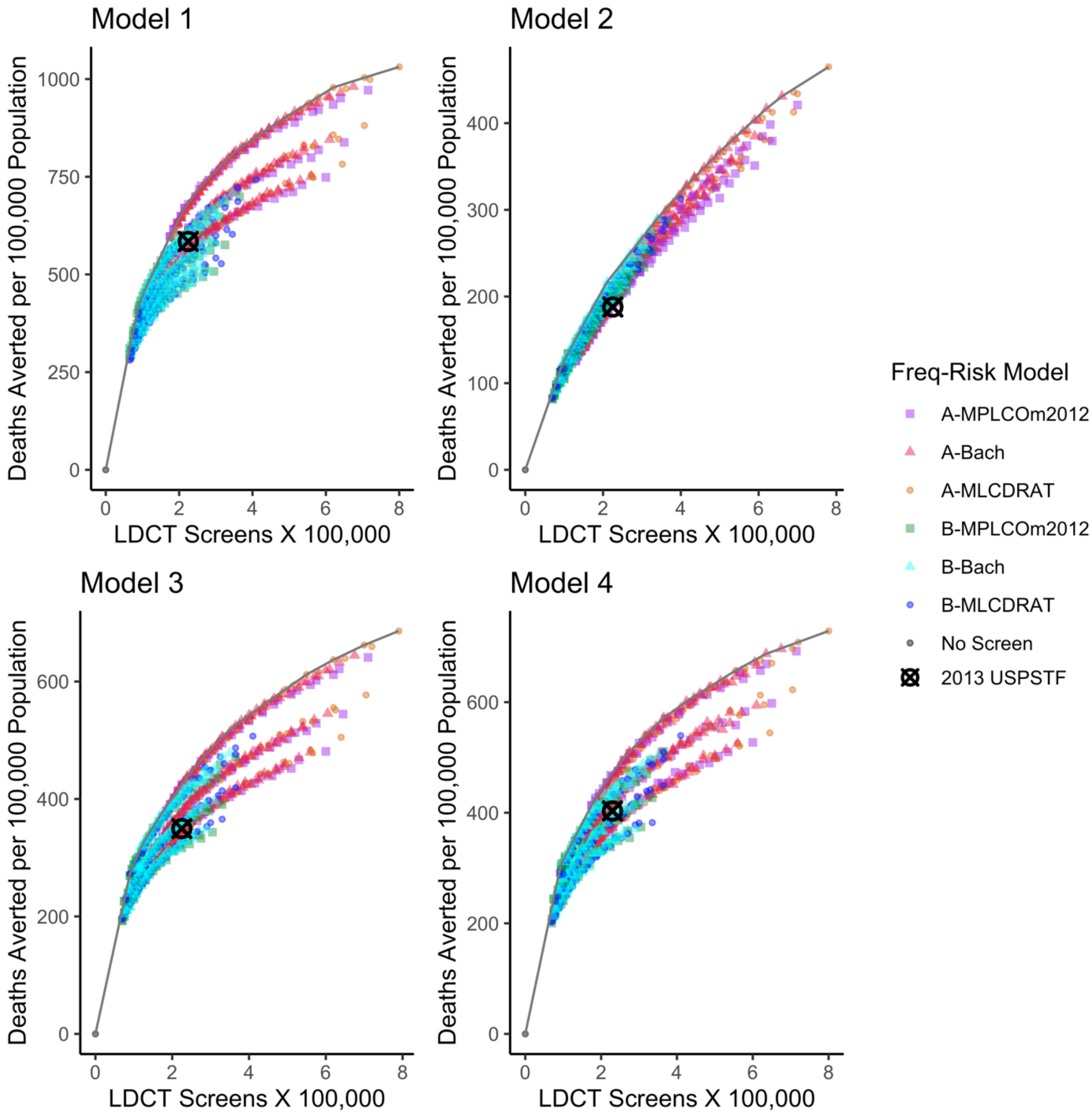
Appendix B Figure 16. Number of LDCT Screening Examinations vs. the Life-Years Gained in Each of the Risk Factor–Based and Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort Women



Note: Risk factor–based screening scenarios (n=288) are represented with triangle points and risk model–based screening scenarios (n=804) by round points. The line represents the estimated overall efficient frontier per model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

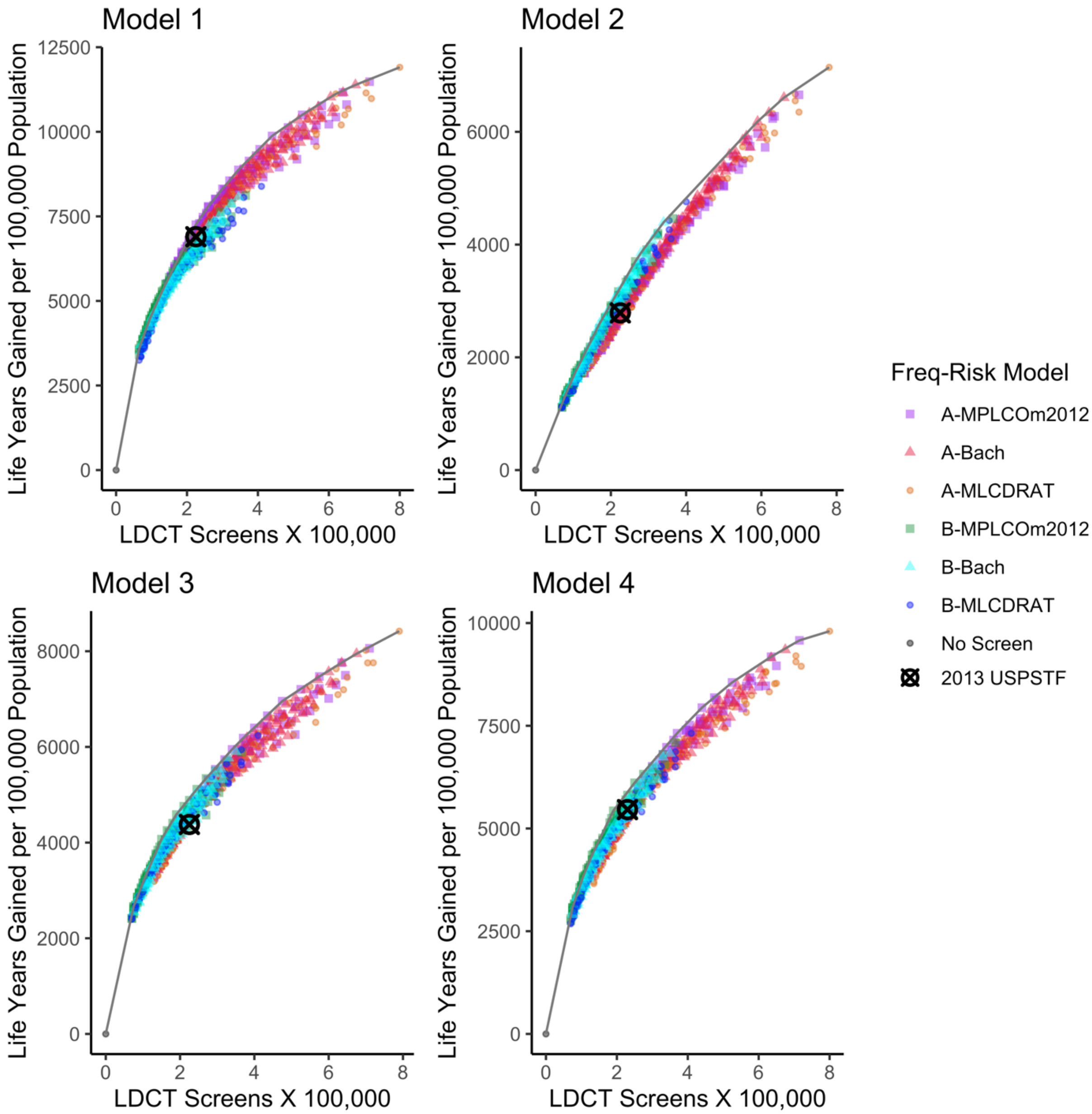
Appendix B Figure 17. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted in Each of the Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Each point represents a different risk model–based screening scenario, and the line represents the estimated efficient frontier per model. Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the risk model (Bach, MLCDRAT, MPLCOm2012). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

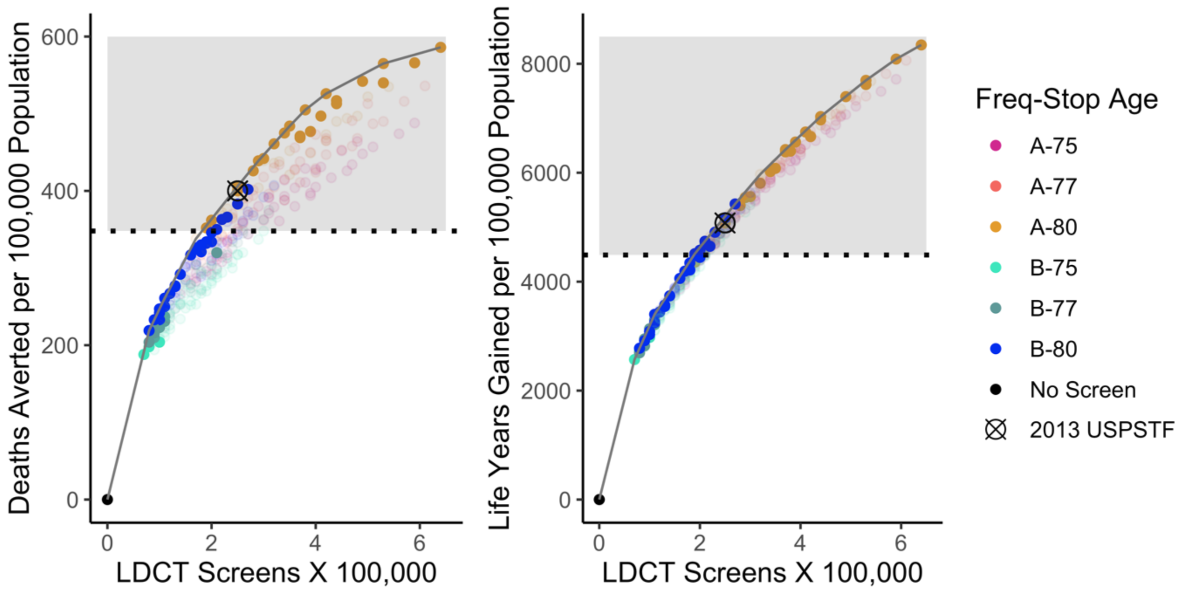
Appendix B Figure 18. Number of LDCT Screening Examinations vs. the Life-Years Gained in Each of the Risk Model–Based Eligibility Strategies Evaluated by the Four CISNET Models—1960 Birth Cohort



Note: Each point represents a different risk model–based screening scenario, and the line represents the estimated efficient frontier per model. Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the risk model (Bach, MLCDRAT, MPLCOm2012). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted.

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

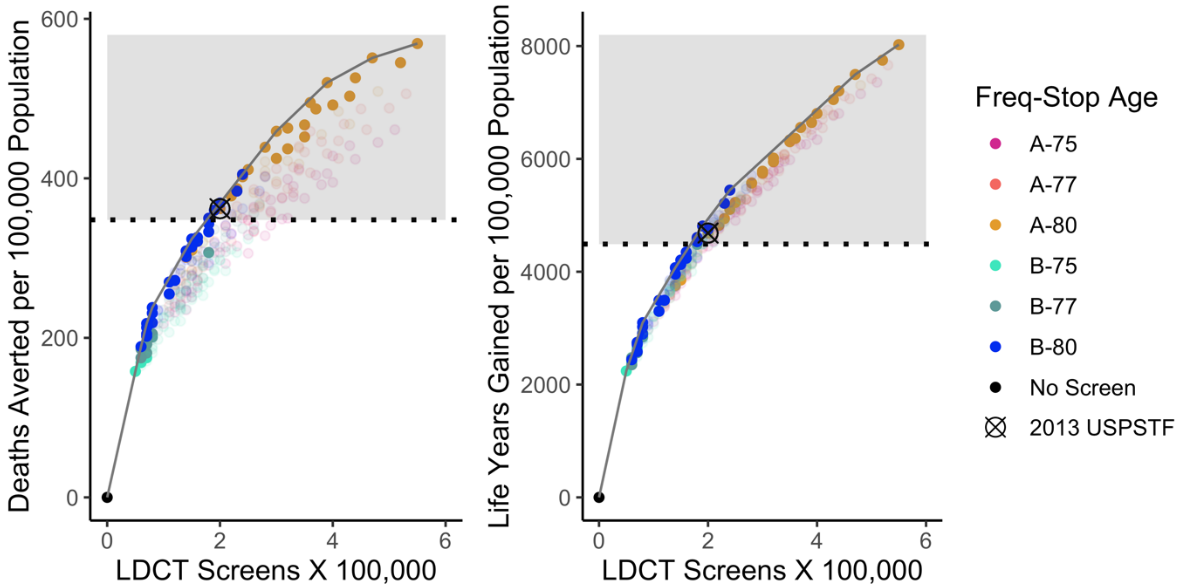
Appendix B Figure 19. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort Men



Note: Each point represents a different scenario, and the curve represents the estimated efficient frontier for the average model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted. The panels show all 288 risk factor–based strategies but highlight (solid color points) those identified as consensus efficient. The horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with at least a 9 percent lung cancer mortality reduction (listed in Appendix C Tables 5 and 6).

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

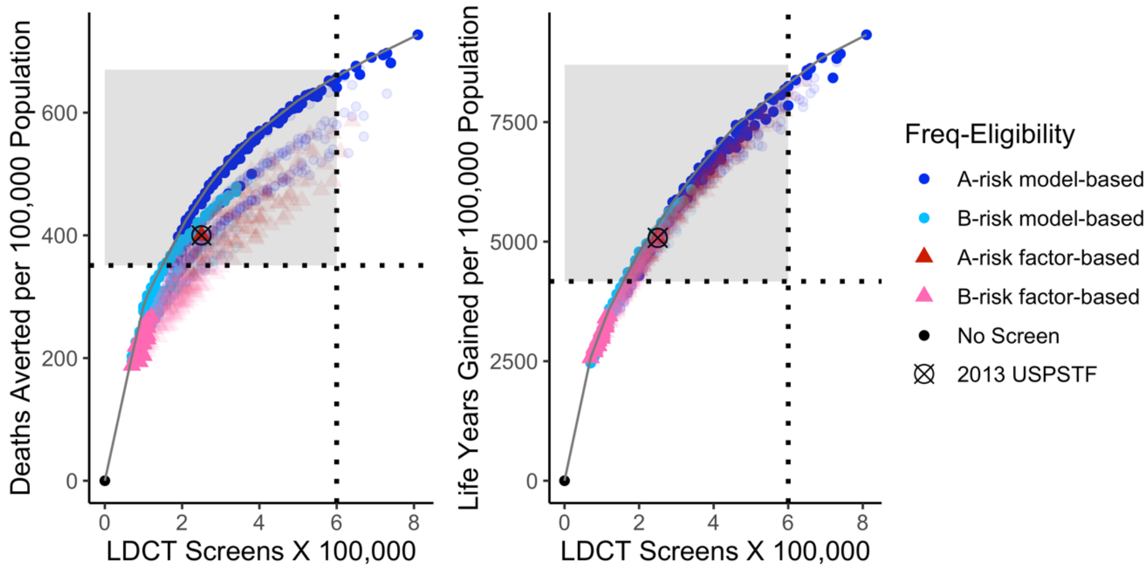
Appendix B Figure 20. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort Women



Note: Each point represents a different scenario, and the curve represents the estimated efficient frontier for the average model. Strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). The colors differentiate strategies by frequency (annual–A vs. biennial–B) and the age at stopping screening (75, 77, 80 years). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted. The panels show all 288 risk factor–based strategies but highlight (solid color points) those identified as consensus efficient. The horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with at least a 9 percent lung cancer mortality reduction (listed in Appendix C Tables 7 and 8).

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

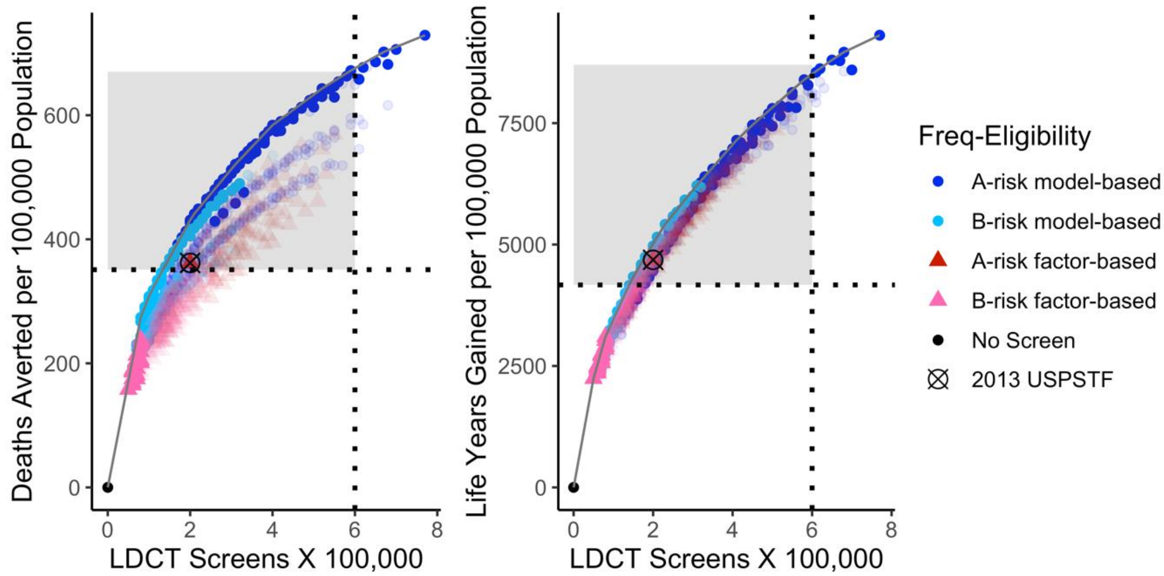
Appendix B Figure 21. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based and Risk Model–Based Eligibility Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort Men



Note: Risk factor–based scenarios are represented with triangle points and risk model–based screening scenarios by round points. The curve represents the estimated overall efficient frontier for the average model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⨂" mark) scenarios are highlighted. The panels show all considered strategies but highlight (solid color points) those identified as consensus efficient. The vertical line represents 600,000 LDCT screens, and the horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with fewer than 600,000 LDCT screens per 100,000 population and providing at least a 9 percent lung cancer mortality reduction (listed in Appendix C Tables 13 and 14).

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix B Figure 22. Number of LDCT Screening Examinations vs. the Number of Lung Cancer Deaths Averted (Left Panel) and Life-Years Gained (Right Panel) in Risk Factor–Based and Risk Model–Based Eligibility Strategies—Average Values Across the Four CISNET Models—1960 Birth Cohort Women



Note: Risk factor–based scenarios are represented with triangle points and risk model–based screening scenarios by round points. The curve represents the estimated overall efficient frontier for the average model. Risk factor–based strategies vary by age at starting and stopping screening, frequency, pack-years criterion, and years since quitting (Table 2). Risk model–based strategies vary by risk model, risk thresholds, and frequency (Table 3). The colors differentiate strategies by frequency (annual–A vs. biennial–B). The no-screening (black dot) and the 2013 USPSTF-recommended ("⊗" mark) scenarios are highlighted. The panels show all considered strategies but highlight (solid color points) those identified as consensus efficient. The vertical line represents 600,000 LDCT screens, and the horizontal line divides strategies with less than or at least a 9 percent lung cancer mortality reduction. The shaded region includes those scenarios with fewer than 600,000 LDCT screens per 100,000 population and providing at least a 9 percent lung cancer mortality reduction (listed in Appendix C Tables 15 and 16).

Abbreviations: CISNET=Cancer Intervention and Surveillance Modeling Network; LDCT=low-dose computed tomography; LYG=life-years gained; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 1. Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort (Average and Range Across CISNET Models)

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
B-55-80-20-20	22 (21.6, 22.4)	189,587 (187,469, 193,002)	1,134 (350, 1,634)	9 (4.8, 14.1)	348 (177, 516)	4,490 (2,649, 6,032)	12.9 (11.7, 14.9)	42 (31, 72)	545 (365, 1,068)	63 (42, 123)
B-55-80-20-25	22.7 (22.2, 23.1)	207,010 (204,167, 210,769)	1,189 (370, 1,722)	9.5 (5.1, 14.7)	366 (188, 536)	4,701 (2,829, 6,222)	12.8 (11.6, 15)	44 (33, 73)	566 (383, 1,092)	62 (42, 119)
B-50-80-25-25	19 (18.6, 19.4)	208,753 (205,300, 212,339)	1,169 (324, 1,701)	9.4 (5.1, 14.5)	363 (189, 529)	4,859 (3,009, 6,362)	13.4 (12, 15.9)	43 (32, 69)	575 (391, 1,086)	52 (36, 98)
A-55-80-30-15	**14.1 (13.8, 14.4)**	**227,443 (225,768, 230,480)**	**1,102 (258, 1,454)**	**9.8 (5.1, 16)**	**381 (188, 584)**	**4,882 (2,788, 6,899)**	**12.8 (11.8, 14.8)**	**47 (33, 82)**	**597 (387, 1,207)**	**37 (24, 73)**
A-55-80-25-10	16 (15.7, 16.3)	234,030 (231,840, 237,539)	1,131 (280, 1,490)	10.1 (5.3, 16.4)	392 (196, 600)	4,969 (2,836, 7,039)	12.7 (11.7, 14.5)	47 (33, 83)	597 (390, 1,194)	41 (27, 80)
B-50-80-20-20	23.3 (22.8, 23.8)	239,223 (235,387, 243,378)	1,226 (366, 1,770)	9.9 (5.7, 15.3)	384 (211, 559)	5,194 (3,390, 6,814)	13.5 (12.2, 16.1)	46 (35, 70)	623 (425, 1,122)	61 (41, 109)
A-55-80-30-20	14.5 (14.2, 14.8)	250,592 (248,922, 254,015)	1,169 (273, 1,552)	10.5 (5.5, 16.8)	406 (203, 614)	5,170 (3,021, 7,177)	12.7 (11.7, 14.9)	48 (35, 83)	617 (405, 1,226)	36 (23, 70)
B-50-80-20-25	23.6 (23, 24)	258,024 (253,262, 262,523)	1,288 (383, 1,869)	10.4 (6, 15.9)	404 (222, 581)	5,436 (3,572, 7,027)	13.5 (12.1, 16)	47 (36, 72)	639 (441, 1,143)	58 (40, 104)
A-55-80-25-15	17.2 (16.9, 17.6)	267,471 (265,565, 271,399)	1,219 (304, 1,614)	11 (5.9, 17.6)	425 (217, 643)	5,387 (3,198, 7,487)	12.7 (11.6, 14.7)	50 (36, 84)	629 (414, 1,227)	40 (27, 78)
A-55-80-30-25	14.8 (14.4, 15.1)	269,096 (266,481, 272,914)	1,218 (283, 1,630)	10.9 (5.8, 17.4)	422 (212, 637)	5,333 (3,146, 7,379)	12.6 (11.6, 14.8)	50 (36, 85)	638 (418, 1,257)	35 (23, 68)
A-55-80-25-20	18 (17.5, 18.3)	298,016 (294,992, 302,450)	1,295 (321, 1,723)	11.6 (6.4, 18.6)	450 (235, 679)	5,690 (3,485, 7,834)	12.6 (11.5, 14.8)	52 (38, 85)	662 (437, 1,259)	40 (26, 75)
A-55-80-25-25	18.3 (17.9, 18.7)	324,008 (319,778, 328,976)	1,354 (336, 1,812)	12.2 (6.7, 19.3)	471 (247, 706)	5,930 (3,672, 8,091)	12.6 (11.5, 14.8)	55 (40, 88)	688 (455, 1,297)	39 (26, 73)
A-55-80-20-15	**20.6 (20.3, 20.9)**	**330,095 (326,746, 335,324)**	**1,334 (353, 1,762)**	**12.1 (7, 19.2)**	**469 (257, 700)**	**6,018 (3,843, 8,198)**	**12.8 (11.7, 14.9)**	**55 (40, 86)**	**704 (471, 1,278)**	**44 (29, 79)**
A-50-80-30-25	15.3 (14.9, 15.6)	334,396 (329,497, 339,808)	1,273 (284, 1,716)	11.5 (6.5, 18.2)	447 (239, 665)	6,066 (3,867, 8,198)	13.6 (12.3, 16.2)	55 (40, 86)	748 (495, 1,377)	34 (23, 62)
A-50-80-25-15	18.5 (18.1, 18.9)	344,294 (340,634, 349,670)	1,282 (311, 1,706)	11.7 (6.8, 18.5)	454 (249, 677)	6,187 (4,000, 8,437)	13.6 (12.4, 16)	56 (41, 86)	758 (506, 1,368)	41 (27, 73)
A-55-80-20-20	**22 (21.6, 22.4)**	**369,610 (364,985, 375,424)**	**1,423 (375, 1,890)**	**12.9 (7.5, 20.3)**	**500 (278, 740)**	**6,379 (4,177, 8,600)**	**12.8 (11.6, 15)**	**58 (43, 89)**	**739 (498, 1,321)**	**44 (30, 78)**
A-50-80-20-10	21.2 (20.9, 21.5)	369,742 (365,540, 375,831)	1,295 (335, 1,716)	12 (7.2, 18.8)	464 (267, 687)	6,435 (4,289, 8,674)	13.9 (12.6, 16.1)	57 (43, 86)	797 (538, 1,376)	46 (31, 79)
A-50-80-25-20	18.9 (18.5, 19.3)	377,405 (372,386, 383,356)	1,357 (327, 1,816)	12.5 (7.2, 19.4)	482 (267, 711)	6,542 (4,299, 8,787)	13.6 (12.4, 16.1)	58 (43, 87)	783 (527, 1,399)	39 (26, 69)
A-50-80-25-25	19 (18.6, 19.4)	404,469 (398,087, 411,019)	1,417 (338, 1,906)	13 (7.6, 20.2)	502 (279, 738)	6,764 (4,490, 9,030)	13.5 (12.2, 16.1)	60 (44, 89)	806 (543, 1,431)	38 (25, 67)
A-55-80-20-25	**22.7 (22.2, 23.1)**	**404,596 (398,475, 411,071)**	**1,492 (394, 1,996)**	**13.5 (8, 21.1)**	**523 (294, 772)**	**6,654 (4,426, 8,907)**	**12.7 (11.5, 15)**	**61 (45, 91)**	**774 (522, 1,362)**	**43 (29, 76)**

Appendix C Table 1. Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort (Average and Range Across CISNET Models)

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
A-50-80-20-15	**22.6 (22.2, 23)**	**419,030 (413,422, 425,782)**	**1,401 (362, 1,862)**	**13 (8, 20.2)**	**503 (294, 738)**	**6,918 (4,761, 9,223)**	**13.8 (12.5, 16.2)**	**61 (45, 88)**	**833 (566, 1,411)**	**45 (31, 76)**
A-50-80-20-20	**23.3 (22.8, 23.8)**	**463,457 (456,067, 470,995)**	**1,487 (382, 1,990)**	**13.8 (8.5, 21.2)**	**534 (315, 776)**	**7,301 (5,129, 9,627)**	**13.7 (12.4, 16.2)**	**63 (48, 90)**	**868 (594, 1,453)**	**44 (30, 73)**
A-45-80-25-25	19.4 (19, 19.8)	482,601 (473,409, 491,032)	1,448 (340, 1,955)	13.5 (8.2, 20.8)	521 (303, 760)	7,336 (5,164, 9,571)	14.1 (12.6, 17)	66 (50, 92)	926 (627, 1,565)	37 (25, 63)
A-50-80-20-25	**23.6 (23, 24)**	**500,430 (491,300, 508,669)**	**1,560 (396, 2,096)**	**14.4 (9, 22.1)**	**558 (331, 807)**	**7,596 (5,381, 9,920)**	**13.6 (12.3, 16.3)**	**66 (50, 92)**	**897 (616, 1,493)**	**42 (29, 70)**
A-45-80-20-20	24 (23.5, 24.5)	557,453 (547,674, 566,689)	1,523 (383, 2,043)	14.4 (9.3, 21.8)	555 (345, 797)	7,919 (5,935, 10,162)	14.3 (12.7, 17.2)	70 (55, 93)	1004 (695, 1,595)	43 (30, 69)
A-45-80-20-25	24.1 (23.5, 24.5)	594,973 (583,344, 604,931)	1,592 (397, 2,149)	14.9 (9.7, 22.7)	578 (359, 828)	8,186 (6,165, 10,463)	14.2 (12.6, 17.1)	73 (56, 95)	1029 (713, 1,631)	42 (29, 66)

*Strategies with at least 9.0 percent lung cancer mortality reduction.

Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. Each cell shows the average and range (lowest and highest) estimate across the four CISNET models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and six selected consensus-efficient 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 2. Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort (Average and Range Across CISNET Models)

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiag-nosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-20-20	189,587 (187,469, 193,002)	209334 (201,862, 220,551)	8.6 (8.6, 8.7)	1.2 (0.5, 2.2)	526 (396, 606)	64 (31, 85)	1.3 (0.6, 1.7)	5.6 (4.4, 8.9)	17.5 (12.8, 22.2)
B-55-80-20-25	207,010 (204,167, 210,769)	227,740 (220,307, 237,455)	9.1 (9.1, 9.2)	1.3 (0.6, 2.3)	557 (421, 641)	67 (32, 88)	1.4 (0.6, 1.8)	5.6 (4.5, 8.7)	18.2 (13.9, 22.5)
B-50-80-25-25	208,753 (205,300, 212,339)	228,965 (221,702, 237,530)	11 (10.9, 11.1)	1.5 (0.6, 2.6)	546 (399, 634)	68 (28, 92)	1.4 (0.5, 1.9)	5.8 (4.6, 8.6)	19.3 (14.4, 24.2)
A-55-80-30-15	**227,443 (225,768, 230,480)**	**247,644 (239,774, 257,540)**	**16.1 (15.9, 16.5)**	**1.9 (0.9, 3.1)**	**518 (336, 658)**	**69 (29, 101)**	**1.4 (0.6, 2.1)**	**6.3 (5, 11.2)**	**20.6 (15.3, 25.8)**
A-55-80-25-10	234,030 (231,840, 237,539)	254,870 (246,460, 264,329)	14.6 (14.6, 14.8)	1.8 (0.8, 2.9)	536 (360, 677)	71 (30, 105)	1.4 (0.6, 2.2)	6.3 (5, 10.8)	21.5 (15.7, 27.3)
B-50-80-20-20	239,223 (235,387, 243,378)	261,627 (254,111, 268,764)	10.3 (10.2, 10.3)	1.4 (0.6, 2.6)	593 (467, 689)	70 (32, 95)	1.4 (0.6, 2)	5.7 (4.4, 8.8)	22.8 (16.6, 29)
A-55-80-30-20	250,592 (248,922, 254,015)	272,008 (264,192, 279,882)	17.3 (17.1, 17.6)	2 (1, 3.2)	554 (357, 701)	73 (32, 106)	1.5 (0.6, 2.2)	6.2 (5.1, 11.5)	21.5 (16.6, 26.3)
B-50-80-20-25	258,024 (253,262, 262,523)	281,421 (273,995, 287,279)	10.9 (10.9, 11)	1.5 (0.7, 2.7)	626 (490, 724)	74 (33, 99)	1.5 (0.6, 2)	5.7 (4.5, 8.7)	23.6 (17.7, 29.5)
A-55-80-25-15	267,471 (265,565, 271,399)	290,163 (282,372, 298,333)	15.6 (15.4, 15.7)	1.9 (0.9, 3)	586 (398, 743)	77 (32, 113)	1.5 (0.6, 2.3)	6.3 (5.1, 10.7)	23.4 (17.8, 29.1)
A-55-80-30-25	269,096 (266,481, 272,914)	291,461 (283,790, 297,939)	18.2 (18.1, 18.6)	2.1 (1, 3.3)	580 (373, 735)	76 (32, 110)	1.5 (0.6, 2.3)	6.2 (5.2, 11.4)	22.1 (17.6, 26.6)
A-55-80-25-20	298,016 (294,992, 302,450)	322,330 (314,570, 331,529)	16.6 (16.5, 16.8)	2 (0.9, 3.1)	630 (429, 798)	82 (36, 119)	1.6 (0.7, 2.4)	6.3 (5.1, 11.1)	24.7 (19.6, 29.8)
A-55-80-25-25	324,008 (319,778, 328,976)	349,657 (342,030, 359,416)	17.7 (17.5, 17.9)	2.1 (1, 3.2)	664 (451, 842)	84 (37, 123)	1.7 (0.7, 2.5)	6.2 (4.9, 10.9)	25.6 (21, 30.2)
A-55-80-20-15	**330,095 (326,746, 335,324)**	**356,390 (348,621, 368,653)**	**16 (16, 16.2)**	**1.9 (0.9, 3)**	**667 (480, 848)**	**83 (38, 121)**	**1.7 (0.7, 2.5)**	**6.2 (4.9, 10.8)**	**29 (22, 36)**
A-50-80-30-25	334,396 (329,497, 339,808)	359,972 (352,943, 368,506)	21.9 (21.7, 22.1)	2.5 (1.2, 3.8)	639 (433, 817)	76 (33, 109)	1.5 (0.6, 2.2)	6 (4.8, 11.6)	29.9 (23, 36.8)
A-50-80-25-15	344,294 (340,634, 349,670)	370,892 (363,381, 383,048)	18.6 (18.4, 18.8)	2.2 (1.1, 3.5)	658 (479, 840)	77 (34, 111)	1.6 (0.7, 2.3)	6 (4.9, 10.9)	32.1 (24.1, 40.2)
A-55-80-20-20	**369,610 (364,985, 375,424)**	**398,094 (390,275, 412,147)**	**16.8 (16.8, 17)**	**2 (1, 3.1)**	**722 (523, 917)**	**89 (42, 127)**	**1.8 (0.8, 2.6)**	**6.3 (5.1, 11.2)**	**30.6 (24.3, 37)**
A-50-80-20-10	369,742 (365,540, 375,831)	397,994 (390,503, 412,275)	17.4 (17.4, 17.5)	2.1 (1, 3.3)	684 (525, 873)	77 (37, 111)	1.5 (0.7, 2.3)	5.9 (4.8, 11.1)	36.5 (26.1, 47)
A-50-80-25-20	377,405 (372,386, 383,356)	405,682 (398,226, 418,755)	20 (19.8, 20.2)	2.3 (1.1, 3.6)	701 (508, 897)	82 (36, 117)	1.6 (0.7, 2.4)	6 (4.9, 11.1)	33.5 (26.1, 40.9)
A-50-80-25-25	404,469 (398,087, 411,019)	434,104 (426,897, 447,570)	21.3 (21.1, 21.5)	2.5 (1.2, 3.8)	735 (527, 942)	85 (37, 121)	1.7 (0.7, 2.5)	6 (4.9, 11)	34.9 (27.6, 42.1)

Appendix C Table 2. Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort (Average and Range Across CISNET Models)

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-20-25	**404,596 (398,475, 411,071)**	**434,892 (427,122, 449,985)**	**17.8 (17.8, 18)**	**2.1 (1, 3.2)**	**765 (556, 973)**	**94 (43, 132)**	**1.9 (0.8, 2.7)**	**6.3 (5.1, 11)**	**31.9 (26.2, 37.6)**
A-50-80-20-15	**419,030 (413,422, 425,782)**	**449,947 (442,335, 466,558)**	**18.5 (18.5, 18.6)**	**2.2 (1, 3.5)**	**750 (578, 959)**	**84 (40, 119)**	**1.7 (0.8, 2.4)**	**6 (4.8, 11.1)**	**38.6 (29.2, 48)**
A-50-80-20-20	**463,457 (456,067, 470,995)**	**496,698 (489,237, 514,727)**	**19.9 (19.8, 20)**	**2.3 (1.1, 3.6)**	**804 (619, 1,031)**	**89 (43, 125)**	**1.8 (0.8, 2.6)**	**6 (4.9, 11.3)**	**40.6 (31.9, 49.3)**
A-45-80-25-25	482,601 (473,409, 491,032)	515,967 (505,095, 531,931)	24.9 (24.7, 25)	2.8 (1.4, 4.4)	797 (610, 1,025)	86 (39, 123)	1.7 (0.8, 2.5)	5.9 (4.7, 11.5)	45.8 (34.1, 57.6)
A-50-80-20-25	**500,430 (491,300, 508,669)**	**535,519 (524,554, 554,368)**	**21.2 (21.2, 21.4)**	**2.5 (1.2, 3.8)**	**849 (647, 1,088)**	**94 (45, 130)**	**1.9 (0.9, 2.7)**	**6 (4.9, 11.3)**	**42.5 (34, 51)**
A-45-80-20-20	557,453 (547,674, 566,689)	595,203 (580,476, 617,835)	23.2 (23.1, 23.4)	2.7 (1.3, 4.2)	879 (721, 1,132)	91 (45, 127)	1.8 (0.9, 2.6)	6 (4.8, 11.7)	53.1 (39.5, 66.8)
A-45-80-20-25	594,973 (583,344, 604,931)	634,568 (616,172, 657,897)	24.7 (24.6, 24.8)	2.8 (1.4, 4.4)	922 (748, 1,189)	95 (46, 132)	1.9 (0.9, 2.7)	6 (4.8, 11.6)	55 (41.7, 68.4)

*Strategies with at least 9.0 percent lung cancer mortality reduction. †Average of two models (MGH-HMS and University of Michigan).
Numbers are per a 100,000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. Each cell shows the average and range (lowest and highest) estimate across the four CISNET models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected consensus-efficient 20-pack-year strategies are shown in bold.
Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; USPSTF=U.S. Preventive Services Task Force

Appendix C Table 3. Benefits of 57 Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-55-75-40-10	9.0	64,607	569	4.5	173	2,405	13.9	27	373	52
B-55-77-40-10	9.0	67,867	627	4.9	189	2,523	13.3	27	359	48
B-55-75-40-15	9.3	70,408	601	4.7	183	2,559	14.0	28	385	51
B-55-80-40-10	9.0	70,999	681	5.3	204	2,610	12.8	27	348	44
B-55-77-40-15	9.3	74,368	663	5.2	201	2,648	13.2	28	370	46
B-55-80-40-15	9.4	78,245	729	5.6	218	2,751	12.6	28	359	43
B-50-77-40-10	9.5	79,248	634	5.0	196	2,765	14.1	29	404	48
B-55-77-40-20	9.5	79,273	689	5.3	207	2,743	13.3	29	383	46
B-50-75-40-15	9.7	81,993	606	4.9	189	2,810	14.9	29	434	51
B-50-80-40-10	9.6	83,744	722	5.6	219	2,910	13.3	29	382	44
B-55-80-40-20	9.6	83,861	761	5.9	227	2,871	12.6	29	369	42
B-50-77-40-15	9.7	86,158	673	5.3	208	2,940	14.1	29	414	47
B-55-80-40-25	9.6	87,795	782	6.0	232	2,915	12.6	30	378	41
B-50-77-40-20	9.8	91,142	695	5.6	216	3,029	14.0	30	422	45
B-50-80-40-15	9.8	91,757	769	6.0	234	3,070	13.1	30	392	42
B-50-77-40-25	9.8	94,455	710	5.7	221	3,104	14.0	30	427	44
B-50-80-40-20	9.9	97,823	806	6.3	246	3,211	13.1	30	398	40
B-50-80-40-25	9.9	101,977	829	6.5	253	3,269	12.9	31	403	39
B-55-80-30-15	14.1	116,975	876	6.9	266	3,435	12.9	34	440	53
B-55-80-25-10	16.0	120,809	900	7.1	273	3,519	12.9	34	443	59
B-55-80-30-20	14.5	128,506	929	7.3	282	3,617	12.8	36	456	51
B-55-80-25-20	18.0	152,967	1,029	8.1	313	4,008	12.8	38	489	58
B-50-80-30-20	15.3	162,722	1,003	8.0	312	4,208	13.5	39	522	49
A-55-80-40-20	9.6	163,476	953	8.4	327	4,058	12.4	40	500	29
B-55-80-25-25	18.3	165,874	1,080	8.4	327	4,173	12.8	40	507	56
B-55-80-20-15	20.6	169,689	1,063	8.4	326	4,215	12.9	40	521	63
A-55-80-40-25	9.7	171,482	981	8.7	336	4,171	12.4	41	510	29
B-50-80-30-25	15.3	172,484	1,047	8.4	324	4,342	13.4	40	532	47
B-50-80-25-15	18.5	178,078	1,051	8.4	327	4,430	13.5	40	545	57
B-55-80-20-20	22.0	189,587	1,134	9.0	348	4,490	12.9	42	545	63
B-50-80-20-10	21.2	191,326	1,061	8.6	333	4,592	13.8	42	575	64
B-50-80-25-20	18.9	194,975	1,115	8.9	346	4,663	13.5	42	564	55
B-50-77-25-25	19.0	195,133	987	8.1	314	4,582	14.6	43	621	61
B-55-80-20-25	22.7	207,010	1,189	9.5	366	4,701	12.8	44	566	62
B-50-80-25-25	19.0	208,753	1,169	9.4	363	4,859	13.4	43	575	52
A-55-80-30-15	**14.1**	**227,443**	**1,102**	**9.8**	**381**	**4,882**	**12.8**	**47**	**597**	**37**
A-55-80-25-10	16.0	234,030	1,131	10.1	392	4,969	12.7	47	597	41
B-50-80-20-20	23.3	239,223	1,226	9.9	384	5,194	13.5	46	623	61

Appendix C Table 3. Benefits of 57 Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-55-80-30-20	14.5	250,592	1,169	10.5	406	5,170	12.7	48	617	36
B-50-80-20-25	23.6	258,024	1,288	10.4	404	5,436	13.5	47	639	58
A-55-80-25-15	17.2	267,471	1,219	11.0	425	5,387	12.7	50	629	40
A-55-80-30-25	14.8	269,096	1,218	10.9	422	5,333	12.6	50	638	35
A-55-80-25-20	18.0	298,016	1,295	11.6	450	5,690	12.6	52	662	40
A-55-80-25-25	18.3	324,008	1,354	12.2	471	5,930	12.6	55	688	39
A-55-80-20-15	**20.6**	**330,095**	**1,334**	**12.1**	**469**	**6,018**	**12.8**	**55**	**704**	**44**
A-50-80-30-25	15.3	334,396	1,273	11.5	447	6,066	13.6	55	748	34
A-50-80-25-15	18.5	344,294	1,282	11.7	454	6,187	13.6	56	758	41
A-55-80-20-20	**22.0**	**369,610**	**1,423**	**12.9**	**500**	**6,379**	**12.8**	**58**	**739**	**44**
A-50-80-20-10	21.2	369,742	1,295	12.0	464	6,435	13.9	57	797	46
A-50-80-25-20	18.9	377,405	1,357	12.5	482	6,542	13.6	58	783	39
A-50-80-25-25	19.0	404,469	1,417	13.0	502	6,764	13.5	60	806	38
A-55-80-20-25	**22.7**	**404,596**	**1,492**	**13.5**	**523**	**6,654**	**12.7**	**61**	**774**	**43**
A-50-80-20-15	**22.6**	**419,030**	**1,401**	**13.0**	**503**	**6,918**	**13.8**	**61**	**833**	**45**
A-50-80-20-20	**23.3**	**463,457**	**1,487**	**13.8**	**534**	**7,301**	**13.7**	**63**	**868**	**44**
A-45-80-25-25	19.4	482,601	1,448	13.5	521	7,336	14.1	66	926	37
A-50-80-20-25	**23.6**	**500,430**	**1,560**	**14.4**	**558**	**7,596**	**13.6**	**66**	**897**	**42**
A-45-80-20-20	24.0	557,453	1,523	14.4	555	7,919	14.3	70	1,004	43
A-45-80-20-25	24.1	594,973	1,592	14.9	578	8,186	14.2	73	1,029	42

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 4. Harms of 57 Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
B-55-75-40-10	64,607	76,031	7.2	1.1	241	27	0.5	4.7	6.8
B-55-77-40-10	67,867	79,460	7.5	1.1	262	32	0.6	5.1	6.8
B-55-75-40-15	70,408	82,183	7.6	1.1	256	28	0.6	4.7	7.3
B-55-80-40-10	70,999	82,748	7.9	1.1	281	38	0.8	5.6	7.0
B-55-77-40-15	74,368	86,348	8.0	1.1	278	34	0.7	5.1	7.3
B-55-80-40-15	78,245	90,409	8.3	1.2	301	41	0.8	5.6	7.4
B-50-77-40-10	79,248	91,457	8.3	1.2	273	30	0.6	4.7	9.0
B-55-77-40-20	79,273	91,528	8.3	1.2	289	35	0.7	5.1	7.5
B-50-75-40-15	81,993	94,358	8.5	1.2	266	27	0.5	4.5	9.3
B-50-80-40-10	83,744	96,205	8.7	1.2	304	40	0.8	5.5	9.1
B-55-80-40-20	83,861	96,341	8.7	1.2	315	44	0.9	5.8	7.7
B-50-77-40-15	86,158	98,746	8.9	1.3	290	32	0.7	4.8	9.4
B-55-80-40-25	87,795	100,483	9.1	1.3	324	44	0.9	5.6	7.7
B-50-77-40-20	91,142	103,995	9.3	1.3	300	34	0.7	4.9	9.6
B-50-80-40-15	91,757	104,657	9.4	1.3	324	43	0.9	5.6	9.5
B-50-77-40-25	94,455	107,470	9.6	1.3	307	34	0.7	4.8	9.7
B-50-80-40-20	97,823	111,033	9.9	1.4	340	46	0.9	5.7	9.7
B-50-80-40-25	101,977	115,402	10.3	1.4	350	47	1.0	5.7	9.8
B-55-80-30-15	116,975	131,843	8.3	1.2	383	50	1.0	5.7	11.6
B-55-80-25-10	120,809	136,159	7.6	1.1	396	52	1.0	5.8	12.2
B-55-80-30-20	128,506	144,018	8.9	1.2	408	53	1.1	5.7	12.1
B-55-80-25-20	152,967	170,246	8.5	1.2	462	59	1.2	5.7	14.2
B-50-80-30-20	162,722	180,006	10.6	1.5	457	58	1.2	5.8	16.2
A-55-80-40-20	163,476	179,811	17.0	2.0	422	60	1.2	6.3	13.8
B-55-80-25-25	165,874	183,864	9.1	1.3	487	62	1.3	5.7	14.6
B-55-80-20-15	169,689	188,224	8.2	1.2	489	60	1.2	5.6	16.7
A-55-80-40-25	171,482	188,230	17.7	2.1	435	61	1.2	6.2	14.0
B-50-80-30-25	172,484	190,291	11.3	1.5	477	60	1.2	5.7	16.5
B-50-80-25-15	178,078	196,667	9.6	1.4	489	60	1.2	5.7	18.1
B-55-80-20-20	189,587	209,334	8.6	1.2	526	64	1.3	5.6	17.5
B-50-80-20-10	191,326	210,985	9.0	1.3	506	61	1.2	5.7	20.7
B-50-80-25-20	194,975	214,471	10.3	1.4	521	65	1.3	5.8	18.7
B-50-77-25-25	195,133	214,624	10.3	1.4	480	48	1.0	4.9	19.0
B-55-80-20-25	207,010	227,740	9.1	1.3	557	67	1.4	5.6	18.2
B-50-80-25-25	208,753	228,965	11.0	1.5	546	68	1.4	5.8	19.3
A-55-80-30-15	**227,443**	**247,644**	**16.1**	**1.9**	**518**	**69**	**1.4**	**6.3**	**20.6**
A-55-80-25-10	234,030	254,870	14.6	1.8	536	71	1.4	6.3	21.5

Appendix C Table 4. Harms of 57 Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
B-50-80-20-20	239,223	261,627	10.3	1.4	593	70	1.4	5.7	22.8
A-55-80-30-20	250,592	272,008	17.3	2.0	554	73	1.5	6.2	21.5
B-50-80-20-25	258,024	281,421	10.9	1.5	626	74	1.5	5.7	23.6
A-55-80-25-15	267,471	290,163	15.6	1.9	586	77	1.5	6.3	23.4
A-55-80-30-25	269,096	291,461	18.2	2.1	580	76	1.5	6.2	22.1
A-55-80-25-20	298,016	322,330	16.6	2.0	630	82	1.6	6.3	24.7
A-55-80-25-25	324,008	349,657	17.7	2.1	664	84	1.7	6.2	25.6
A-55-80-20-15	**330,095**	**356,390**	**16.0**	**1.9**	**667**	**83**	**1.7**	**6.2**	**29.0**
A-50-80-30-25	334,396	359,972	21.9	2.5	639	76	1.5	6.0	29.9
A-50-80-25-15	344,294	370,892	18.6	2.2	658	77	1.6	6.0	32.1
A-55-80-20-20	**369,610**	**398,094**	**16.8**	**2.0**	**722**	**89**	**1.8**	**6.3**	**30.6**
A-50-80-20-10	369,742	397,994	17.4	2.1	684	77	1.5	5.9	36.5
A-50-80-25-20	377,405	405,682	20.0	2.3	701	82	1.6	6.0	33.5
A-50-80-25-25	404,469	434,104	21.3	2.5	735	85	1.7	6.0	34.9
A-55-80-20-25	**404,596**	**434,892**	**17.8**	**2.1**	**765**	**94**	**1.9**	**6.3**	**31.9**
A-50-80-20-15	**419,030**	**449,947**	**18.5**	**2.2**	**750**	**84**	**1.7**	**6.0**	**38.6**
A-50-80-20-20	**463,457**	**496,698**	**19.9**	**2.3**	**804**	**89**	**1.8**	**6.0**	**40.6**
A-45-80-25-25	482,601	515,967	24.9	2.8	797	86	1.7	5.9	45.8
A-50-80-20-25	**500,430**	**535,519**	**21.2**	**2.5**	**849**	**94**	**1.9**	**6.0**	**42.5**
A-45-80-20-20	557,453	595,203	23.2	2.7	879	91	1.8	6.0	53.1
A-45-80-20-25	594,973	634,568	24.7	2.8	922	95	1.9	6.0	55.0

*Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 5. Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-55-80-20-20	23.5	195,717	1,188	8.6	346	4,446	12.8	44	566	68
B-55-80-20-25	24.4	215,054	1,244	9.0	363	4,650	12.8	46	592	67
B-50-80-25-25	21.1	227,415	1,248	9.1	366	4,908	13.4	46	621	58
A-55-80-25-10	17.2	249,626	1,223	10.1	406	5,116	12.6	49	615	42
A-55-80-30-15	**15.7**	**250,071**	**1,209**	**10.0**	**400**	**5,078**	**12.7**	**49**	**625**	**39**
B-50-80-20-20	25.3	251,271	1,290	9.5	383	5,174	13.5	49	656	66
B-50-80-20-25	25.6	272,290	1,353	10.0	402	5,427	13.5	50	677	64
A-55-80-30-20	16.3	275,890	1,278	10.6	426	5,398	12.7	51	648	38
A-55-80-25-15	18.8	285,370	1,310	10.9	439	5,544	12.6	51	650	43
A-55-80-30-25	16.7	297,195	1,328	11.0	442	5,561	12.6	53	672	38
A-55-80-25-20	19.7	318,886	1,388	11.5	461	5,808	12.6	55	692	43
A-55-80-20-15	**21.8**	**338,814**	**1,415**	**11.8**	**475**	**6,022**	**12.7**	**56**	**713**	**46**
A-55-80-25-25	20.2	348,216	1,451	12.0	484	6,080	12.6	57	719	42
A-50-80-25-15	20.4	372,871	1,389	11.8	471	6,425	13.6	58	792	43
A-50-80-30-25	17.4	373,581	1,399	11.7	469	6,383	13.6	59	797	37
A-55-80-20-20	**23.5**	**380,919**	**1,502**	**12.6**	**505**	**6,396**	**12.7**	**60**	**754**	**47**
A-50-80-20-10	22.6	386,227	1,392	11.9	477	6,564	13.8	59	810	47
A-50-80-25-20	21.0	409,766	1,467	12.4	497	6,748	13.6	61	824	42
A-55-80-20-25	**24.4**	**419,641**	**1,572**	**13.1**	**526**	**6,664**	**12.7**	**63**	**798**	**46**
A-50-80-20-15	**24.4**	**438,248**	**1,497**	**12.8**	**513**	**7,031**	**13.7**	**62**	**854**	**48**
A-50-80-25-25	21.1	440,553	1,529	12.9	517	6,970	13.5	63	852	41
A-50-80-20-20	**25.3**	**486,445**	**1,584**	**13.5**	**542**	**7,397**	**13.6**	**66**	**898**	**47**
A-50-80-20-25	**25.6**	**527,801**	**1,657**	**14.1**	**565**	**7,696**	**13.6**	**69**	**934**	**45**
A-45-80-25-25	21.7	531,572	1,569	13.5	540	7,619	14.1	70	984	40
A-45-80-20-20	26.2	594,043	1,628	14.2	566	8,087	14.3	73	1,050	46
A-45-80-20-25	26.3	636,177	1,698	14.7	586	8,346	14.2	76	1,086	45

*Strategies with at least 9.0 percent lung cancer mortality reduction.

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 6. Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-20-20	195,717	215,799	8.3	1.2	550	66	1.3	5.6	15.9
B-55-80-20-25	215,054	236,240	8.8	1.2	582	68	1.3	5.5	16.5
B-50-80-25-25	227,415	248,683	10.8	1.5	588	71	1.4	5.7	18.1
A-55-80-25-10	249,626	271,247	14.5	1.8	577	74	1.5	6.1	19.8
A-55-80-30-15	**250,071**	**271,454**	**15.9**	**1.9**	**569**	**74**	**1.4**	**6.1**	**19.2**
B-50-80-20-20	251,271	274,358	9.9	1.4	626	72	1.4	5.6	20.9
B-50-80-20-25	272,290	296,497	10.6	1.5	660	75	1.5	5.5	21.3
A-55-80-30-20	275,890	298,634	16.9	2.0	608	78	1.5	6.1	20.0
A-55-80-25-15	285,370	309,010	15.2	1.8	630	80	1.6	6.1	21.7
A-55-80-30-25	297,195	321,032	17.8	2.1	636	80	1.6	6.0	20.5
A-55-80-25-20	318,886	344,314	16.2	1.9	676	85	1.7	6.1	22.8
A-55-80-20-15	**338,814**	**365,553**	**15.5**	**1.9**	**701**	**85**	**1.7**	**6.0**	**25.5**
A-55-80-25-25	348,216	375,168	17.2	2.0	713	88	1.7	6.1	23.5
A-50-80-25-15	372,871	400,959	18.3	2.2	714	80	1.6	5.8	30.4
A-50-80-30-25	373,581	401,173	21.5	2.5	708	81	1.6	5.8	28.4
A-55-80-20-20	**380,919**	**409,986**	**16.2**	**1.9**	**757**	**92**	**1.8**	**6.1**	**27.0**
A-50-80-20-10	386,227	415,291	17.1	2.1	728	80	1.6	5.7	32.9
A-50-80-25-20	409,766	439,725	19.5	2.3	761	86	1.7	5.9	31.6
A-55-80-20-25	**419,641**	**450,762**	**17.2**	**2.0**	**804**	**96**	**1.9**	**6.1**	**28.0**
A-50-80-20-15	**438,248**	**470,133**	**18.0**	**2.1**	**796**	**87**	**1.7**	**5.8**	**34.8**
A-50-80-25-25	440,553	472,067	20.9	2.4	798	89	1.7	5.8	32.8
A-50-80-20-20	**486,445**	**520,898**	**19.2**	**2.3**	**854**	**92**	**1.8**	**5.8**	**36.6**
A-50-80-20-25	**527,801**	**564,345**	**20.6**	**2.4**	**902**	**97**	**1.9**	**5.9**	**38.3**
A-45-80-25-25	531,572	567,427	24.5	2.8	871	89	1.8	5.7	42.7
A-45-80-20-20	594,043	633,633	22.7	2.7	941	95	1.9	5.8	47.4
A-45-80-20-25	636,177	677,865	24.2	2.8	987	98	1.9	5.8	49.4

*Strategies with at least 9.0 percent lung cancer mortality reduction. †Average of two models (MGH-HMS and University of Michigan).
Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.
Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 7. Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-55-80-20-20	20.4	183,456	1,080	9.4	350	4,534	13.0	40	524	58
B-50-80-25-25	17.0	190,090	1,089	9.7	360	4,810	13.4	40	528	47
B-55-80-20-25	20.9	198,965	1,134	9.9	369	4,751	12.9	42	539	57
A-55-80-30-15	**12.4**	**204,815**	**995**	**9.7**	**362**	**4,685**	**12.9**	**44**	**566**	**34**
A-55-80-25-10	14.7	218,434	1,039	10.1	378	4,822	12.8	45	578	39
A-55-80-30-20	12.7	225,294	1,060	10.4	387	4,942	12.8	46	582	33
B-50-80-20-20	21.4	227,175	1,161	10.3	384	5,214	13.6	44	592	56
A-55-80-30-25	12.9	240,997	1,107	10.8	402	5,106	12.7	47	599	32
B-50-80-20-25	21.5	243,757	1,222	10.8	405	5,446	13.4	45	602	53
A-55-80-25-15	15.7	249,571	1,128	11.0	411	5,229	12.7	48	607	38
A-55-80-25-20	16.3	277,146	1,202	11.8	439	5,572	12.7	50	631	37
A-50-80-30-25	13.2	295,210	1,147	11.4	425	5,748	13.5	51	695	31
A-55-80-25-25	16.5	299,799	1,257	12.3	459	5,781	12.6	52	653	36
A-50-80-25-15	16.6	315,717	1,174	11.7	437	5,948	13.6	53	722	38
A-55-80-20-15	**19.3**	**321,376**	**1,253**	**12.4**	**463**	**6,014**	**13.0**	**53**	**694**	**42**
A-50-80-25-20	16.9	345,044	1,248	12.5	467	6,336	13.6	54	739	36
A-50-80-20-10	19.7	353,258	1,198	12.1	452	6,306	14.0	56	782	44
A-55-80-20-20	**20.4**	**358,302**	**1,345**	**13.2**	**495**	**6,363**	**12.9**	**56**	**724**	**41**
A-50-80-25-25	17.0	368,385	1,304	13.0	487	6,557	13.5	56	756	35
A-55-80-20-25	**20.9**	**389,551**	**1,413**	**13.9**	**520**	**6,645**	**12.8**	**59**	**749**	**40**
A-50-80-20-15	**20.9**	**399,813**	**1,305**	**13.2**	**492**	**6,805**	**13.8**	**59**	**813**	**42**
A-45-80-25-25	17.2	433,630	1,327	13.5	503	7,052	14.0	61	862	34
A-50-80-20-20	**21.4**	**440,469**	**1,391**	**14.1**	**526**	**7,205**	**13.7**	**61**	**837**	**41**
A-50-80-20-25	**21.5**	**473,059**	**1,463**	**14.7**	**551**	**7,496**	**13.6**	**63**	**859**	**39**
A-45-80-20-20	21.9	520,864	1,419	14.6	545	7,750	14.2	67	956	40
A-45-80-20-25	21.9	553,768	1,486	15.2	569	8,025	14.1	69	973	38

*Strategies with at least 9.0 percent lung cancer mortality reduction.

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 8. Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-20-20	183,456	202,870	9.0	1.3	502	62	1.3	5.7	19.2
B-50-80-25-25	190,090	209,246	11.2	1.5	505	66	1.4	6.1	20.5
B-55-80-20-25	198,965	219,240	9.5	1.3	531	67	1.4	5.9	19.8
A-55-80-30-15	**204,815**	**223,834**	**16.5**	**2.0**	**467**	**64**	**1.3**	**6.4**	**22.0**
A-55-80-25-10	218,434	238,493	14.9	1.8	495	68	1.4	6.5	23.2
A-55-80-30-20	225,294	245,381	17.7	2.1	500	68	1.4	6.4	22.9
B-50-80-20-20	227,175	248,896	10.6	1.5	561	69	1.4	5.9	24.8
A-55-80-30-25	240,997	261,890	18.7	2.2	524	73	1.5	6.6	23.7
B-50-80-20-25	243,757	266,344	11.3	1.5	591	73	1.5	6.0	25.8
A-55-80-25-15	249,571	271,315	15.9	1.9	543	74	1.5	6.6	25.2
A-55-80-25-20	277,146	300,346	17.0	2.0	584	78	1.6	6.5	26.6
A-50-80-30-25	295,210	318,771	22.4	2.5	571	71	1.5	6.2	31.4
A-55-80-25-25	299,799	324,146	18.2	2.1	614	81	1.7	6.4	27.8
A-50-80-25-15	315,717	340,825	19.0	2.2	602	74	1.5	6.3	33.9
A-55-80-20-15	**321,376**	**347,227**	**16.7**	**2.0**	**633**	**80**	**1.6**	**6.4**	**32.4**
A-50-80-25-20	345,044	371,638	20.4	2.4	642	77	1.6	6.2	35.4
A-50-80-20-10	353,258	380,696	17.9	2.1	639	74	1.5	6.2	40.1
A-55-80-20-20	**358,302**	**386,201**	**17.6**	**2.1**	**686**	**87**	**1.8**	**6.5**	**34.2**
A-50-80-25-25	368,385	396,142	21.7	2.5	673	81	1.7	6.2	36.9
A-55-80-20-25	**389,551**	**419,022**	**18.6**	**2.2**	**726**	**91**	**1.9**	**6.4**	**35.8**
A-50-80-20-15	**399,813**	**429,762**	**19.1**	**2.3**	**703**	**82**	**1.7**	**6.3**	**42.4**
A-45-80-25-25	433,630	464,507	25.2	2.9	723	82	1.7	6.2	49.0
A-50-80-20-20	**440,469**	**472,498**	**20.6**	**2.4**	**754**	**86**	**1.8**	**6.2**	**44.6**
A-50-80-20-25	**473,059**	**506,693**	**22.0**	**2.5**	**796**	**90**	**1.9**	**6.2**	**46.7**
A-45-80-20-20	520,864	556,773	23.8	2.8	817	86	1.8	6.1	58.9
A-45-80-20-25	553,768	591,272	25.3	2.9	857	92	1.9	6.2	60.7

*Strategies with at least 9.0 percent lung cancer mortality reduction. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 9. Comparison of 2013 USPSTF-Recommended (A-55-80-30-15) and Selected Risk Factor–Based Screening (20 Pack-Year Consensus-Efficient) Scenarios—1960 Birth Cohort Men

Outcome	A-55-80-30-15	A-55-80-20-15	A-55-80-20-20	A-55-80-20-25	A-50-80-20-15	A-50-80-20-20	A-50-80-20-25
% eligible	15.7%	21.8%	23.5%	24.4%	24.4%	25.3%	25.6%
# LDCT screens*	250,071	338,814	380,919	419,641	438,248	486,445	527,801
Avg. # of LDCT screens per person screened	15.9	15.5	16.2	17.2	18.0	19.2	20.6
Avg. age at first screen	55.9	55.6	55.5	55.5	51.2	51.2	51.2
Avg. age at last screen	70.6	70.0	70.6	71.6	68.1	69.3	70.7
Avg. age at screening	64.8	64.9	65.0	65.2	58.5	58.9	59.4
LC deaths averted*	400	475	505	526	513	542	565
Mortality reduction	10.0%	11.8%	12.6%	13.1%	12.8%	13.5%	14.1%
Difference in LC deaths averted vs. USPSTF strategy	NA	18.8%	26.2%	31.5%	28.2%	35.5%	41.2%
Avg. # screens per LC deaths averted	625	713	754	798	854	898	934
LYG*	5,078	6,022	6,396	6,664	7,031	7,397	7,696
Difference in LYG vs. USPSTF strategy	NA	18.6%	26.0%	31.2%	38.5%	45.7%	51.6%
Avg. # screens per LYG	49	56	60	63	62	66	69
NNS	39	46	47	46	48	47	45
False-positive screens per person screened	1.9	1.9	1.9	2.0	2.1	2.3	2.4
Biopsies	569	701	757	804	796	854	902
Overdiagnosed cases*	74	85	92	96	87	92	97
Overdiagnosis rate per screen-detected cancers	6.1%	6.0%	6.1%	6.1%	5.8%	5.8%	5.9%
Radiation-related lung cancer deaths*	19.2	25.5	27.0	28.0	34.8	36.6	38.3

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 10. Comparison of 2013 USPSTF-Recommended (A-55-80-30-15) and Selected Risk Factor–Based Screening (20 Pack-Year Consensus-Efficient) Scenarios—1960 Birth Cohort Women

Outcome	A-55-80-30-15	A-55-80-20-15	A-55-80-20-20	A-55-80-20-25	A-50-80-20-15	A-50-80-20-20	A-50-80-20-25
% eligible	12.4%	19.3%	20.4%	20.9%	20.9%	21.4%	21.5%
# LDCT screens*	204,815	321,376	358,302	389,551	399,813	440,469	473,059
Avg. # of LDCT screens per person screened	16.5	16.7	17.6	18.6	19.1	20.6	22.0
Avg. age at first screen	56.7	55.8	55.8	55.8	51.9	51.8	51.8
Avg. age at last screen	72.1	71.5	72.3	73.4	70.0	71.4	72.7
Avg. age at screening	65.4	65.4	65.6	65.9	59.5	60.0	60.5
LC deaths averted*	362	463	495	520	492	526	551
Mortality reduction	9.7%	12.4%	13.2%	13.9%	13.2%	14.1%	14.7%
Difference in LC deaths averted vs. USPSTF strategy	NA	27.9%	36.7%	43.6%	35.9%	45.3%	52.2%
Avg. # screens per LC deaths averted	566	694	724	749	813	837	859
LYG*	4,685	6,014	6,363	6,645	6,805	7,205	7,496
Difference in LYG vs. USPSTF strategy	NA	28.4%	35.8%	41.8%	45.3%	53.8%	60.0%
Avg. # screens per LYG	44	53	56	59	59	61	63
NNS	34	42	41	40	42	41	39
False-positive screens per person screened	2.0	2.0	2.1	2.2	2.3	2.4	2.5
Biopsies	467	633	686	726	703	754	796
Overdiagnosed cases*	64	80	87	91	82	86	90
Overdiagnosis rate per screen-detected cancers	6.4%	6.4%	6.5%	6.4%	6.3%	6.2%	6.2%
Radiation-related lung cancer deaths*	22.0	32.4	34.2	35.8	42.4	44.6	46.7

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-55-75-40-10	9.0	64,607	569	4.5	173	2,405	13.9	27	373	52
B-50-75-MPLCOm2012-0.023	12.6	67,076	654	4.9	192	2,436	12.7	28	349	66
B-55-77-40-10	9.0	67,867	627	4.9	189	2,523	13.3	27	359	48
B-55-75-MPLCOm2012-0.023	12.7	68,309	671	5.1	196	2,471	12.6	28	349	65
B-55-75-40-15	9.3	70,408	601	4.7	183	2,559	14.0	28	385	51
B-55-80-40-10	9.0	70,999	681	5.3	204	2,610	12.8	27	348	44
B-50-75-MPLCOm2012-0.022	13.1	71,120	672	5.1	199	2,546	12.8	28	357	66
B-55-75-MPLCOm2012-0.022	13.1	72,215	688	5.3	206	2,602	12.6	28	351	64
B-50-75-Bach-0.034	14.6	72,902	685	5.2	203	2,577	12.7	28	359	72
B-55-75-Bach-0.034	14.7	74,244	698	5.4	207	2,599	12.6	29	359	71
B-55-77-40-15	9.3	74,368	663	5.2	201	2,648	13.2	28	370	46
B-50-75-MPLCOm2012-0.021	13.5	75,334	693	5.3	206	2,665	12.9	28	366	66
B-50-75-40-10	9.5	75,796	578	4.6	179	2,666	14.9	28	423	53
B-55-75-MPLCOm2012-0.021	13.6	76,427	706	5.4	210	2,670	12.7	29	364	65
B-50-77-MPLCOm2012-0.023	13.2	76,449	767	5.8	224	2,673	11.9	29	341	59
B-50-75-Bach-0.033	15.1	76,596	700	5.3	207	2,648	12.8	29	370	73
B-55-77-MPLCOm2012-0.023	13.3	77,651	781	5.9	230	2,705	11.8	29	338	58
B-55-75-Bach-0.033	15.2	77,925	713	5.5	214	2,685	12.5	29	364	71
B-55-80-40-15	9.4	78,245	729	5.6	218	2,751	12.6	28	359	43
B-50-77-MLCDRAT-0.023	14.8	78,818	767	5.7	223	2,608	11.7	30	353	66
B-50-77-40-10	9.5	79,248	634	5.0	196	2,765	14.1	29	404	48
B-55-77-40-20	9.5	79,273	689	5.3	207	2,743	13.3	29	383	46
B-55-77-MLCDRAT-0.023	14.9	80,013	782	5.8	227	2,618	11.5	31	352	66
B-50-75-MPLCOm2012-0.02	14.0	80,036	714	5.4	211	2,755	13.1	29	379	66
B-50-77-MPLCOm2012-0.022	13.7	80,825	786	5.9	230	2,782	12.1	29	351	60
B-55-75-MPLCOm2012-0.02	14.1	81,162	725	5.6	217	2,787	12.8	29	374	65
B-55-77-MPLCOm2012-0.022	13.8	81,893	799	6.1	236	2,809	11.9	29	347	58
B-50-75-40-15	9.7	81,993	606	4.9	189	2,810	14.9	29	434	51
B-50-80-40-10	9.6	83,744	722	5.6	219	2,910	13.3	29	382	44
B-55-80-40-20	9.6	83,861	761	5.9	227	2,871	12.6	29	369	42
B-50-77-Bach-0.034	15.5	83,925	804	6.1	237	2,821	11.9	30	354	65
B-55-77-Bach-0.034	15.7	85,280	816	6.3	243	2,868	11.8	30	351	65
B-50-75-MPLCOm2012-0.019	14.6	85,284	735	5.7	220	2,887	13.1	30	388	66
B-50-77-MPLCOm2012-0.021	14.2	85,344	808	6.1	236	2,870	12.2	30	362	60
B-50-77-40-15	9.7	86,158	673	5.3	208	2,940	14.1	29	414	47
B-55-77-MPLCOm2012-0.021	14.2	86,395	821	6.3	244	2,910	11.9	30	354	58
B-55-75-MPLCOm2012-0.019	14.7	86,605	748	5.8	225	2,907	12.9	30	385	65

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-50-77-Bach-0.033	16.0	87,952	821	6.3	244	2,930	12.0	30	360	66
B-55-77-Bach-0.033	16.1	89,277	836	6.4	247	2,935	11.9	30	361	65
B-55-80-MPLCOm2012-0.023	14.1	89,961	934	6.9	269	2,938	10.9	31	334	52
B-50-77-MPLCOm2012-0.02	14.7	90,392	830	6.3	246	3,006	12.2	30	367	60
B-50-80-MPLCOm2012-0.023	14.2	90,966	951	7.1	275	2,970	10.8	31	331	52
B-50-77-40-20	9.8	91,142	695	5.6	216	3,029	14.0	30	422	45
B-55-77-MPLCOm2012-0.02	14.8	91,484	841	6.5	250	3,012	12.0	30	366	59
B-50-80-40-15	9.8	91,757	769	6.0	234	3,070	13.1	30	392	42
B-50-77-Bach-0.032	16.5	92,216	840	6.4	248	2,990	12.1	31	372	67
B-55-80-MLCDRAT-0.023	15.5	92,514	933	6.8	265	2,838	10.7	33	349	58
B-50-80-MLCDRAT-0.023	15.5	93,592	951	7.1	274	2,881	10.5	32	342	57
B-50-77-40-25	9.8	94,455	710	5.7	221	3,104	14.0	30	427	44
B-55-80-MPLCOm2012-0.022	14.6	94,628	957	7.2	278	3,062	11.0	31	340	53
B-50-80-MPLCOm2012-0.022	14.7	95,837	974	7.3	283	3,074	10.9	31	339	52
B-50-77-MPLCOm2012-0.019	15.2	95,987	853	6.6	254	3,131	12.3	31	378	60
B-50-77-Bach-0.031	17.0	96,543	862	6.6	254	3,069	12.1	31	380	67
B-50-75-MPLCOm2012-0.017	15.7	97,041	776	6.0	232	3,117	13.4	31	418	68
B-55-77-MPLCOm2012-0.019	15.3	97,287	865	6.7	260	3,154	12.1	31	374	59
B-50-80-40-20	9.9	97,823	806	6.3	246	3,211	13.1	30	398	40
B-55-77-Bach-0.031	17.1	97,940	874	6.7	262	3,111	11.9	31	374	65
B-55-80-MPLCOm2012-0.021	15.1	99,674	984	7.3	285	3,161	11.1	32	350	53
B-50-80-MPLCOm2012-0.021	15.2	101,031	1,001	7.5	292	3,203	11.0	32	346	52
B-50-77-Bach-0.03	17.5	101,222	880	6.8	262	3,180	12.1	32	386	67
B-50-80-Bach-0.034	16.9	101,409	1,009	7.5	292	3,137	10.7	32	347	58
B-55-80-Bach-0.034	16.9	101,612	1,013	7.3	284	3,100	10.9	33	358	60
B-50-77-MPLCOm2012-0.018	15.8	101,924	876	6.8	263	3,268	12.4	31	388	60
B-50-80-40-25	9.9	101,977	829	6.5	253	3,269	12.9	31	403	39
B-55-77-MPLCOm2012-0.018	15.9	102,872	888	6.8	264	3,226	12.2	32	390	60
B-55-80-MLCDRAT-0.021	16.6	103,248	984	7.4	287	3,097	10.8	33	360	58
B-50-75-MPLCOm2012-0.016	16.4	103,782	799	6.2	242	3,274	13.5	32	429	68
B-55-75-MPLCOm2012-0.016	16.4	103,925	812	6.4	247	3,254	13.2	32	421	66
B-55-80-MPLCOm2012-0.02	15.6	105,030	1,001	7.5	292	3,268	11.2	32	360	53
B-50-80-Bach-0.033	17.4	106,067	1,027	7.7	300	3,239	10.8	33	354	58
B-55-80-Bach-0.033	17.4	106,108	1,034	7.5	289	3,177	11.0	33	367	60
B-50-80-MPLCOm2012-0.02	15.7	106,418	1,023	7.7	300	3,322	11.1	32	355	52
B-50-77-MPLCOm2012-0.017	16.4	108,577	901	6.9	269	3,370	12.5	32	404	61
B-55-77-MPLCOm2012-0.017	16.5	109,070	912	7.0	272	3,352	12.3	33	401	61
B-55-80-Bach-0.032	17.9	110,822	1,054	7.6	295	3,266	11.1	34	376	61

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-50-80-Bach-0.032	17.9	110,827	1,049	7.8	304	3,299	10.9	34	365	59
B-55-80-MPLCOm2012-0.019	16.2	110,978	1,022	7.7	301	3,398	11.3	33	369	54
B-50-75-MPLCOm2012-0.015	17.1	111,552	824	6.4	250	3,410	13.6	33	446	68
B-50-80-MPLCOm2012-0.019	16.3	112,284	1,046	7.9	307	3,423	11.1	33	366	53
B-55-80-Bach-0.031	18.3	115,487	1,074	7.8	302	3,345	11.1	35	382	61
B-50-80-Bach-0.031	18.4	115,564	1,068	8.1	313	3,412	10.9	34	369	59
B-50-77-MPLCOm2012-0.016	17.1	115,780	924	7.2	278	3,529	12.7	33	416	62
B-55-77-MPLCOm2012-0.016	17.2	115,846	938	7.3	283	3,519	12.4	33	409	61
B-50-80-MLCDRAT-0.019	18.0	117,231	1,058	8.0	311	3,402	10.9	34	377	58
B-55-80-MPLCOm2012-0.018	16.8	117,313	1,047	7.9	306	3,476	11.4	34	383	55
B-55-80-Bach-0.03	18.8	119,154	1,069	8.0	312	3,473	11.1	34	382	60
B-50-80-MPLCOm2012-0.018	16.9	119,159	1,073	8.1	314	3,554	11.3	34	379	54
B-50-75-MPLCOm2012-0.014	17.9	120,192	847	6.6	258	3,542	13.7	34	466	69
B-50-80-Bach-0.03	18.9	120,957	1,090	8.3	321	3,518	11.0	34	377	59
B-55-80-MLCDRAT-0.018	18.4	121,586	1,066	8.0	310	3,446	11.1	35	392	59
B-50-80-MLCDRAT-0.018	18.5	123,032	1,084	8.2	318	3,497	11.0	35	387	58
B-55-77-MPLCOm2012-0.015	17.9	123,731	963	7.5	292	3,641	12.5	34	424	61
B-50-77-MPLCOm2012-0.015	17.8	124,014	951	7.4	286	3,654	12.8	34	434	62
B-55-80-Bach-0.029	19.3	124,216	1,090	8.2	318	3,537	11.1	35	391	61
B-55-80-MPLCOm2012-0.017	17.4	124,249	1,078	8.1	315	3,591	11.4	35	394	55
B-50-80-Bach-0.029	19.4	126,151	1,112	8.4	327	3,606	11.0	35	386	59
B-50-80-MPLCOm2012-0.017	17.5	126,738	1,105	8.4	326	3,699	11.3	34	389	54
B-50-75-MPLCOm2012-0.013	18.7	129,678	873	6.9	269	3,718	13.8	35	482	70
B-55-80-Bach-0.028	19.8	129,813	1,108	8.4	326	3,634	11.1	36	398	61
B-55-80-MPLCOm2012-0.016	18.1	131,558	1,102	8.4	325	3,761	11.6	35	405	56
B-50-80-Bach-0.028	19.9	131,788	1,131	8.6	333	3,696	11.1	36	396	60
B-55-77-MPLCOm2012-0.014	18.7	132,093	988	7.8	303	3,797	12.5	35	436	62
B-50-77-MPLCOm2012-0.014	18.6	133,200	976	7.7	297	3,834	12.9	35	448	63
B-50-80-MPLCOm2012-0.016	18.2	134,642	1,130	8.6	335	3,873	11.6	35	402	54
B-50-80-Bach-0.027	20.5	137,862	1,152	8.7	339	3,799	11.2	36	407	60
B-50-80-MLCDRAT-0.016	19.9	138,763	1,141	8.7	337	3,774	11.2	37	412	59
B-55-80-MPLCOm2012-0.015	18.8	139,739	1,128	8.6	335	3,901	11.6	36	417	56
B-50-77-MPLCOm2012-0.013	19.5	143,278	1,004	7.9	307	4,005	13.0	36	467	64
B-50-80-MPLCOm2012-0.015	18.9	143,399	1,158	8.9	346	4,021	11.6	36	414	55
B-50-80-Bach-0.026	21.0	143,828	1,174	8.9	347	3,912	11.3	37	414	61
B-55-80-Bach-0.025	21.5	147,758	1,169	8.9	346	3,948	11.4	37	427	62
B-50-80-MLCDRAT-0.015	20.7	148,360	1,174	9.0	348	3,940	11.3	38	426	59
B-55-80-MPLCOm2012-0.014	19.6	148,615	1,155	8.9	344	4,049	11.8	37	432	57

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-50-80-Bach-0.025	21.6	150,601	1,197	9.2	355	4,017	11.3	37	424	61
B-50-80-MPLCOm2012-0.014	19.7	153,324	1,187	9.2	356	4,147	11.6	37	431	55
B-55-80-Bach-0.024	22.0	154,299	1,190	9.1	354	4,056	11.5	38	436	62
B-50-77-MPLCOm2012-0.012	20.4	154,882	1,035	8.2	317	4,152	13.1	37	489	64
B-50-80-Bach-0.024	22.2	157,520	1,222	9.4	362	4,125	11.4	38	435	61
B-55-80-MPLCOm2012-0.013	20.4	158,123	1,181	9.1	354	4,177	11.8	38	447	58
B-50-80-MLCDRAT-0.014	21.6	158,658	1,206	9.3	361	4,106	11.4	39	439	60
B-50-80-MPLCOm2012-0.013	20.6	164,259	1,218	9.5	367	4,348	11.8	38	448	56
B-50-80-Bach-0.023	22.7	164,603	1,242	9.5	370	4,239	11.5	39	445	61
B-50-77-MPLCOm2012-0.011	21.4	167,727	1,059	8.4	325	4,336	13.3	39	516	66
B-50-80-Bach-0.022	23.3	172,049	1,262	9.7	377	4,365	11.6	39	456	62
A-55-80-MPLCOm2012-0.023	14.3	174,860	1,177	10.0	388	4,161	10.7	42	451	37
A-50-80-MPLCOm2012-0.023	14.3	174,911	1,178	10.0	388	4,187	10.8	42	451	37
B-55-80-Bach-0.021	23.8	175,310	1,245	9.6	372	4,325	11.6	41	471	64
B-50-80-MPLCOm2012-0.012	21.6	176,755	1,253	9.7	378	4,527	12.0	39	468	57
A-55-80-MLCDRAT-0.023	15.6	179,310	1,178	10.0	388	4,087	10.5	44	462	40
B-50-80-Bach-0.021	23.9	180,105	1,280	9.9	384	4,457	11.6	40	469	62
B-50-77-MPLCOm2012-0.01	22.6	182,246	1,092	8.8	340	4,598	13.5	40	536	66
B-55-80-Bach-0.02	24.4	182,833	1,264	9.8	381	4,439	11.7	41	480	64
A-55-80-MPLCOm2012-0.022	14.7	184,176	1,204	10.3	400	4,334	10.8	42	460	37
A-50-80-MPLCOm2012-0.022	14.7	184,284	1,205	10.3	399	4,336	10.9	43	462	37
B-50-80-Bach-0.02	24.6	188,573	1,301	10.2	394	4,596	11.7	41	479	62
B-55-80-Bach-0.019	25.0	190,612	1,282	10.0	387	4,547	11.7	42	493	65
B-50-80-MPLCOm2012-0.011	22.7	191,379	1,290	10.1	393	4,766	12.1	40	487	58
A-55-80-MPLCOm2012-0.021	15.3	193,965	1,232	10.6	411	4,515	11.0	43	472	37
A-55-80-Bach-0.034	17.1	194,099	1,247	10.6	409	4,404	10.8	44	475	42
A-50-80-MPLCOm2012-0.021	15.3	194,193	1,235	10.6	410	4,502	11.0	43	474	37
A-50-80-Bach-0.034	17.1	194,261	1,248	10.6	411	4,417	10.7	44	473	42
B-50-80-Bach-0.019	25.2	197,209	1,323	10.3	400	4,727	11.8	42	493	63
A-55-80-Bach-0.033	17.5	202,943	1,272	10.8	420	4,539	10.8	45	483	42
A-50-80-Bach-0.033	17.5	203,167	1,271	10.8	419	4,526	10.8	45	485	42
A-55-80-MPLCOm2012-0.02	15.8	204,612	1,262	10.9	421	4,645	11.0	44	486	38
A-50-80-MPLCOm2012-0.02	15.8	205,020	1,262	10.8	419	4,662	11.1	44	489	38
B-50-80-Bach-0.018	25.8	206,581	1,343	10.5	408	4,830	11.8	43	506	63
B-50-80-MPLCOm2012-0.01	23.8	206,957	1,323	10.4	404	4,967	12.3	42	512	59
A-50-80-MLCDRAT-0.02	17.4	210,560	1,273	10.9	423	4,566	10.8	46	498	41
A-55-80-Bach-0.032	18.0	212,181	1,296	11.1	431	4,655	10.8	46	492	42
A-50-80-Bach-0.032	18.0	212,490	1,298	11.1	430	4,668	10.9	46	494	42

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-55-80-MPLCOm2012-0.019	16.3	216,291	1,293	11.2	434	4,833	11.1	45	498	38
A-50-80-MPLCOm2012-0.019	16.4	217,030	1,293	11.2	435	4,859	11.2	45	499	38
A-55-80-Bach-0.031	18.5	221,421	1,321	11.3	439	4,791	10.9	46	504	42
A-50-80-Bach-0.031	18.5	221,847	1,321	11.4	441	4,831	11.0	46	503	42
B-50-80-MPLCOm2012-0.009	25.0	225,054	1,357	10.8	417	5,169	12.4	44	540	60
A-50-80-MLCDRAT-0.019	18.1	225,292	1,310	11.3	437	4,774	10.9	47	516	41
B-50-80-Bach-0.016	27.3	227,395	1,388	10.9	423	5,099	12.1	45	538	65
A-55-80-30-15	**14.1**	**227,443**	**1,102**	**9.8**	**381**	**4,882**	**12.8**	**47**	**597**	**37**
A-55-80-MPLCOm2012-0.018	17.0	228,676	1,320	11.5	444	4,982	11.2	46	515	38
A-50-80-MPLCOm2012-0.018	17.0	229,944	1,327	11.5	445	5,021	11.3	46	517	38
A-55-80-Bach-0.03	19.0	231,518	1,347	11.6	450	4,936	11.0	47	514	42
A-50-80-Bach-0.03	19.0	232,092	1,350	11.6	450	4,969	11.0	47	516	42
A-50-80-MLCDRAT-0.018	18.6	236,479	1,339	11.6	450	4,942	11.0	48	526	41
A-55-80-MLCDRAT-0.018	18.6	236,483	1,340	11.5	448	4,916	11.0	48	528	42
A-55-80-Bach-0.029	19.5	241,484	1,370	11.8	459	5,063	11.0	48	526	42
A-50-80-Bach-0.029	19.5	242,278	1,374	11.8	459	5,084	11.1	48	528	42
A-55-80-MPLCOm2012-0.017	17.6	242,329	1,352	11.8	455	5,163	11.3	47	533	39
A-50-80-MPLCOm2012-0.017	17.6	244,349	1,359	11.8	457	5,227	11.4	47	535	39
B-50-80-MPLCOm2012-0.008	26.5	245,777	1,399	11.2	432	5,407	12.5	45	569	61
B-50-80-Bach-0.014	28.8	250,390	1,430	11.3	438	5,358	12.2	47	572	66
A-55-80-Bach-0.028	20.0	252,590	1,396	12.1	468	5,199	11.1	49	540	43
A-50-80-Bach-0.028	20.0	253,613	1,399	12.1	471	5,225	11.1	49	538	42
A-50-80-MLCDRAT-0.017	19.3	253,620	1,376	12.0	463	5,153	11.1	49	548	42
A-55-80-MPLCOm2012-0.016	18.3	256,724	1,383	12.1	468	5,341	11.4	48	549	39
A-50-80-MPLCOm2012-0.016	18.3	259,832	1,394	12.3	475	5,502	11.6	47	547	39
B-50-80-Bach-0.013	29.6	263,135	1,451	11.5	445	5,498	12.4	48	591	67
A-55-80-Bach-0.027	20.6	263,986	1,420	12.3	478	5,328	11.1	50	552	43
A-50-80-Bach-0.027	20.6	265,411	1,424	12.3	478	5,353	11.2	50	555	43
A-50-80-MLCDRAT-0.016	20.0	267,426	1,409	12.3	478	5,355	11.2	50	559	42
B-50-80-MPLCOm2012-0.007	28.1	270,148	1,442	11.6	449	5,644	12.6	48	602	63
A-55-80-MPLCOm2012-0.015	19.0	272,809	1,415	12.4	481	5,533	11.5	49	567	40
A-55-80-Bach-0.026	21.1	275,329	1,444	12.6	489	5,463	11.2	50	563	43
B-50-80-Bach-0.012	30.5	277,033	1,476	11.8	456	5,639	12.4	49	608	67
A-50-80-Bach-0.026	21.1	277,066	1,447	12.6	489	5,495	11.2	50	567	43
A-50-80-MPLCOm2012-0.015	19.0	277,426	1,429	12.6	488	5,685	11.6	49	568	39
A-50-77-MPLCOm2012-0.013	19.7	280,113	1,260	11.4	441	5,712	13.0	49	635	45
A-50-80-MLCDRAT-0.015	20.8	286,154	1,451	12.7	491	5,562	11.3	51	583	42
A-55-80-Bach-0.025	21.7	287,935	1,470	12.8	495	5,572	11.3	52	582	44

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-Bach-0.025	21.7	290,340	1,475	12.9	498	5,657	11.4	51	583	44
A-55-80-MPLCOm2012-0.014	19.8	290,431	1,452	12.7	494	5,717	11.6	51	588	40
B-50-80-Bach-0.011	31.5	292,128	1,499	12.0	465	5,800	12.5	50	628	68
B-50-80-MPLCOm2012-0.006	29.9	296,680	1,482	11.9	461	5,867	12.7	51	644	65
A-50-80-MPLCOm2012-0.014	19.8	297,009	1,466	13.0	503	5,925	11.8	50	590	39
A-55-80-Bach-0.024	22.2	300,842	1,494	13.1	507	5,735	11.3	52	593	44
A-50-77-MPLCOm2012-0.012	20.6	303,023	1,296	11.7	455	5,960	13.1	51	666	45
A-55-80-MLCDRAT-0.014	21.7	303,286	1,480	13.0	504	5,722	11.4	53	602	43
A-50-80-Bach-0.024	22.3	303,778	1,502	13.2	510	5,840	11.5	52	596	44
A-50-80-MLCDRAT-0.014	21.7	306,138	1,487	13.1	507	5,808	11.5	53	604	43
B-50-80-Bach-0.01	32.6	308,091	1,527	12.2	472	5,924	12.6	52	653	69
A-55-80-MPLCOm2012-0.013	20.6	309,284	1,482	13.1	508	5,933	11.7	52	609	41
A-55-80-Bach-0.023	22.8	313,914	1,520	13.4	518	5,898	11.4	53	606	44
A-50-80-Bach-0.023	22.9	317,678	1,530	13.4	521	5,999	11.5	53	610	44
A-50-80-MPLCOm2012-0.013	20.7	318,502	1,502	13.3	514	6,136	11.9	52	620	40
A-55-80-MLCDRAT-0.013	22.6	320,862	1,516	13.4	520	5,935	11.4	54	617	43
A-50-80-MLCDRAT-0.013	22.7	325,175	1,524	13.5	522	6,033	11.6	54	623	43
B-50-80-Bach-0.009	33.8	325,901	1,554	12.5	484	6,136	12.7	53	673	70
B-50-80-MPLCOm2012-0.005	31.9	327,272	1,522	12.3	477	6,149	12.9	53	686	67
A-55-80-Bach-0.022	23.4	327,719	1,542	13.6	527	6,024	11.4	54	622	44
A-50-77-MPLCOm2012-0.011	21.6	328,622	1,331	12.1	469	6,212	13.2	53	701	46
A-55-80-20-15	**20.6**	**330,095**	**1,334**	**12.1**	**469**	**6,018**	**12.8**	**55**	**704**	**44**
A-55-80-MPLCOm2012-0.012	21.6	330,347	1,519	13.4	520	6,146	11.8	54	635	42
A-50-80-Bach-0.022	23.4	332,451	1,550	13.7	531	6,167	11.6	54	626	44
A-55-80-Bach-0.021	24.0	342,337	1,566	13.9	538	6,197	11.5	55	636	45
A-50-80-MPLCOm2012-0.012	21.7	343,293	1,543	13.7	532	6,409	12.0	54	645	41
A-55-80-MLCDRAT-0.012	23.8	343,713	1,551	13.7	532	6,126	11.5	56	646	45
A-50-80-Bach-0.021	24.1	348,282	1,577	14.0	541	6,340	11.7	55	644	45
A-50-80-MLCDRAT-0.012	23.9	350,286	1,564	13.9	537	6,271	11.7	56	652	45
A-55-80-MPLCOm2012-0.011	22.6	352,002	1,552	13.8	535	6,348	11.9	55	658	42
A-55-80-Bach-0.02	24.6	357,203	1,586	14.1	545	6,319	11.6	57	655	45
A-50-77-MPLCOm2012-0.01	22.7	357,345	1,369	12.6	488	6,529	13.4	55	732	47
A-50-80-Bach-0.02	24.7	364,767	1,603	14.3	555	6,545	11.8	56	657	45
A-55-80-MLCDRAT-0.011	25.5	369,025	1,595	14.2	549	6,384	11.6	58	672	46
A-55-80-20-20	**22.0**	**369,610**	**1,423**	**12.9**	**500**	**6,379**	**12.8**	**58**	**739**	**44**
A-50-80-MPLCOm2012-0.011	22.8	370,909	1,582	14.2	550	6,686	12.2	55	674	41
A-55-80-Bach-0.019	25.2	372,598	1,611	14.3	554	6,458	11.7	58	673	45
A-55-80-MPLCOm2012-0.01	23.7	375,484	1,586	14.1	548	6,519	11.9	58	685	43

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-MLCDRAT-0.011	25.5	377,864	1,613	14.4	558	6,607	11.8	57	677	46
A-50-80-Bach-0.019	25.3	381,778	1,624	14.4	559	6,652	11.9	57	683	45
A-55-80-Bach-0.018	25.8	389,243	1,632	14.5	563	6,589	11.7	59	691	46
A-55-80-MLCDRAT-0.01	27.7	398,180	1,641	14.6	564	6,605	11.7	60	706	49
A-50-80-Bach-0.018	26.0	400,457	1,653	14.8	572	6,846	12.0	58	700	45
A-50-80-MPLCOm2012-0.01	23.9	401,856	1,622	14.6	564	6,957	12.3	58	713	42
A-55-80-20-25	**22.7**	**404,596**	**1,492**	**13.5**	**523**	**6,654**	**12.7**	**61**	**774**	**43**
A-55-80-Bach-0.017	26.5	406,323	1,657	14.9	575	6,774	11.8	60	707	46
A-50-80-MLCDRAT-0.01	27.9	409,804	1,662	14.8	575	6,871	11.9	60	713	49
A-50-80-20-15	**22.6**	**419,030**	**1,401**	**13.0**	**503**	**6,918**	**13.8**	**61**	**833**	**45**
A-50-80-Bach-0.017	26.6	420,352	1,678	15.1	586	7,039	12.0	60	717	45
A-55-80-Bach-0.016	27.2	423,929	1,677	15.0	582	6,908	11.9	61	728	47
A-55-80-MPLCOm2012-0.008	26.2	432,557	1,662	14.9	579	6,975	12.0	62	747	45
A-55-80-MLCDRAT-0.009	30.4	433,597	1,696	15.0	583	6,869	11.8	63	744	52
A-50-80-MPLCOm2012-0.009	25.1	437,273	1,665	15.0	582	7,291	12.5	60	751	43
A-50-80-Bach-0.016	27.4	441,294	1,704	15.4	595	7,190	12.1	61	742	46
A-55-80-Bach-0.015	27.9	442,384	1,700	15.3	592	7,034	11.9	63	747	47
A-50-80-MLCDRAT-0.009	30.6	449,030	1,717	15.4	596	7,168	12.0	63	753	51
A-55-80-Bach-0.014	28.7	461,609	1,723	15.5	602	7,179	11.9	64	767	48
A-50-80-Bach-0.015	28.1	463,301	1,727	15.6	605	7,391	12.2	63	766	46
A-50-80-20-20	**23.3**	**463,457**	**1,487**	**13.8**	**534**	**7,301**	**13.7**	**63**	**868**	**44**
A-55-80-MLCDRAT-0.008	33.3	474,060	1,749	15.6	606	7,147	11.8	66	782	55
A-50-80-MPLCOm2012-0.008	26.6	478,349	1,710	15.5	601	7,564	12.6	63	796	44
A-55-80-Bach-0.013	29.5	482,093	1,744	15.8	610	7,330	12.0	66	790	48
A-50-80-Bach-0.014	28.9	486,484	1,752	15.9	616	7,582	12.3	64	790	47
A-50-80-MLCDRAT-0.008	33.5	495,424	1,779	16.0	619	7,508	12.1	66	800	54
A-50-80-20-25	**23.6**	**500,430**	**1,560**	**14.4**	**558**	**7,596**	**13.6**	**66**	**897**	**42**
A-55-80-Bach-0.012	30.3	503,871	1,768	16.0	617	7,467	12.1	67	817	49
A-50-80-Bach-0.013	29.7	511,462	1,778	16.2	627	7,746	12.4	66	816	47
A-55-80-MLCDRAT-0.007	36.3	520,869	1,805	16.2	629	7,496	11.9	69	828	58
A-50-80-MPLCOm2012-0.007	28.2	524,392	1,754	16.0	620	7,904	12.7	66	846	45
A-55-80-Bach-0.011	31.3	527,263	1,793	16.2	628	7,606	12.1	69	840	50
A-50-80-Bach-0.012	30.6	538,488	1,806	16.4	635	7,914	12.5	68	848	48
A-50-80-MLCDRAT-0.007	36.5	550,777	1,843	16.7	647	7,943	12.3	69	851	56
A-55-80-Bach-0.01	32.3	551,762	1,816	16.5	639	7,773	12.2	71	863	51
A-50-80-Bach-0.011	31.6	568,005	1,834	16.7	648	8,156	12.6	70	877	49
A-50-80-MPLCOm2012-0.006	30.0	575,496	1,797	16.4	635	8,164	12.9	70	906	47
A-55-80-MLCDRAT-0.006	39.0	577,420	1,865	16.9	655	7,830	12.0	74	882	60

Appendix C Table 11. Benefits of 267 Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-Bach-0.01	32.7	599,143	1,862	17.1	662	8,387	12.7	71	905	49
A-50-80-MLCDRAT-0.006	39.3	616,864	1,908	17.4	674	8,383	12.4	74	915	58
A-50-80-Bach-0.009	33.9	633,671	1,888	17.5	676	8,600	12.7	74	937	50
A-50-80-MPLCOm2012-0.005	32.0	635,352	1,848	17.1	660	8,585	13.0	74	963	48
A-50-80-Bach-0.008	35.1	671,522	1,920	17.8	688	8,822	12.8	76	976	51
A-50-80-MLCDRAT-0.005	41.9	700,139	1,969	18.1	700	8,805	12.6	80	1,000	60
A-50-80-MPLCOm2012-0.004	34.2	708,806	1,894	17.6	681	8,944	13.1	79	1,041	50
A-55-80-MLCDRAT-0.004	43.4	714,694	1,967	18.1	700	8,509	12.2	84	1,021	62
A-50-80-MLCDRAT-0.004	44.0	790,911	2,027	18.8	728	9,318	12.8	85	1,086	60

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 12. Harms of 267 Consensus-Efficient Risk Model-Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
B-55-75-40-10	64,607	76,031	7.2	1.1	241	27	0.5	4.7	6.8
B-50-75-MPLCOm2012-0.023	67,076	79,108	5.3	0.8	274	33	0.7	5.0	5.7
B-55-77-40-10	67,867	79,460	7.5	1.1	262	32	0.6	5.1	6.8
B-55-75-MPLCOm2012-0.023	68,309	80,492	5.4	0.8	280	35	0.7	5.2	5.7
B-55-75-40-15	70,408	82,183	7.6	1.1	256	28	0.6	4.7	7.3
B-55-80-40-10	70,999	82,748	7.9	1.1	281	38	0.8	5.6	7.0
B-50-75-MPLCOm2012-0.022	71,120	83,443	5.4	0.8	283	34	0.7	5.1	6.1
B-55-75-MPLCOm2012-0.022	72,215	84,666	5.5	0.9	289	36	0.7	5.2	6.1
B-50-75-Bach-0.034	72,902	85,518	5.0	0.8	290	35	0.7	5.1	6.5
B-55-75-Bach-0.034	74,244	87,029	5.1	0.8	295	35	0.7	5.0	6.4
B-55-77-40-15	74,368	86,348	8.0	1.1	278	34	0.7	5.1	7.3
B-50-75-MPLCOm2012-0.021	75,334	87,933	5.6	0.9	293	35	0.7	5.1	6.7
B-50-75-40-10	75,796	87,827	8.0	1.2	253	26	0.5	4.5	8.9
B-55-75-MPLCOm2012-0.021	76,427	89,164	5.6	0.9	299	37	0.7	5.2	6.6
B-50-77-MPLCOm2012-0.023	76,449	89,055	5.8	0.9	317	43	0.9	5.6	6.1
B-50-75-Bach-0.033	76,596	89,468	5.1	0.8	298	35	0.7	5.0	7.0
B-55-77-MPLCOm2012-0.023	77,651	90,393	5.8	0.9	322	44	0.9	5.6	6.1
B-55-75-Bach-0.033	77,925	90,958	5.1	0.8	304	36	0.7	5.0	6.9
B-55-80-40-15	78,245	90,409	8.3	1.2	301	41	0.8	5.6	7.4
B-50-77-MLCDRAT-0.023	78,818	91,788	5.3	0.8	320	44	0.9	5.7	5.8
B-50-77-40-10	79,248	91,457	8.3	1.2	273	30	0.6	4.7	9.0
B-55-77-40-20	79,273	91,528	8.3	1.2	289	35	0.7	5.1	7.5
B-55-77-MLCDRAT-0.023	80,013	93,128	5.4	0.8	326	46	0.9	5.9	5.8
B-50-75-MPLCOm2012-0.02	80,036	92,949	5.7	0.9	304	36	0.7	5.0	7.2
B-50-77-MPLCOm2012-0.022	80,825	93,729	5.9	0.9	327	44	0.9	5.6	6.5
B-55-75-MPLCOm2012-0.02	81,162	94,209	5.8	0.9	309	37	0.8	5.1	7.1
B-55-77-MPLCOm2012-0.022	81,893	94,926	5.9	0.9	332	45	0.9	5.6	6.5
B-50-75-40-15	81,993	94,358	8.5	1.2	266	27	0.5	4.5	9.3
B-50-80-40-10	83,744	96,205	8.7	1.2	304	40	0.8	5.5	9.1
B-55-80-40-20	83,861	96,341	8.7	1.2	315	44	0.9	5.8	7.7
B-50-77-Bach-0.034	83,925	97,234	5.4	0.8	336	45	0.9	5.6	6.8
B-55-77-Bach-0.034	85,280	98,765	5.4	0.8	342	46	0.9	5.6	6.8
B-50-75-MPLCOm2012-0.019	85,284	98,517	5.8	0.9	315	36	0.7	4.9	7.9
B-50-77-MPLCOm2012-0.021	85,344	98,554	6.0	0.9	337	45	0.9	5.6	7.0
B-50-77-40-15	86,158	98,746	8.9	1.3	290	32	0.7	4.8	9.4
B-55-77-MPLCOm2012-0.021	86,395	99,720	6.1	0.9	343	46	0.9	5.6	7.0
B-55-75-MPLCOm2012-0.019	86,605	100,021	5.9	0.9	321	38	0.8	5.1	7.7

Appendix C Table 12. Harms of 267 Consensus-Efficient Risk Model-Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
B-50-77-Bach-0.033	87,952	101,542	5.5	0.8	345	45	0.9	5.5	7.4
B-55-77-Bach-0.033	89,277	103,030	5.5	0.8	351	47	1.0	5.6	7.3
B-55-80-MPLCOm2012-0.023	89,961	103,385	6.4	0.9	380	60	1.2	6.4	6.4
B-50-77-MPLCOm2012-0.02	90,392	103,922	6.1	0.9	348	46	0.9	5.5	7.5
B-50-80-MPLCOm2012-0.023	90,966	104,505	6.4	0.9	386	62	1.3	6.5	6.4
B-50-77-40-20	91,142	103,995	9.3	1.3	300	34	0.7	4.9	9.6
B-55-77-MPLCOm2012-0.02	91,484	105,148	6.2	0.9	353	47	0.9	5.6	7.4
B-50-80-40-15	91,757	104,657	9.4	1.3	324	43	0.9	5.6	9.5
B-50-77-Bach-0.032	92,216	106,093	5.6	0.8	355	47	0.9	5.6	7.6
B-55-80-MLCDRAT-0.023	92,514	106,280	6.0	0.9	383	62	1.2	6.6	6.2
B-50-80-MLCDRAT-0.023	93,592	107,488	6.0	0.9	390	63	1.3	6.6	6.2
B-50-77-40-25	94,455	107,470	9.6	1.3	307	34	0.7	4.8	9.7
B-55-80-MPLCOm2012-0.022	94,628	108,355	6.5	0.9	391	61	1.2	6.4	6.7
B-50-80-MPLCOm2012-0.022	95,837	109,701	6.5	0.9	397	64	1.3	6.6	6.7
B-50-77-MPLCOm2012-0.019	95,987	109,867	6.3	0.9	361	47	0.9	5.5	8.3
B-50-77-Bach-0.031	96,543	110,714	5.7	0.9	366	48	1.0	5.6	7.8
B-50-75-MPLCOm2012-0.017	97,041	111,072	6.2	0.9	338	38	0.8	4.9	9.0
B-55-77-MPLCOm2012-0.019	97,287	111,339	6.4	0.9	366	48	1.0	5.5	8.1
B-50-80-40-20	97,823	111,033	9.9	1.4	340	46	0.9	5.7	9.7
B-55-77-Bach-0.031	97,940	112,294	5.7	0.9	371	49	1.0	5.6	7.7
B-55-80-MPLCOm2012-0.021	99,674	113,735	6.6	1.0	404	63	1.3	6.4	7.3
B-50-80-MPLCOm2012-0.021	101,031	115,245	6.6	1.0	411	66	1.3	6.6	7.3
B-50-77-Bach-0.03	101,222	115,720	5.8	0.9	376	49	1.0	5.6	8.3
B-50-80-Bach-0.034	101,409	115,892	6.0	0.9	415	67	1.3	6.6	7.0
B-55-80-Bach-0.034	101,612	116,031	6.0	0.9	416	65	1.3	6.4	7.0
B-50-77-MPLCOm2012-0.018	101,924	116,201	6.5	1.0	373	49	1.0	5.6	8.5
B-50-80-40-25	101,977	115,402	10.3	1.4	350	47	1.0	5.7	9.8
B-55-77-MPLCOm2012-0.018	102,872	117,290	6.5	1.0	378	50	1.0	5.6	8.3
B-55-80-MLCDRAT-0.021	103,248	117,727	6.2	0.9	408	64	1.3	6.5	7.3
B-50-75-MPLCOm2012-0.016	103,782	118,247	6.3	1.0	351	39	0.8	4.9	9.8
B-55-75-MPLCOm2012-0.016	103,925	118,497	6.3	1.0	356	41	0.8	5.0	9.4
B-55-80-MPLCOm2012-0.02	105,030	119,440	6.7	1.0	413	63	1.3	6.3	7.7
B-50-80-Bach-0.033	106,067	120,862	6.1	0.9	425	67	1.4	6.5	7.7
B-55-80-Bach-0.033	106,108	120,822	6.1	0.9	426	67	1.3	6.5	7.6
B-50-80-MPLCOm2012-0.02	106,418	120,972	6.8	1.0	422	66	1.3	6.5	7.8
B-50-77-MPLCOm2012-0.017	108,577	123,290	6.6	1.0	386	50	1.0	5.5	9.4
B-55-77-MPLCOm2012-0.017	109,070	123,890	6.6	1.0	391	50	1.0	5.5	9.0
B-55-80-Bach-0.032	110,822	125,850	6.2	0.9	436	67	1.4	6.4	7.9

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Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
B-50-80-Bach-0.032	110,827	125,935	6.2	0.9	436	69	1.4	6.6	7.9
B-55-80-MPLCOm2012-0.019	110,978	125,778	6.9	1.0	425	64	1.3	6.3	8.5
B-50-75-MPLCOm2012-0.015	111,552	126,508	6.5	1.0	366	40	0.8	4.9	10.0
B-50-80-MPLCOm2012-0.019	112,284	127,214	6.9	1.0	434	66	1.3	6.3	8.7
B-55-80-Bach-0.031	115,487	130,820	6.3	0.9	446	68	1.4	6.3	8.1
B-50-80-Bach-0.031	115,564	130,987	6.3	0.9	446	69	1.4	6.5	8.2
B-50-77-MPLCOm2012-0.016	115,780	130,964	6.8	1.0	400	50	1.0	5.4	10.3
B-55-77-MPLCOm2012-0.016	115,846	131,117	6.7	1.0	405	52	1.0	5.5	9.7
B-50-80-MLCDRAT-0.019	117,231	132,697	6.5	0.9	443	70	1.4	6.6	8.3
B-55-80-MPLCOm2012-0.018	117,313	132,517	7.0	1.0	438	65	1.3	6.2	8.7
B-55-80-Bach-0.03	119,154	134,726	6.3	0.9	448	67	1.4	6.3	8.6
B-50-80-MPLCOm2012-0.018	119,159	134,536	7.1	1.0	448	68	1.4	6.3	9.0
B-50-75-MPLCOm2012-0.014	120,192	135,706	6.7	1.0	380	41	0.8	4.8	11.0
B-50-80-Bach-0.03	120,957	136,726	6.4	0.9	457	70	1.4	6.4	8.7
B-55-80-MLCDRAT-0.018	121,586	137,265	6.6	0.9	449	68	1.4	6.4	8.9
B-50-80-MLCDRAT-0.018	123,032	138,877	6.7	1.0	457	71	1.4	6.5	8.9
B-55-77-MPLCOm2012-0.015	123,731	139,522	6.9	1.0	419	53	1.1	5.5	10.0
B-50-77-MPLCOm2012-0.015	124,014	139,709	7.0	1.0	415	51	1.0	5.4	10.4
B-55-80-Bach-0.029	124,216	140,132	6.4	0.9	459	69	1.4	6.3	9.3
B-55-80-MPLCOm2012-0.017	124,249	139,896	7.1	1.0	454	67	1.3	6.2	9.5
B-50-80-Bach-0.029	126,151	142,261	6.5	0.9	468	72	1.4	6.5	9.4
B-50-80-MPLCOm2012-0.017	126,738	142,603	7.2	1.0	465	70	1.4	6.3	9.8
B-50-75-MPLCOm2012-0.013	129,678	145,797	6.9	1.0	396	41	0.8	4.7	12.4
B-55-80-Bach-0.028	129,813	146,107	6.6	0.9	470	70	1.4	6.3	9.7
B-55-80-MPLCOm2012-0.016	131,558	147,676	7.3	1.0	467	68	1.4	6.2	10.3
B-50-80-Bach-0.028	131,788	148,269	6.6	1.0	479	73	1.5	6.5	10.0
B-55-77-MPLCOm2012-0.014	132,093	148,432	7.1	1.0	434	53	1.1	5.4	10.8
B-50-77-MPLCOm2012-0.014	133,200	149,468	7.2	1.0	430	52	1.0	5.3	11.3
B-50-80-MPLCOm2012-0.016	134,642	151,004	7.4	1.0	479	71	1.4	6.3	10.8
B-50-80-Bach-0.027	137,862	154,728	6.7	1.0	490	74	1.5	6.4	10.3
B-50-80-MLCDRAT-0.016	138,763	155,616	7.0	1.0	487	74	1.5	6.5	10.3
B-55-80-MPLCOm2012-0.015	139,739	156,391	7.4	1.0	482	69	1.4	6.1	10.5
B-50-77-MPLCOm2012-0.013	143,278	160,195	7.3	1.1	448	52	1.1	5.2	13.0
B-50-80-MPLCOm2012-0.015	143,399	160,323	7.6	1.1	495	73	1.5	6.3	10.9
B-50-80-Bach-0.026	143,828	161,083	6.8	1.0	503	75	1.5	6.4	10.3
B-55-80-Bach-0.025	147,758	165,203	6.9	1.0	504	72	1.5	6.2	10.6
B-50-80-MLCDRAT-0.015	148,360	165,827	7.2	1.0	506	76	1.5	6.5	11.1
B-55-80-MPLCOm2012-0.014	148,615	165,839	7.6	1.1	498	69	1.4	6.0	11.4

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B-50-80-Bach-0.025	150,601	168,292	7.0	1.0	516	76	1.5	6.3	11.0
B-50-80-MPLCOm2012-0.014	153,324	170,855	7.8	1.1	512	73	1.5	6.1	11.9
B-55-80-Bach-0.024	154,299	172,167	7.0	1.0	516	74	1.5	6.2	11.5
B-50-77-MPLCOm2012-0.012	154,882	172,502	7.6	1.1	467	54	1.1	5.2	13.3
B-50-80-Bach-0.024	157,520	175,651	7.1	1.0	529	77	1.5	6.3	11.8
B-55-80-MPLCOm2012-0.013	158,123	175,963	7.8	1.1	514	71	1.4	6.0	12.5
B-50-80-MLCDRAT-0.014	158,658	176,788	7.3	1.0	524	77	1.6	6.4	12.0
B-50-80-MPLCOm2012-0.013	164,259	182,478	8.0	1.1	531	74	1.5	6.1	13.4
B-50-80-Bach-0.023	164,603	183,169	7.3	1.0	541	78	1.6	6.3	12.3
B-50-77-MPLCOm2012-0.011	167,727	186,154	7.8	1.1	485	55	1.1	5.2	14.9
B-50-80-Bach-0.022	172,049	191,083	7.4	1.0	553	79	1.6	6.3	12.8
A-55-80-MPLCOm2012-0.023	174,860	192,554	12.2	1.5	508	80	1.6	6.8	11.2
A-50-80-MPLCOm2012-0.023	174,911	192,601	12.2	1.5	508	80	1.6	6.8	11.2
B-55-80-Bach-0.021	175,310	194,510	7.4	1.0	550	75	1.5	6.0	13.1
B-50-80-MPLCOm2012-0.012	176,755	195,746	8.2	1.1	552	76	1.5	6.1	13.7
A-55-80-MLCDRAT-0.023	179,310	197,439	11.5	1.4	513	84	1.7	7.1	10.9
B-50-80-Bach-0.021	180,105	199,649	7.5	1.1	565	79	1.6	6.2	13.7
B-50-77-MPLCOm2012-0.01	182,246	201,560	8.1	1.1	507	56	1.1	5.1	16.3
B-55-80-Bach-0.02	182,833	202,516	7.5	1.1	562	76	1.5	6.0	13.9
A-55-80-MPLCOm2012-0.022	184,176	202,396	12.5	1.5	523	82	1.6	6.8	12.1
A-50-80-MPLCOm2012-0.022	184,284	202,513	12.5	1.5	523	82	1.6	6.8	12.1
B-50-80-Bach-0.02	188,573	208,640	7.7	1.1	579	80	1.6	6.1	14.6
B-55-80-Bach-0.019	190,612	210,780	7.6	1.1	574	77	1.5	6.0	14.5
B-50-80-MPLCOm2012-0.011	191,379	211,271	8.4	1.2	575	77	1.6	6.0	15.3
A-55-80-MPLCOm2012-0.021	193,965	212,755	12.7	1.5	539	84	1.7	6.8	13.2
A-55-80-Bach-0.034	194,099	213,177	11.4	1.4	546	88	1.8	7.1	12.8
A-50-80-MPLCOm2012-0.021	194,193	212,990	12.7	1.5	540	84	1.7	6.8	13.2
A-50-80-Bach-0.034	194,261	213,338	11.4	1.4	546	87	1.7	7.0	12.8
B-50-80-Bach-0.019	197,209	217,812	7.8	1.1	593	81	1.6	6.1	15.2
A-55-80-Bach-0.033	202,943	222,529	11.6	1.4	560	88	1.8	6.9	13.5
A-50-80-Bach-0.033	203,167	222,759	11.6	1.4	560	88	1.8	6.9	13.6
A-55-80-MPLCOm2012-0.02	204,612	224,001	13.0	1.6	555	86	1.7	6.8	14.1
A-50-80-MPLCOm2012-0.02	205,020	224,420	13.0	1.6	555	85	1.7	6.7	14.2
B-50-80-Bach-0.018	206,581	227,744	8.0	1.1	606	82	1.7	6.1	16.0
B-50-80-MPLCOm2012-0.01	206,957	227,804	8.7	1.2	598	79	1.6	6.0	16.9
A-50-80-MLCDRAT-0.02	210,560	230,513	12.1	1.5	565	89	1.8	7.0	13.3
A-55-80-Bach-0.032	212,181	232,294	11.8	1.4	574	90	1.8	6.9	14.1
A-50-80-Bach-0.032	212,490	232,621	11.8	1.4	575	89	1.8	6.9	14.1

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A-55-80-MPLCOm2012-0.019	216,291	236,355	13.3	1.6	573	87	1.7	6.7	15.1
A-50-80-MPLCOm2012-0.019	217,030	237,128	13.2	1.6	574	87	1.7	6.7	15.2
A-55-80-Bach-0.031	221,421	242,072	12.0	1.5	589	91	1.8	6.9	14.8
A-50-80-Bach-0.031	221,847	242,513	12.0	1.5	589	90	1.8	6.8	14.9
B-50-80-MPLCOm2012-0.009	225,054	247,007	9.0	1.2	623	80	1.6	5.9	18.5
A-50-80-MLCDRAT-0.019	225,292	246,094	12.4	1.5	587	91	1.8	6.9	14.6
B-50-80-Bach-0.016	227,395	249,832	8.3	1.2	637	84	1.7	6.1	18.2
A-55-80-30-15	**227,443**	**247,644**	**16.1**	**1.9**	**518**	**69**	**1.4**	**6.3**	**20.6**
A-55-80-MPLCOm2012-0.018	228,676	249,442	13.5	1.6	591	89	1.8	6.7	15.8
A-50-80-MPLCOm2012-0.018	229,944	250,782	13.5	1.6	594	90	1.8	6.8	15.9
A-55-80-Bach-0.03	231,518	252,744	12.2	1.5	604	93	1.9	6.9	15.5
A-50-80-Bach-0.03	232,092	253,350	12.2	1.5	605	93	1.9	6.9	15.6
A-50-80-MLCDRAT-0.018	236,479	257,928	12.7	1.5	604	92	1.8	6.9	15.6
A-55-80-MLCDRAT-0.018	236,483	257,918	12.7	1.5	604	92	1.8	6.9	15.6
A-55-80-Bach-0.029	241,484	263,290	12.4	1.5	618	94	1.9	6.9	16.2
A-50-80-Bach-0.029	242,278	264,120	12.4	1.5	620	94	1.9	6.8	16.3
A-55-80-MPLCOm2012-0.017	242,329	263,878	13.8	1.6	610	90	1.8	6.7	17.1
A-50-80-MPLCOm2012-0.017	244,349	265,995	13.9	1.7	614	92	1.8	6.8	17.4
B-50-80-MPLCOm2012-0.008	245,777	268,980	9.3	1.3	653	83	1.7	5.9	20.0
B-50-80-Bach-0.014	250,390	274,208	8.7	1.2	668	86	1.7	6.0	19.6
A-55-80-Bach-0.028	252,590	275,022	12.6	1.5	634	96	1.9	6.9	16.8
A-50-80-Bach-0.028	253,613	276,110	12.7	1.5	636	95	1.9	6.8	17.0
A-50-80-MLCDRAT-0.017	253,620	276,030	13.1	1.6	628	95	1.9	6.9	17.0
A-55-80-MPLCOm2012-0.016	256,724	279,088	14.0	1.7	630	92	1.8	6.7	18.3
A-50-80-MPLCOm2012-0.016	259,832	282,347	14.2	1.7	635	94	1.9	6.7	18.9
B-50-80-Bach-0.013	263,135	287,720	8.9	1.2	685	86	1.7	5.9	20.8
A-55-80-Bach-0.027	263,986	287,083	12.8	1.5	650	97	1.9	6.8	17.9
A-50-80-Bach-0.027	265,411	288,573	12.9	1.6	652	97	1.9	6.8	18.1
A-50-80-MLCDRAT-0.016	267,426	290,613	13.4	1.6	648	97	1.9	6.9	18.1
B-50-80-MPLCOm2012-0.007	270,148	294,837	9.6	1.3	685	85	1.7	5.9	21.9
A-55-80-MPLCOm2012-0.015	272,809	296,092	14.4	1.7	651	93	1.9	6.6	19.5
A-55-80-Bach-0.026	275,329	299,073	13.0	1.6	665	99	2.0	6.9	18.7
B-50-80-Bach-0.012	277,033	302,448	9.1	1.2	704	87	1.8	5.9	22.1
A-50-80-Bach-0.026	277,066	300,897	13.1	1.6	667	98	2.0	6.8	18.9
A-50-80-MPLCOm2012-0.015	277,426	300,937	14.6	1.7	659	94	1.9	6.6	20.2
A-50-77-MPLCOm2012-0.013	280,113	303,848	14.2	1.7	609	72	1.4	5.7	22.0
A-50-80-MLCDRAT-0.015	286,154	310,413	13.8	1.6	674	99	2.0	6.8	19.2
A-55-80-Bach-0.025	287,935	312,383	13.3	1.6	682	99	2.0	6.7	19.6

Appendix C Table 12. Harms of 267 Consensus-Efficient Risk Model-Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
A-50-80-Bach-0.025	290,340	314,916	13.4	1.6	685	99	2.0	6.7	20.0
A-55-80-MPLCOm2012-0.014	290,431	314,704	14.7	1.7	675	95	1.9	6.5	20.5
B-50-80-Bach-0.011	292,128	318,447	9.3	1.3	723	89	1.8	5.9	23.0
B-50-80-MPLCOm2012-0.006	296,680	322,996	9.9	1.3	719	88	1.8	5.9	23.8
A-50-80-MPLCOm2012-0.014	297,009	321,624	15.0	1.8	684	96	1.9	6.5	21.3
A-55-80-Bach-0.024	300,842	326,030	13.6	1.6	698	101	2.0	6.8	20.3
A-50-77-MPLCOm2012-0.012	303,023	328,035	14.7	1.8	637	73	1.5	5.6	24.1
A-55-80-MLCDRAT-0.014	303,286	328,536	14.0	1.7	695	100	2.0	6.8	20.4
A-50-80-Bach-0.024	303,778	329,091	13.6	1.6	703	100	2.0	6.7	20.6
A-50-80-MLCDRAT-0.014	306,138	331,531	14.1	1.7	699	100	2.0	6.7	20.7
B-50-80-Bach-0.01	308,091	335,373	9.5	1.3	744	90	1.8	5.9	24.4
A-55-80-MPLCOm2012-0.013	309,284	334,629	15.0	1.8	697	96	1.9	6.5	21.8
A-55-80-Bach-0.023	313,914	339,831	13.8	1.6	716	102	2.0	6.7	21.0
A-50-80-Bach-0.023	317,678	343,778	13.9	1.7	721	101	2.0	6.6	21.5
A-50-80-MPLCOm2012-0.013	318,502	344,299	15.4	1.8	709	98	2.0	6.5	23.1
A-55-80-MLCDRAT-0.013	320,862	347,108	14.2	1.7	718	102	2.0	6.7	21.3
A-50-80-MLCDRAT-0.013	325,175	351,637	14.3	1.7	724	102	2.0	6.7	21.9
B-50-80-Bach-0.009	325,901	354,263	9.6	1.3	767	91	1.8	5.9	25.7
B-50-80-MPLCOm2012-0.005	327,272	355,416	10.3	1.4	756	89	1.8	5.8	25.3
A-55-80-Bach-0.022	327,719	354,413	14.0	1.7	732	103	2.1	6.7	22.3
A-50-77-MPLCOm2012-0.011	328,622	355,052	15.2	1.8	665	74	1.5	5.6	26.0
A-55-80-20-15	**330,095**	**356,390**	**16.0**	**1.9**	**667**	**83**	**1.7**	**6.2**	**29.0**
A-55-80-MPLCOm2012-0.012	330,347	356,878	15.3	1.8	723	98	2.0	6.5	23.3
A-50-80-Bach-0.022	332,451	359,385	14.2	1.7	738	103	2.1	6.6	22.9
A-55-80-Bach-0.021	342,337	369,858	14.3	1.7	750	105	2.1	6.7	23.1
A-50-80-MPLCOm2012-0.012	343,293	370,477	15.8	1.9	740	99	2.0	6.4	25.2
A-55-80-MLCDRAT-0.012	343,713	371,269	14.4	1.7	745	104	2.1	6.7	23.0
A-50-80-Bach-0.021	348,282	376,097	14.5	1.7	757	104	2.1	6.6	24.0
A-50-80-MLCDRAT-0.012	350,286	378,187	14.7	1.7	754	103	2.1	6.6	23.9
A-55-80-MPLCOm2012-0.011	352,002	379,754	15.6	1.8	749	100	2.0	6.4	24.7
A-55-80-Bach-0.02	357,203	385,566	14.5	1.7	766	105	2.1	6.6	24.1
A-50-77-MPLCOm2012-0.01	357,345	385,345	15.7	1.9	697	76	1.5	5.6	28.7
A-50-80-Bach-0.02	364,767	393,511	14.8	1.7	776	105	2.1	6.6	25.1
A-55-80-MLCDRAT-0.011	369,025	398,078	14.5	1.7	777	105	2.1	6.6	24.6
A-55-80-20-20	**369,610**	**398,094**	**16.8**	**2.0**	**722**	**89**	**1.8**	**6.3**	**30.6**
A-50-80-MPLCOm2012-0.011	370,909	399,603	16.3	1.9	770	101	2.0	6.4	27.2
A-55-80-Bach-0.019	372,598	401,805	14.8	1.7	784	106	2.1	6.6	25.2
A-55-80-MPLCOm2012-0.01	375,484	404,571	15.8	1.9	776	102	2.0	6.4	26.5

Appendix C Table 12. Harms of 267 Consensus-Efficient Risk Model-Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
A-50-80-MLCDRAT-0.011	377,864	407,366	14.8	1.7	789	105	2.1	6.5	25.8
A-50-80-Bach-0.019	381,778	411,439	15.1	1.8	794	106	2.1	6.5	26.4
A-55-80-Bach-0.018	389,243	419,367	15.1	1.8	802	107	2.2	6.6	26.5
A-55-80-MLCDRAT-0.01	398,180	429,019	14.4	1.7	813	108	2.2	6.6	26.5
A-50-80-Bach-0.018	400,457	431,163	15.4	1.8	816	107	2.1	6.5	28.0
A-50-80-MPLCOm2012-0.01	401,856	432,251	16.8	2.0	804	104	2.1	6.4	29.8
A-55-80-20-25	**404,596**	**434,892**	**17.8**	**2.1**	**765**	**94**	**1.9**	**6.3**	**31.9**
A-55-80-Bach-0.017	406,323	437,409	15.3	1.8	822	109	2.2	6.6	28.0
A-50-80-MLCDRAT-0.01	409,804	441,216	14.7	1.7	827	108	2.2	6.5	28.2
A-50-80-20-15	**419,030**	**449,947**	**18.5**	**2.2**	**750**	**84**	**1.7**	**6.0**	**38.6**
A-50-80-Bach-0.017	420,352	452,129	15.8	1.8	837	108	2.2	6.4	30.1
A-55-80-Bach-0.016	423,929	455,993	15.6	1.8	840	110	2.2	6.6	29.2
A-55-80-MPLCOm2012-0.008	432,557	464,850	16.5	1.9	839	106	2.1	6.4	30.0
A-55-80-MLCDRAT-0.009	433,597	466,571	14.3	1.7	856	112	2.2	6.6	29.3
A-50-80-MPLCOm2012-0.009	437,273	469,612	17.4	2.0	841	105	2.1	6.3	32.3
A-50-80-Bach-0.016	441,294	474,232	16.1	1.9	860	110	2.2	6.5	31.6
A-55-80-Bach-0.015	442,384	475,479	15.9	1.9	860	111	2.2	6.5	30.4
A-50-80-MLCDRAT-0.009	449,030	482,762	14.7	1.7	872	111	2.2	6.5	31.4
A-55-80-Bach-0.014	461,609	495,768	16.1	1.9	880	112	2.2	6.5	31.8
A-50-80-Bach-0.015	463,301	497,449	16.5	1.9	882	110	2.2	6.4	33.3
A-50-80-20-20	**463,457**	**496,698**	**19.9**	**2.3**	**804**	**89**	**1.8**	**6.0**	**40.6**
A-55-80-MLCDRAT-0.008	474,060	509,474	14.2	1.7	902	114	2.3	6.5	31.5
A-50-80-MPLCOm2012-0.008	478,349	512,920	18.0	2.1	883	108	2.2	6.3	35.4
A-55-80-Bach-0.013	482,093	517,364	16.3	1.9	900	113	2.3	6.5	33.3
A-50-80-Bach-0.014	486,484	521,881	16.8	2.0	905	111	2.2	6.3	35.0
A-50-80-MLCDRAT-0.008	495,424	531,893	14.8	1.7	925	114	2.3	6.4	34.2
A-50-80-20-25	**500,430**	**535,519**	**21.2**	**2.5**	**849**	**94**	**1.9**	**6.0**	**42.5**
A-55-80-Bach-0.012	503,871	540,363	16.6	1.9	922	114	2.3	6.4	34.6
A-50-80-Bach-0.013	511,462	548,218	17.2	2.0	930	112	2.2	6.3	37.1
A-55-80-MLCDRAT-0.007	520,869	559,024	14.3	1.7	953	117	2.3	6.5	34.0
A-50-80-MPLCOm2012-0.007	524,392	561,495	18.6	2.1	928	110	2.2	6.3	38.6
A-55-80-Bach-0.011	527,263	565,051	16.8	2.0	946	115	2.3	6.4	36.0
A-50-80-Bach-0.012	538,488	576,709	17.6	2.0	957	113	2.3	6.3	39.1
A-50-80-MLCDRAT-0.007	550,777	590,414	15.1	1.8	984	117	2.3	6.3	37.6
A-55-80-Bach-0.01	551,762	590,917	17.1	2.0	970	116	2.3	6.4	37.5
A-50-80-Bach-0.011	568,005	607,834	18.0	2.1	985	115	2.3	6.3	41.1
A-50-80-MPLCOm2012-0.006	575,496	615,371	19.2	2.2	976	112	2.2	6.2	42.0
A-55-80-MLCDRAT-0.006	577,420	618,778	14.8	1.7	1,011	120	2.4	6.4	37.3

Appendix C Table 12. Harms of 267 Consensus-Efficient Risk Model-Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths*
A-50-80-Bach-0.01	599,143	640,649	18.3	2.1	1,015	117	2.3	6.3	43.3
A-50-80-MLCDRAT-0.006	616,864	660,217	15.7	1.8	1,050	120	2.4	6.3	42.3
A-50-80-Bach-0.009	633,671	677,053	18.7	2.1	1,046	118	2.3	6.2	45.6
A-50-80-MPLCOm2012-0.005	635,352	678,491	19.9	2.3	1,032	114	2.3	6.2	45.7
A-50-80-Bach-0.008	671,522	716,944	19.1	2.2	1,081	119	2.4	6.2	48.3
A-50-80-MLCDRAT-0.005	700,139	747,972	16.7	1.9	1,125	123	2.5	6.2	47.2
A-50-80-MPLCOm2012-0.004	708,806	755,847	20.7	2.4	1,094	115	2.3	6.1	49.6
A-55-80-MLCDRAT-0.004	714,694	763,529	16.5	1.9	1,135	125	2.5	6.4	43.4
A-50-80-MLCDRAT-0.004	790,911	843,539	18.0	2.1	1,203	125	2.5	6.2	52.3

*Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 13. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-50-80-Bach-0.025	22.3	159,773	1,255	8.8	354	4,056	11.5	39	451	63
B-50-80-MLCDRAT-0.015	22.0	161,822	1,253	8.8	355	4,064	11.4	40	456	62
B-50-80-MPLCOm2012-0.014	20.9	162,809	1,246	8.8	356	4,167	11.7	39	457	59
B-55-80-Bach-0.024	22.7	162,817	1,245	8.7	352	4,078	11.6	40	463	64
B-50-80-Bach-0.024	22.9	166,596	1,278	9.0	361	4,139	11.5	40	461	63
B-55-80-MPLCOm2012-0.013	21.6	166,735	1,241	8.7	353	4,176	11.8	40	472	61
B-50-80-MLCDRAT-0.014	22.8	170,783	1,274	9.0	361	4,135	11.5	41	473	63
B-50-80-Bach-0.023	23.4	173,502	1,297	9.1	367	4,241	11.6	41	473	64
B-50-80-MPLCOm2012-0.013	21.8	174,275	1,276	9.0	364	4,359	12.0	40	479	60
B-50-80-Bach-0.022	24.0	181,151	1,318	9.3	375	4,376	11.7	41	483	64
B-55-80-Bach-0.021	24.5	183,290	1,299	9.1	367	4,272	11.6	43	499	67
B-50-80-MPLCOm2012-0.012	22.8	187,331	1,317	9.3	375	4,524	12.1	41	500	61
A-55-80-MPLCOm2012-0.023	15.1	187,833	1,258	9.9	398	4,295	10.8	44	472	38
A-50-80-MPLCOm2012-0.023	15.1	187,903	1,262	9.8	397	4,309	10.9	44	473	38
B-50-80-Bach-0.021	24.7	189,239	1,336	9.5	381	4,441	11.7	43	497	65
B-55-80-Bach-0.02	25.1	190,476	1,317	9.3	377	4,397	11.7	43	505	67
A-55-80-MPLCOm2012-0.022	15.6	197,533	1,286	10.1	409	4,455	10.9	44	483	38
B-50-80-Bach-0.02	25.3	197,676	1,356	9.7	390	4,566	11.7	43	507	65
A-50-80-MPLCOm2012-0.022	15.6	197,695	1,288	10.1	407	4,440	10.9	45	486	38
B-55-80-Bach-0.019	25.8	198,153	1,337	9.5	384	4,553	11.9	44	516	67
A-55-80-MLCDRAT-0.023	16.8	198,541	1,285	10.0	404	4,292	10.6	46	491	42
B-50-80-MPLCOm2012-0.011	24.0	202,477	1,356	9.7	393	4,787	12.2	42	515	61
B-50-80-Bach-0.019	26.0	206,172	1,379	9.8	394	4,701	11.9	44	523	66
A-55-80-MPLCOm2012-0.021	16.1	207,708	1,316	10.4	419	4,630	11.1	45	496	38
A-50-80-MPLCOm2012-0.021	16.1	208,036	1,321	10.4	418	4,642	11.1	45	498	39
A-55-80-Bach-0.034	17.8	210,852	1,337	10.5	423	4,603	10.9	46	498	42
A-50-80-Bach-0.034	17.8	211,124	1,341	10.5	425	4,630	10.9	46	497	42
B-50-80-Bach-0.018	26.6	215,660	1,395	9.9	400	4,775	11.9	45	539	66
B-50-80-MPLCOm2012-0.01	25.2	218,734	1,390	10.0	403	4,959	12.3	44	543	63
A-55-80-MPLCOm2012-0.02	16.7	218,788	1,348	10.7	429	4,758	11.1	46	510	39
A-50-80-MPLCOm2012-0.02	16.7	219,385	1,347	10.6	427	4,783	11.2	46	514	39
A-55-80-Bach-0.033	18.2	219,722	1,362	10.7	432	4,725	10.9	47	509	42
A-50-80-Bach-0.033	18.2	220,098	1,360	10.7	430	4,702	10.9	47	512	42
A-55-80-Bach-0.032	18.7	229,326	1,388	11.0	442	4,843	11.0	47	519	42
A-50-80-Bach-0.032	18.7	229,844	1,389	11.0	443	4,877	11.0	47	519	42
A-55-80-MPLCOm2012-0.019	17.3	230,831	1,380	10.9	441	4,959	11.2	47	523	39
A-50-80-MPLCOm2012-0.019	17.3	231,879	1,381	11.0	442	4,982	11.3	47	525	39

Appendix C Table 13. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-MLCDRAT-0.02	18.8	232,308	1,386	10.9	440	4,801	10.9	48	528	43
B-50-80-Bach-0.016	28.1	236,644	1,447	10.5	421	5,101	12.1	46	562	67
B-50-80-MPLCOm2012-0.009	26.5	237,535	1,424	10.3	416	5,184	12.5	46	571	64
A-55-80-Bach-0.031	19.2	238,433	1,410	11.2	452	4,968	11.0	48	528	42
A-50-80-Bach-0.031	19.2	239,121	1,411	11.2	451	5,010	11.1	48	530	43
A-55-80-MPLCOm2012-0.018	17.9	243,611	1,409	11.2	451	5,091	11.3	48	540	40
A-50-80-MPLCOm2012-0.018	17.9	245,376	1,418	11.2	451	5,131	11.4	48	544	40
A-50-80-MLCDRAT-0.019	19.5	247,829	1,422	11.3	455	5,027	11.0	49	545	43
A-55-80-Bach-0.03	19.7	248,734	1,435	11.4	459	5,089	11.1	49	542	43
A-50-80-Bach-0.03	19.7	249,665	1,442	11.4	460	5,152	11.2	48	543	43
A-55-80-30-15	**15.7**	**250,071**	**1,209**	**10.0**	**400**	**5,078**	**12.7**	**49**	**625**	**39**
A-55-80-MPLCOm2012-0.017	18.6	257,599	1,439	11.5	462	5,266	11.4	49	558	40
A-55-80-Bach-0.029	20.2	258,471	1,457	11.7	469	5,239	11.2	49	551	43
B-50-80-MPLCOm2012-0.008	28.0	258,855	1,466	10.7	431	5,397	12.5	48	601	65
A-50-80-MLCDRAT-0.018	20.0	259,222	1,449	11.6	467	5,184	11.1	50	555	43
A-55-80-MLCDRAT-0.018	20.0	259,229	1,451	11.6	467	5,182	11.1	50	555	43
A-50-80-Bach-0.029	20.2	259,707	1,465	11.7	469	5,270	11.2	49	554	43
B-50-80-Bach-0.014	29.7	259,722	1,486	10.8	433	5,332	12.3	49	600	69
A-50-80-MPLCOm2012-0.017	18.6	260,376	1,449	11.6	467	5,366	11.5	49	558	40
A-55-80-Bach-0.028	20.7	269,770	1,481	11.9	477	5,348	11.2	50	566	43
A-50-80-Bach-0.028	20.7	271,389	1,488	12.0	482	5,405	11.2	50	563	43
A-55-80-MPLCOm2012-0.016	19.3	272,384	1,470	11.8	475	5,427	11.4	50	573	41
B-50-80-Bach-0.013	30.6	272,403	1,507	10.9	438	5,417	12.4	50	622	70
A-50-80-MPLCOm2012-0.016	19.3	276,601	1,485	12.1	485	5,637	11.6	49	570	40
A-50-80-MLCDRAT-0.017	20.7	277,443	1,488	12.0	482	5,412	11.2	51	576	43
A-55-80-Bach-0.027	21.2	280,992	1,505	12.1	488	5,486	11.2	51	576	43
A-50-80-Bach-0.027	21.3	283,167	1,516	12.1	488	5,552	11.4	51	580	44
B-50-80-MPLCOm2012-0.007	29.7	283,776	1,505	11.0	444	5,619	12.7	51	639	67
B-50-80-Bach-0.012	31.5	285,918	1,538	11.2	448	5,560	12.4	51	638	70
A-55-80-MPLCOm2012-0.015	20.0	288,785	1,501	12.2	489	5,645	11.5	51	591	41
A-50-80-MLCDRAT-0.016	21.3	291,376	1,518	12.3	494	5,614	11.4	52	590	43
A-55-80-Bach-0.026	21.8	292,283	1,530	12.4	498	5,617	11.3	52	587	44
A-50-80-Bach-0.026	21.8	294,924	1,537	12.4	498	5,663	11.4	52	592	44
A-50-80-MPLCOm2012-0.015	20.1	294,962	1,520	12.4	498	5,826	11.7	51	592	40
A-50-77-MPLCOm2012-0.013	20.8	299,824	1,357	11.3	453	5,876	13.0	51	662	46
B-50-80-Bach-0.011	32.6	301,272	1,557	11.4	458	5,734	12.5	53	658	71
A-55-80-Bach-0.025	22.4	304,744	1,554	12.5	504	5,698	11.3	53	605	44
A-55-80-MPLCOm2012-0.014	20.9	306,772	1,538	12.5	502	5,839	11.6	53	611	42

Appendix C Table 13. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-Bach-0.025	22.4	308,347	1,564	12.6	507	5,820	11.5	53	608	44
B-50-80-MPLCOm2012-0.006	31.5	310,648	1,547	11.4	456	5,814	12.8	53	681	69
A-50-80-MLCDRAT-0.015	22.1	311,463	1,561	12.6	507	5,798	11.4	54	614	44
A-50-80-MPLCOm2012-0.014	21.0	315,485	1,559	12.8	514	6,089	11.8	52	614	41
B-50-80-Bach-0.01	33.7	317,492	1,583	11.6	465	5,851	12.6	54	683	72
A-55-80-Bach-0.024	22.9	317,493	1,578	12.9	517	5,871	11.4	54	614	44
A-50-80-Bach-0.024	23.0	321,715	1,591	13.0	522	6,024	11.5	53	616	44
A-50-77-MPLCOm2012-0.012	21.8	323,796	1,394	11.7	468	6,118	13.1	53	692	47
A-55-80-MPLCOm2012-0.013	21.7	325,898	1,571	12.8	515	6,041	11.7	54	633	42
A-55-80-MLCDRAT-0.014	22.9	326,637	1,582	12.9	518	5,915	11.4	55	631	44
A-55-80-Bach-0.023	23.5	329,902	1,603	13.1	525	6,003	11.4	55	628	45
A-50-80-MLCDRAT-0.014	23.0	331,138	1,593	13.0	523	6,030	11.5	55	633	44
B-50-80-Bach-0.009	34.9	335,044	1,612	11.9	479	6,090	12.7	55	699	73
A-50-80-Bach-0.023	23.6	335,415	1,618	13.2	529	6,145	11.6	55	634	45
A-50-80-MPLCOm2012-0.013	21.9	337,953	1,597	13.0	523	6,272	12.0	54	646	42
A-55-80-20-15	**21.8**	**338,814**	**1,415**	**11.8**	**475**	**6,022**	**12.7**	**56**	**713**	**46**
B-50-80-MPLCOm2012-0.005	33.6	341,618	1,587	11.7	471	6,084	12.9	56	725	71
A-55-80-Bach-0.022	24.0	343,709	1,621	13.3	534	6,117	11.5	56	644	45
A-55-80-MLCDRAT-0.013	23.8	344,246	1,619	13.3	534	6,128	11.5	56	645	45
A-55-80-MPLCOm2012-0.012	22.7	347,253	1,604	13.1	525	6,223	11.9	56	661	43
A-50-80-Bach-0.022	24.1	350,428	1,639	13.5	541	6,331	11.7	55	648	45
A-50-77-MPLCOm2012-0.011	22.9	350,473	1,428	12.0	480	6,343	13.2	55	730	48
A-50-80-MLCDRAT-0.013	23.8	351,020	1,633	13.4	538	6,273	11.7	56	652	44
A-55-80-Bach-0.021	24.7	357,845	1,649	13.5	544	6,279	11.5	57	658	45
A-50-80-MPLCOm2012-0.012	22.9	363,819	1,640	13.4	540	6,542	12.1	56	674	42
A-50-80-Bach-0.021	24.8	366,256	1,668	13.7	548	6,453	11.8	57	668	45
A-55-80-MLCDRAT-0.012	24.9	367,142	1,648	13.5	543	6,291	11.6	58	676	46
A-55-80-MPLCOm2012-0.011	23.8	368,985	1,639	13.5	541	6,414	11.9	58	682	44
A-55-80-Bach-0.02	25.3	372,015	1,667	13.7	549	6,382	11.6	58	678	46
A-50-80-MLCDRAT-0.012	25.0	376,831	1,669	13.7	551	6,489	11.8	58	684	45
A-50-77-MPLCOm2012-0.01	24.1	380,379	1,468	12.5	500	6,660	13.3	57	761	48
A-55-80-20-20	**23.5**	**380,919**	**1,502**	**12.6**	**505**	**6,396**	**12.7**	**60**	**754**	**47**
A-50-80-Bach-0.02	25.4	382,555	1,695	14.0	561	6,640	11.8	58	682	45
A-55-80-Bach-0.019	25.9	387,182	1,691	13.9	558	6,489	11.6	60	694	46
A-55-80-MLCDRAT-0.011	26.6	391,357	1,691	14.0	560	6,543	11.7	60	699	48
A-50-80-MPLCOm2012-0.011	24.0	392,507	1,680	13.9	557	6,813	12.2	58	705	43
A-55-80-MPLCOm2012-0.01	24.9	392,619	1,675	13.8	555	6,599	11.9	59	707	45
A-50-80-Bach-0.019	26.1	399,519	1,714	14.1	565	6,745	11.9	59	707	46

Appendix C Table 13. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-55-80-Bach-0.018	26.6	402,967	1,712	14.1	564	6,621	11.7	61	714	47
A-50-80-MLCDRAT-0.011	26.7	403,985	1,718	14.2	570	6,794	11.9	59	709	47
A-50-80-Bach-0.018	26.7	418,219	1,742	14.4	576	6,951	12.1	60	726	46
A-55-80-Bach-0.017	27.2	419,571	1,739	14.4	576	6,799	11.8	62	728	47
A-55-80-20-25	**24.4**	**419,641**	**1,572**	**13.1**	**526**	**6,664**	**12.7**	**63**	**798**	**46**
A-55-80-MLCDRAT-0.01	29.0	420,681	1,736	14.3	573	6,718	11.7	63	734	51
A-50-80-MPLCOm2012-0.01	25.3	424,646	1,718	14.3	572	7,082	12.4	60	742	44
A-55-80-Bach-0.016	28.0	436,416	1,758	14.6	585	6,938	11.9	63	746	48
A-50-80-MLCDRAT-0.01	29.2	437,146	1,763	14.6	585	7,060	12.1	62	747	50
A-50-80-20-15	**24.4**	**438,248**	**1,497**	**12.8**	**513**	**7,031**	**13.7**	**62**	**854**	**48**
A-50-80-Bach-0.017	27.5	438,368	1,766	14.6	587	7,103	12.1	62	747	47
A-55-80-MPLCOm2012-0.008	27.6	450,041	1,748	14.5	583	7,015	12.0	64	772	47
A-55-80-Bach-0.015	28.7	454,682	1,778	14.8	592	7,053	11.9	64	768	48
A-55-80-MLCDRAT-0.009	31.7	455,814	1,791	14.7	591	6,971	11.8	65	771	54
A-50-80-Bach-0.016	28.2	459,189	1,792	14.9	599	7,278	12.2	63	767	47
A-50-80-MPLCOm2012-0.009	26.6	461,261	1,763	14.7	590	7,435	12.6	62	782	45
A-55-80-Bach-0.014	29.5	473,162	1,802	15.0	600	7,171	12.0	66	789	49
A-50-80-MLCDRAT-0.009	31.9	477,198	1,821	15.1	605	7,322	12.1	65	789	53
A-50-80-Bach-0.015	29.0	481,441	1,819	15.2	610	7,477	12.3	64	789	48
A-50-80-20-20	**25.3**	**486,445**	**1,584**	**13.5**	**542**	**7,397**	**13.6**	**66**	**898**	**47**
A-55-80-Bach-0.013	30.3	493,124	1,820	15.1	607	7,300	12.0	68	812	50
A-55-80-MLCDRAT-0.008	34.6	493,984	1,836	15.2	609	7,214	11.8	68	811	57
A-50-80-MPLCOm2012-0.008	28.1	503,446	1,808	15.2	608	7,666	12.6	66	828	46
A-50-80-Bach-0.014	29.8	504,514	1,844	15.5	620	7,645	12.3	66	814	48
A-55-80-Bach-0.012	31.2	513,666	1,846	15.3	615	7,431	12.1	69	835	51
A-50-80-MLCDRAT-0.008	34.9	523,694	1,881	15.7	628	7,668	12.2	68	834	56
A-50-80-20-25	**25.6**	**527,801**	**1,657**	**14.1**	**565**	**7,696**	**13.6**	**69**	**934**	**45**
A-50-80-Bach-0.013	30.7	529,448	1,869	15.7	630	7,800	12.4	68	840	49
A-55-80-Bach-0.011	32.2	536,628	1,870	15.6	627	7,564	12.1	71	856	51
A-55-80-MLCDRAT-0.007	37.4	540,710	1,892	15.8	632	7,554	12.0	72	856	59
A-50-80-MPLCOm2012-0.007	29.7	550,625	1,854	15.6	626	8,004	12.8	69	880	47
A-50-80-Bach-0.012	31.6	555,908	1,897	15.9	636	7,966	12.5	70	874	50
A-55-80-Bach-0.01	33.2	560,821	1,892	15.9	637	7,716	12.1	73	880	52
A-50-80-MLCDRAT-0.007	37.8	579,320	1,942	16.3	652	8,064	12.4	72	889	58
A-50-80-Bach-0.011	32.7	585,729	1,922	16.2	649	8,180	12.6	72	903	50
A-55-80-MLCDRAT-0.006	40.0	596,266	1,947	16.4	656	7,843	12.0	76	909	61
A-50-80-MPLCOm2012-0.006	31.6	602,353	1,895	16.0	641	8,249	12.9	73	940	49
A-50-80-Bach-0.01	33.8	617,099	1,950	16.5	662	8,378	12.7	74	932	51

Appendix C Table 13. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs.
Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.
Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 14. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-50-80-Bach-0.025	159,773	177,817	7.2	1.0	541	76	1.5	6.1	10.3
B-50-80-MLCDRAT-0.015	161,822	179,943	7.4	1.0	542	78	1.5	6.2	10.7
B-50-80-MPLCOm2012-0.014	162,809	180,756	7.8	1.1	539	75	1.5	6.0	11.1
B-55-80-Bach-0.024	162,817	181,009	7.2	1.0	540	76	1.5	6.1	10.7
B-50-80-Bach-0.024	166,596	185,070	7.3	1.0	554	78	1.5	6.1	11.0
B-55-80-MPLCOm2012-0.013	166,735	184,962	7.7	1.1	540	72	1.4	5.8	11.6
B-50-80-MLCDRAT-0.014	170,783	189,472	7.5	1.1	556	78	1.5	6.1	11.4
B-50-80-Bach-0.023	173,502	192,402	7.4	1.0	566	78	1.5	6.0	11.7
B-50-80-MPLCOm2012-0.013	174,275	192,952	8.0	1.1	558	75	1.5	5.9	12.2
B-50-80-Bach-0.022	181,151	200,524	7.5	1.1	578	79	1.5	6.0	11.8
B-55-80-Bach-0.021	183,290	202,795	7.5	1.1	574	77	1.5	5.9	12.3
B-50-80-MPLCOm2012-0.012	187,331	206,816	8.2	1.1	581	77	1.5	5.8	12.7
A-55-80-MPLCOm2012-0.023	187,833	206,087	12.4	1.5	543	83	1.6	6.6	10.6
A-50-80-MPLCOm2012-0.023	187,903	206,149	12.4	1.5	544	84	1.6	6.7	10.6
B-50-80-Bach-0.021	189,239	209,132	7.7	1.1	591	80	1.6	6.0	13.0
B-55-80-Bach-0.02	190,476	210,430	7.6	1.1	586	77	1.5	5.8	13.0
A-55-80-MPLCOm2012-0.022	197,533	216,343	12.7	1.5	559	85	1.7	6.6	11.1
B-50-80-Bach-0.02	197,676	218,094	7.8	1.1	604	80	1.6	5.9	13.7
A-50-80-MPLCOm2012-0.022	197,695	216,505	12.7	1.5	559	85	1.7	6.6	11.1
B-55-80-Bach-0.019	198,153	218,611	7.7	1.1	598	78	1.5	5.8	13.3
A-55-80-MLCDRAT-0.023	198,541	217,591	11.8	1.4	561	90	1.8	7.0	10.3
B-50-80-MPLCOm2012-0.011	202,477	222,890	8.4	1.2	605	78	1.5	5.8	14.4
B-50-80-Bach-0.019	206,172	227,110	7.9	1.1	618	80	1.6	5.8	14.2
A-55-80-MPLCOm2012-0.021	207,708	227,097	12.9	1.5	575	87	1.7	6.6	12.4
A-50-80-MPLCOm2012-0.021	208,036	227,444	12.9	1.6	577	88	1.7	6.7	12.4
A-55-80-Bach-0.034	210,852	230,654	11.8	1.4	586	91	1.8	6.8	12.4
A-50-80-Bach-0.034	211,124	230,939	11.9	1.4	587	91	1.8	6.8	12.4
B-50-80-Bach-0.018	215,660	237,177	8.1	1.1	630	81	1.6	5.8	15.0
B-50-80-MPLCOm2012-0.01	218,734	240,164	8.7	1.2	629	79	1.6	5.7	15.2
A-55-80-MPLCOm2012-0.02	218,788	238,809	13.1	1.6	593	88	1.7	6.5	13.2
A-50-80-MPLCOm2012-0.02	219,385	239,424	13.1	1.6	593	89	1.7	6.6	13.3
A-55-80-Bach-0.033	219,722	240,035	12.1	1.5	600	92	1.8	6.8	12.9
A-50-80-Bach-0.033	220,098	240,422	12.1	1.5	600	93	1.8	6.8	13.0
A-55-80-Bach-0.032	229,326	250,179	12.3	1.5	615	93	1.8	6.7	13.5
A-50-80-Bach-0.032	229,844	250,737	12.3	1.5	616	93	1.8	6.7	13.6
A-55-80-MPLCOm2012-0.019	230,831	251,544	13.3	1.6	611	90	1.8	6.5	13.9
A-50-80-MPLCOm2012-0.019	231,879	252,644	13.4	1.6	613	91	1.8	6.6	14.0

Appendix C Table 14. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-MLCDRAT-0.02	232,308	253,318	12.4	1.5	617	95	1.9	6.9	12.6
B-50-80-Bach-0.016	236,644	259,440	8.4	1.2	664	83	1.6	5.7	16.7
B-50-80-MPLCOm2012-0.009	237,535	260,113	9.0	1.2	655	80	1.6	5.6	16.8
A-55-80-Bach-0.031	238,433	259,818	12.4	1.5	629	94	1.8	6.7	14.3
A-50-80-Bach-0.031	239,121	260,536	12.5	1.5	629	94	1.8	6.7	14.4
A-55-80-MPLCOm2012-0.018	243,611	265,042	13.6	1.6	629	93	1.8	6.6	14.6
A-50-80-MPLCOm2012-0.018	245,376	266,914	13.7	1.6	634	94	1.8	6.6	14.6
A-50-80-MLCDRAT-0.019	247,829	269,732	12.7	1.5	639	95	1.9	6.7	13.9
A-55-80-Bach-0.03	248,734	270,709	12.6	1.5	644	96	1.9	6.7	15.0
A-50-80-Bach-0.03	249,665	271,690	12.7	1.5	647	98	1.9	6.8	15.0
A-55-80-30-15	**250,071**	**271,454**	**15.9**	**1.9**	**569**	**74**	**1.4**	**6.1**	**19.2**
A-55-80-MPLCOm2012-0.017	257,599	279,846	13.8	1.7	649	94	1.8	6.5	15.8
A-55-80-Bach-0.029	258,471	281,008	12.8	1.5	658	97	1.9	6.7	15.5
B-50-80-MPLCOm2012-0.008	258,855	282,714	9.2	1.3	685	83	1.6	5.7	18.4
A-50-80-MLCDRAT-0.018	259,222	281,781	13.0	1.6	655	97	1.9	6.7	14.6
A-55-80-MLCDRAT-0.018	259,229	281,781	13.0	1.6	656	96	1.9	6.6	14.6
A-50-80-Bach-0.029	259,707	282,302	12.9	1.5	661	99	1.9	6.8	15.6
B-50-80-Bach-0.014	259,722	283,917	8.7	1.2	694	85	1.7	5.7	18.0
A-50-80-MPLCOm2012-0.017	260,376	282,753	14.0	1.7	654	96	1.9	6.6	16.1
A-55-80-Bach-0.028	269,770	292,932	13.0	1.6	673	99	1.9	6.7	16.0
A-50-80-Bach-0.028	271,389	294,655	13.1	1.6	676	100	2.0	6.7	16.0
A-55-80-MPLCOm2012-0.016	272,384	295,471	14.1	1.7	669	97	1.9	6.6	16.9
B-50-80-Bach-0.013	272,403	297,367	8.9	1.2	710	85	1.7	5.6	18.6
A-50-80-MPLCOm2012-0.016	276,601	299,891	14.3	1.7	676	98	1.9	6.6	17.5
A-50-80-MLCDRAT-0.017	277,443	301,020	13.4	1.6	680	99	1.9	6.7	15.9
A-55-80-Bach-0.027	280,992	304,828	13.3	1.6	688	100	2.0	6.6	16.8
A-50-80-Bach-0.027	283,167	307,107	13.3	1.6	693	102	2.0	6.7	16.9
B-50-80-MPLCOm2012-0.007	283,776	309,157	9.6	1.3	717	85	1.7	5.6	19.6
B-50-80-Bach-0.012	285,918	311,687	9.1	1.2	731	87	1.7	5.7	19.5
A-55-80-MPLCOm2012-0.015	288,785	312,806	14.4	1.7	690	97	1.9	6.5	17.8
A-50-80-MLCDRAT-0.016	291,376	315,736	13.7	1.6	699	100	2.0	6.6	17.0
A-55-80-Bach-0.026	292,283	316,751	13.4	1.6	704	101	2.0	6.6	17.5
A-50-80-Bach-0.026	294,924	319,534	13.5	1.6	708	102	2.0	6.6	17.5
A-50-80-MPLCOm2012-0.015	294,962	319,290	14.7	1.7	700	98	1.9	6.4	18.5
A-50-77-MPLCOm2012-0.013	299,824	324,503	14.4	1.7	655	76	1.5	5.6	20.0
B-50-80-Bach-0.011	301,272	327,971	9.2	1.3	749	89	1.7	5.7	20.4
A-55-80-Bach-0.025	304,744	329,910	13.6	1.6	720	102	2.0	6.6	18.2
A-55-80-MPLCOm2012-0.014	306,772	331,792	14.7	1.7	714	98	1.9	6.4	18.6

Appendix C Table 14. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-Bach-0.025	308,347	333,700	13.8	1.6	726	103	2.0	6.6	18.5
B-50-80-MPLCOm2012-0.006	310,648	337,686	9.9	1.3	751	89	1.7	5.8	21.1
A-50-80-MLCDRAT-0.015	311,463	336,952	14.1	1.7	727	103	2.0	6.6	17.8
A-50-80-MPLCOm2012-0.014	315,485	340,961	15.0	1.8	727	99	1.9	6.4	19.6
B-50-80-Bach-0.01	317,492	345,173	9.4	1.3	770	90	1.8	5.7	21.1
A-55-80-Bach-0.024	317,493	343,389	13.9	1.6	736	103	2.0	6.5	18.6
A-50-80-Bach-0.024	321,715	347,798	14.0	1.7	743	104	2.0	6.5	18.9
A-50-77-MPLCOm2012-0.012	323,796	349,800	14.9	1.8	683	76	1.5	5.5	22.3
A-55-80-MPLCOm2012-0.013	325,898	352,028	15.0	1.8	738	100	2.0	6.4	19.7
A-55-80-MLCDRAT-0.014	326,637	353,017	14.3	1.7	744	103	2.0	6.5	19.0
A-55-80-Bach-0.023	329,902	356,492	14.0	1.7	753	104	2.0	6.5	19.2
A-50-80-MLCDRAT-0.014	331,138	357,743	14.4	1.7	750	104	2.0	6.5	19.2
B-50-80-Bach-0.009	335,044	363,803	9.6	1.3	793	91	1.8	5.6	22.1
A-50-80-Bach-0.023	335,415	362,284	14.2	1.7	761	105	2.1	6.5	19.7
A-50-80-MPLCOm2012-0.013	337,953	364,676	15.4	1.8	754	102	2.0	6.4	20.9
A-55-80-20-15	**338,814**	**365,553**	**15.5**	**1.9**	**701**	**85**	**1.7**	**6.0**	**25.5**
B-50-80-MPLCOm2012-0.005	341,618	370,499	10.2	1.4	788	89	1.7	5.6	22.4
A-55-80-Bach-0.022	343,709	371,077	14.3	1.7	768	105	2.0	6.5	20.1
A-55-80-MLCDRAT-0.013	344,246	371,602	14.5	1.7	768	104	2.0	6.4	19.6
A-55-80-MPLCOm2012-0.012	347,253	374,586	15.3	1.8	763	101	2.0	6.3	21.2
A-50-80-Bach-0.022	350,428	378,144	14.5	1.7	778	106	2.1	6.5	20.8
A-50-77-MPLCOm2012-0.011	350,473	377,955	15.3	1.8	712	78	1.5	5.5	24.0
A-50-80-MLCDRAT-0.013	351,020	378,721	14.7	1.7	777	105	2.1	6.4	20.2
A-55-80-Bach-0.021	357,845	386,027	14.5	1.7	787	107	2.1	6.5	20.7
A-50-80-MPLCOm2012-0.012	363,819	391,987	15.9	1.9	785	103	2.0	6.3	23.2
A-50-80-Bach-0.021	366,256	394,849	14.8	1.7	798	107	2.1	6.4	21.8
A-55-80-MLCDRAT-0.012	367,142	395,803	14.7	1.7	792	106	2.1	6.4	20.8
A-55-80-MPLCOm2012-0.011	368,985	397,533	15.5	1.8	789	103	2.0	6.3	22.3
A-55-80-Bach-0.02	372,015	400,988	14.7	1.7	802	108	2.1	6.5	21.4
A-50-80-MLCDRAT-0.012	376,831	406,001	15.1	1.8	805	106	2.1	6.4	21.9
A-50-77-MPLCOm2012-0.01	380,379	409,508	15.8	1.9	745	80	1.6	5.4	26.2
A-55-80-20-20	**380,919**	**409,986**	**16.2**	**1.9**	**757**	**92**	**1.8**	**6.1**	**27.0**
A-50-80-Bach-0.02	382,555	412,078	15.1	1.8	818	109	2.1	6.4	22.4
A-55-80-Bach-0.019	387,182	417,016	14.9	1.8	820	109	2.1	6.4	22.4
A-55-80-MLCDRAT-0.011	391,357	421,465	14.7	1.7	823	107	2.1	6.3	21.7
A-50-80-MPLCOm2012-0.011	392,507	422,240	16.4	1.9	817	105	2.0	6.2	25.0
A-55-80-MPLCOm2012-0.01	392,619	422,531	15.8	1.8	817	106	2.1	6.3	23.7
A-50-80-Bach-0.019	399,519	429,959	15.3	1.8	835	110	2.1	6.4	23.5

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Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-Bach-0.018	402,967	433,679	15.1	1.8	837	109	2.1	6.4	23.4
A-50-80-MLCDRAT-0.011	403,985	434,727	15.1	1.8	840	108	2.1	6.3	23.0
A-50-80-Bach-0.018	418,219	449,707	15.7	1.8	857	111	2.2	6.4	25.0
A-55-80-Bach-0.017	419,571	451,223	15.4	1.8	857	110	2.2	6.3	25.0
A-55-80-20-25	**419,641**	**450,762**	**17.2**	**2.0**	**804**	**96**	**1.9**	**6.1**	**28.0**
A-55-80-MLCDRAT-0.01	420,681	452,612	14.5	1.7	859	110	2.1	6.3	23.3
A-50-80-MPLCOm2012-0.01	424,646	456,160	16.8	2.0	851	108	2.1	6.3	27.2
A-55-80-Bach-0.016	436,416	468,989	15.6	1.8	875	111	2.2	6.3	26.0
A-50-80-MLCDRAT-0.01	437,146	469,895	15.0	1.8	878	109	2.1	6.2	25.4
A-50-80-20-15	**438,248**	**470,133**	**18.0**	**2.1**	**796**	**87**	**1.7**	**5.8**	**34.8**
A-50-80-Bach-0.017	438,368	470,946	15.9	1.9	878	112	2.2	6.3	27.3
A-55-80-MPLCOm2012-0.008	450,041	483,185	16.3	1.9	879	110	2.1	6.3	26.0
A-55-80-Bach-0.015	454,682	488,283	15.8	1.9	894	112	2.2	6.3	26.6
A-55-80-MLCDRAT-0.009	455,814	489,876	14.4	1.7	902	113	2.2	6.3	26.5
A-50-80-Bach-0.016	459,189	492,919	16.3	1.9	901	114	2.2	6.4	28.7
A-50-80-MPLCOm2012-0.009	461,261	494,773	17.3	2.0	890	108	2.1	6.1	29.0
A-55-80-Bach-0.014	473,162	507,797	16.0	1.9	913	112	2.2	6.2	27.5
A-50-80-MLCDRAT-0.009	477,198	512,305	15.0	1.8	925	113	2.2	6.2	29.1
A-50-80-Bach-0.015	481,441	516,395	16.6	1.9	924	113	2.2	6.2	29.8
A-50-80-20-20	**486,445**	**520,898**	**19.2**	**2.3**	**854**	**92**	**1.8**	**5.8**	**36.6**
A-55-80-Bach-0.013	493,124	528,833	16.3	1.9	932	113	2.2	6.2	28.9
A-55-80-MLCDRAT-0.008	493,984	530,349	14.3	1.7	944	115	2.3	6.3	27.8
A-50-80-MPLCOm2012-0.008	503,446	539,247	17.9	2.1	933	112	2.2	6.2	31.9
A-50-80-Bach-0.014	504,514	540,717	16.9	2.0	947	114	2.2	6.2	30.7
A-55-80-Bach-0.012	513,666	550,548	16.5	1.9	954	115	2.2	6.2	29.9
A-50-80-MLCDRAT-0.008	523,694	561,540	15.0	1.8	977	117	2.3	6.2	31.1
A-50-80-20-25	**527,801**	**564,345**	**20.6**	**2.4**	**902**	**97**	**1.9**	**5.9**	**38.3**
A-50-80-Bach-0.013	529,448	567,018	17.2	2.0	972	115	2.3	6.2	32.7
A-55-80-Bach-0.011	536,628	574,791	16.7	1.9	978	116	2.3	6.2	30.7
A-55-80-MLCDRAT-0.007	540,710	579,802	14.5	1.7	995	118	2.3	6.2	29.8
A-50-80-MPLCOm2012-0.007	550,625	589,036	18.5	2.1	979	113	2.2	6.1	34.5
A-50-80-Bach-0.012	555,908	594,910	17.6	2.0	998	116	2.3	6.1	34.6
A-55-80-Bach-0.01	560,821	600,336	16.9	2.0	1,001	117	2.3	6.2	31.8
A-50-80-MLCDRAT-0.007	579,320	620,339	15.3	1.8	1,036	119	2.3	6.1	34.0
A-50-80-Bach-0.011	585,729	626,353	17.9	2.1	1,027	118	2.3	6.1	36.1
A-55-80-MLCDRAT-0.006	596,266	638,485	14.9	1.8	1,050	121	2.4	6.2	32.0
A-50-80-MPLCOm2012-0.006	602,353	643,586	19.1	2.2	1,027	115	2.3	6.1	37.1
A-50-80-Bach-0.01	617,099	659,415	18.3	2.1	1,056	120	2.4	6.2	37.6

Appendix C Table 14. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Men

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs. [†]Average of two models (MGH-HMS and University of Michigan).
Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.
Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 15. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
B-50-80-MLCDRAT-0.015	19.4	134,898	1,095	9.2	342	3,817	11.2	35	394	57
B-50-80-Bach-0.025	20.9	141,428	1,140	9.5	356	3,977	11.2	36	397	59
B-50-80-MPLCOm2012-0.014	18.6	143,839	1,128	9.5	355	4,127	11.6	35	405	52
B-55-80-Bach-0.024	21.3	145,782	1,135	9.5	355	4,034	11.4	36	411	60
B-50-80-MLCDRAT-0.014	20.4	146,532	1,139	9.7	361	4,078	11.3	36	406	57
B-50-80-Bach-0.024	21.5	148,445	1,165	9.7	364	4,111	11.3	36	408	59
B-55-80-MPLCOm2012-0.013	19.3	149,511	1,122	9.5	355	4,179	11.8	36	421	54
B-50-80-MPLCOm2012-0.013	19.4	154,244	1,159	9.9	369	4,337	11.8	36	418	53
B-50-80-Bach-0.023	22.1	155,703	1,187	10.0	373	4,238	11.4	37	417	59
A-55-80-MLCDRAT-0.023	14.4	160,079	1,071	10.0	372	3,881	10.4	41	430	39
A-55-80-MPLCOm2012-0.023	13.5	161,887	1,097	10.2	379	4,027	10.6	40	427	36
A-50-80-MPLCOm2012-0.023	13.5	161,919	1,094	10.2	379	4,065	10.7	40	427	36
B-50-80-Bach-0.022	22.6	162,947	1,205	10.2	380	4,355	11.5	37	429	59
B-50-80-MPLCOm2012-0.012	20.3	166,180	1,188	10.2	380	4,531	11.9	37	437	53
B-55-80-Bach-0.021	23.1	167,330	1,190	10.1	378	4,378	11.6	38	443	61
A-55-80-MPLCOm2012-0.022	13.9	170,819	1,122	10.5	392	4,213	10.7	41	436	35
A-50-80-MPLCOm2012-0.022	13.9	170,873	1,122	10.5	391	4,231	10.8	40	437	36
B-50-80-Bach-0.021	23.2	170,970	1,224	10.3	386	4,472	11.6	38	443	60
B-55-80-Bach-0.02	23.7	175,191	1,210	10.3	385	4,481	11.6	39	455	62
A-55-80-Bach-0.034	16.4	177,346	1,158	10.6	396	4,205	10.6	42	448	41
A-50-80-Bach-0.034	16.4	177,398	1,156	10.6	397	4,204	10.6	42	447	41
B-50-80-Bach-0.02	23.8	179,470	1,245	10.6	398	4,627	11.6	39	451	60
A-55-80-MPLCOm2012-0.021	14.4	180,223	1,149	10.8	403	4,399	10.9	41	447	36
B-50-80-MPLCOm2012-0.011	21.4	180,282	1,223	10.5	394	4,744	12.0	38	458	54
A-50-80-MPLCOm2012-0.021	14.4	180,349	1,149	10.8	402	4,363	10.9	41	449	36
B-55-80-Bach-0.019	24.3	183,071	1,227	10.4	390	4,541	11.6	40	469	62
A-55-80-Bach-0.033	16.8	186,164	1,182	11.0	409	4,353	10.6	43	455	41
A-50-80-Bach-0.033	16.8	186,235	1,181	11.0	409	4,349	10.6	43	455	41
B-50-80-Bach-0.019	24.4	188,246	1,268	10.9	406	4,753	11.7	40	464	60
A-50-80-MLCDRAT-0.02	16.1	188,813	1,160	10.9	406	4,331	10.7	44	465	40
A-55-80-MPLCOm2012-0.02	14.9	190,436	1,176	11.1	413	4,531	11.0	42	461	36
A-50-80-MPLCOm2012-0.02	14.9	190,654	1,177	11.0	411	4,541	11.0	42	464	36
A-55-80-Bach-0.032	17.3	195,037	1,205	11.3	420	4,466	10.6	44	464	41
A-50-80-Bach-0.032	17.3	195,135	1,207	11.2	418	4,459	10.7	44	467	41
B-50-80-MPLCOm2012-0.01	22.4	195,180	1,255	10.8	405	4,974	12.3	39	482	55
B-50-80-Bach-0.018	25.0	197,502	1,292	11.1	416	4,885	11.7	40	475	60
A-55-80-MPLCOm2012-0.019	15.4	201,751	1,206	11.5	427	4,707	11.0	43	472	36

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Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-MPLCOm2012-0.019	15.4	202,181	1,206	11.5	428	4,737	11.1	43	472	36
A-50-80-MLCDRAT-0.019	16.8	202,754	1,198	11.2	419	4,521	10.8	45	484	40
A-55-80-Bach-0.031	17.8	204,408	1,232	11.5	427	4,614	10.8	44	479	42
A-50-80-Bach-0.031	17.8	204,573	1,231	11.6	431	4,652	10.8	44	475	41
A-55-80-30-15	**12.4**	**204,815**	**995**	**9.7**	**362**	**4,685**	**12.9**	**44**	**566**	**34**
B-50-80-MPLCOm2012-0.009	23.6	212,574	1,289	11.2	418	5,154	12.3	41	509	56
A-55-80-MLCDRAT-0.018	17.3	213,736	1,229	11.5	429	4,650	10.8	46	498	40
A-50-80-MLCDRAT-0.018	17.3	213,737	1,229	11.6	433	4,699	10.9	45	494	40
A-55-80-MPLCOm2012-0.018	16.0	213,742	1,232	11.8	438	4,873	11.1	44	488	37
A-55-80-Bach-0.03	18.3	214,301	1,259	11.8	441	4,784	10.8	45	486	41
A-50-80-MPLCOm2012-0.018	16.0	214,512	1,237	11.8	440	4,911	11.2	44	488	36
A-50-80-Bach-0.03	18.3	214,518	1,258	11.8	439	4,787	10.9	45	489	42
B-50-80-Bach-0.016	26.4	218,146	1,328	11.4	425	5,097	12.0	43	513	62
A-55-80-Bach-0.029	18.8	224,497	1,283	12.0	449	4,886	10.9	46	500	42
A-50-80-Bach-0.029	18.8	224,848	1,283	12.0	449	4,897	10.9	46	501	42
A-55-80-MPLCOm2012-0.017	16.6	227,059	1,265	12.0	449	5,060	11.3	45	506	37
A-50-80-MPLCOm2012-0.017	16.6	228,322	1,269	12.0	448	5,088	11.4	45	510	37
A-50-80-MLCDRAT-0.017	18.0	229,798	1,265	11.9	445	4,893	11.0	47	516	40
B-50-80-MPLCOm2012-0.008	25.0	232,698	1,331	11.6	433	5,417	12.5	43	537	58
A-55-80-Bach-0.028	19.3	235,410	1,311	12.3	459	5,051	11.0	47	513	42
A-50-80-Bach-0.028	19.3	235,837	1,309	12.3	459	5,046	11.0	47	514	42
B-50-80-Bach-0.014	27.9	241,059	1,374	11.8	442	5,383	12.2	45	545	63
A-55-80-MPLCOm2012-0.016	17.3	241,064	1,297	12.4	461	5,255	11.4	46	523	38
A-50-80-MPLCOm2012-0.016	17.3	243,063	1,303	12.5	465	5,366	11.5	45	523	37
A-50-80-MLCDRAT-0.016	18.6	243,477	1,300	12.4	461	5,097	11.1	48	528	40
A-55-80-Bach-0.027	19.9	246,980	1,336	12.6	469	5,170	11.0	48	527	42
A-50-80-Bach-0.027	19.9	247,655	1,333	12.5	468	5,154	11.0	48	529	43
B-50-80-Bach-0.013	28.7	253,866	1,395	12.1	453	5,579	12.3	46	560	63
B-50-80-MPLCOm2012-0.007	26.5	256,519	1,379	12.2	454	5,669	12.5	45	565	58
A-55-80-MPLCOm2012-0.015	17.9	256,832	1,328	12.7	473	5,422	11.5	47	543	38
A-55-80-Bach-0.026	20.4	258,376	1,358	12.9	480	5,309	11.1	49	538	42
A-50-80-Bach-0.026	20.5	259,208	1,357	12.9	480	5,327	11.1	49	540	43
A-50-80-MPLCOm2012-0.015	18.0	259,891	1,339	12.8	478	5,544	11.6	47	544	38
A-50-77-MPLCOm2012-0.013	18.5	260,403	1,163	11.5	429	5,548	12.9	47	607	43
A-50-80-MLCDRAT-0.015	19.5	260,844	1,340	12.7	474	5,326	11.2	49	550	41
B-50-80-Bach-0.012	29.6	268,148	1,415	12.4	463	5,717	12.3	47	579	64
A-55-80-Bach-0.025	21.0	271,125	1,385	13.0	486	5,446	11.2	50	558	43
A-50-80-Bach-0.025	21.0	272,333	1,386	13.1	489	5,494	11.2	50	557	43

Appendix C Table 15. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-55-80-MPLCOm2012-0.014	18.7	274,089	1,366	13.0	486	5,595	11.5	49	564	38
A-50-80-MPLCOm2012-0.014	18.7	278,533	1,372	13.2	492	5,761	11.7	48	566	38
A-55-80-MLCDRAT-0.014	20.5	279,935	1,378	13.1	491	5,528	11.3	51	570	42
A-50-80-MLCDRAT-0.014	20.5	281,138	1,382	13.2	492	5,585	11.4	50	571	42
A-50-77-MPLCOm2012-0.012	19.4	282,250	1,198	11.8	442	5,803	13.1	49	639	44
B-50-80-MPLCOm2012-0.006	28.3	282,713	1,418	12.5	467	5,920	12.7	48	605	61
B-50-80-Bach-0.011	30.5	282,984	1,441	12.6	472	5,866	12.4	48	600	65
A-55-80-Bach-0.024	21.6	284,191	1,411	13.3	497	5,599	11.3	51	572	43
A-50-80-Bach-0.024	21.6	285,840	1,413	13.3	498	5,655	11.4	51	574	43
A-55-80-MPLCOm2012-0.013	19.5	292,670	1,393	13.4	500	5,824	11.6	50	585	39
A-55-80-MLCDRAT-0.013	21.5	297,479	1,412	13.6	506	5,742	11.3	52	588	42
A-55-80-Bach-0.023	22.1	297,926	1,437	13.7	512	5,794	11.3	51	582	43
B-50-80-Bach-0.01	31.5	298,689	1,472	12.8	478	5,997	12.5	50	625	66
A-50-80-MPLCOm2012-0.013	19.5	299,050	1,406	13.5	506	6,000	11.9	50	591	39
A-50-80-MLCDRAT-0.013	21.5	299,330	1,414	13.6	507	5,793	11.4	52	590	42
A-50-80-Bach-0.023	22.2	299,941	1,442	13.7	512	5,852	11.4	51	586	43
A-50-77-MPLCOm2012-0.011	20.3	306,772	1,234	12.3	458	6,081	13.3	50	670	44
A-55-80-Bach-0.022	22.7	311,728	1,462	13.9	521	5,931	11.4	53	598	44
B-50-80-MPLCOm2012-0.005	30.3	312,927	1,458	12.9	484	6,215	12.8	50	647	63
A-55-80-MPLCOm2012-0.012	20.4	313,442	1,433	13.8	514	6,069	11.8	52	610	40
A-50-80-Bach-0.022	22.7	314,475	1,462	13.9	521	6,004	11.5	52	604	44
B-50-80-Bach-0.009	32.6	316,758	1,496	13.1	490	6,182	12.6	51	646	67
A-55-80-MLCDRAT-0.012	22.8	320,284	1,454	13.9	521	5,961	11.4	54	615	44
A-55-80-20-15	**19.3**	**321,376**	**1,253**	**12.4**	**463**	**6,014**	**13.0**	**53**	**694**	**42**
A-50-80-MPLCOm2012-0.012	20.4	322,767	1,447	14.0	524	6,276	12.0	51	616	39
A-50-80-MLCDRAT-0.012	22.8	323,741	1,460	14.0	524	6,054	11.6	53	618	44
A-55-80-Bach-0.021	23.3	326,829	1,483	14.2	532	6,115	11.5	53	614	44
A-50-80-Bach-0.021	23.3	330,309	1,487	14.3	535	6,226	11.6	53	617	44
A-50-77-MPLCOm2012-0.01	21.4	334,311	1,270	12.7	476	6,397	13.4	52	702	45
A-55-80-MPLCOm2012-0.011	21.4	335,019	1,465	14.2	530	6,282	11.9	53	632	40
A-55-80-Bach-0.02	23.9	342,391	1,506	14.5	542	6,255	11.5	55	632	44
A-55-80-MLCDRAT-0.011	24.3	346,694	1,499	14.4	537	6,226	11.6	56	646	45
A-50-80-Bach-0.02	23.9	346,979	1,511	14.7	549	6,451	11.8	54	632	44
A-50-80-MPLCOm2012-0.011	21.5	349,310	1,484	14.5	543	6,559	12.1	53	643	40
A-50-80-MLCDRAT-0.011	24.4	351,744	1,509	14.6	547	6,420	11.7	55	643	45
A-55-80-Bach-0.019	24.5	358,013	1,530	14.7	551	6,428	11.7	56	650	44
A-55-80-20-20	**20.4**	**358,302**	**1,345**	**13.2**	**495**	**6,363**	**12.9**	**56**	**724**	**41**
A-55-80-MPLCOm2012-0.01	22.4	358,348	1,497	14.5	541	6,438	11.9	56	662	41

Appendix C Table 15. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC deaths averted	NNS
A-50-80-Bach-0.019	24.5	364,037	1,534	14.8	554	6,560	11.8	55	657	44
A-55-80-Bach-0.018	25.1	375,520	1,553	15.0	561	6,557	11.7	57	669	45
A-55-80-MLCDRAT-0.01	26.5	375,679	1,546	14.8	555	6,493	11.7	58	677	48
A-50-80-MPLCOm2012-0.01	22.5	379,066	1,525	14.9	556	6,832	12.3	55	682	40
A-50-80-MLCDRAT-0.01	26.6	382,462	1,560	15.1	565	6,682	11.8	57	677	47
A-50-80-Bach-0.018	25.2	382,696	1,563	15.2	567	6,740	11.9	57	675	44
A-55-80-20-25	**20.9**	**389,551**	**1,413**	**13.9**	**520**	**6,645**	**12.8**	**59**	**749**	**40**
A-55-80-Bach-0.017	25.7	393,075	1,576	15.4	574	6,748	11.8	58	685	45
A-50-80-20-15	**20.9**	**399,813**	**1,305**	**13.2**	**492**	**6,805**	**13.8**	**59**	**813**	**42**
A-50-80-Bach-0.017	25.8	402,336	1,590	15.6	584	6,974	11.9	58	689	44
A-55-80-MLCDRAT-0.009	29.1	411,379	1,600	15.3	574	6,767	11.8	61	717	51
A-55-80-Bach-0.016	26.4	411,443	1,596	15.5	579	6,879	11.9	60	711	46
A-50-80-MPLCOm2012-0.009	23.7	413,285	1,567	15.3	574	7,148	12.5	58	720	41
A-55-80-MPLCOm2012-0.008	24.8	415,073	1,576	15.4	575	6,935	12.1	60	722	43
A-50-80-MLCDRAT-0.009	29.2	420,863	1,613	15.7	587	7,014	11.9	60	717	50
A-50-80-Bach-0.016	26.5	423,398	1,615	15.8	590	7,101	12.0	60	718	45
A-55-80-Bach-0.015	27.1	430,085	1,622	15.8	591	7,014	11.9	61	728	46
A-50-80-20-20	**21.4**	**440,469**	**1,391**	**14.1**	**526**	**7,205**	**13.7**	**61**	**837**	**41**
A-50-80-Bach-0.015	27.2	445,160	1,635	16.0	601	7,305	12.2	61	741	45
A-55-80-Bach-0.014	27.8	450,056	1,644	16.1	603	7,186	11.9	63	746	46
A-50-80-MPLCOm2012-0.008	25.1	453,251	1,612	15.9	594	7,461	12.6	61	763	42
A-55-80-MLCDRAT-0.008	32.1	454,135	1,662	16.1	602	7,081	11.8	64	754	53
A-50-80-MLCDRAT-0.008	32.2	467,154	1,677	16.3	611	7,349	12.0	64	765	53
A-50-80-Bach-0.014	28.0	468,455	1,660	16.4	612	7,520	12.3	62	765	46
A-55-80-Bach-0.013	28.6	471,061	1,667	16.4	613	7,361	12.0	64	768	47
A-50-80-20-25	**21.5**	**473,059**	**1,463**	**14.7**	**551**	**7,496**	**13.6**	**63**	**859**	**39**
A-50-80-Bach-0.013	28.8	493,477	1,687	16.7	624	7,692	12.3	64	791	46
A-55-80-Bach-0.012	29.5	494,075	1,690	16.6	620	7,503	12.1	66	797	48
A-50-80-MPLCOm2012-0.007	26.6	498,159	1,655	16.4	613	7,804	12.7	64	813	43
A-55-80-MLCDRAT-0.007	35.1	501,028	1,718	16.7	627	7,437	11.9	67	799	56
A-55-80-Bach-0.011	30.4	517,897	1,715	16.8	630	7,647	12.1	68	822	48
A-50-80-Bach-0.012	29.7	521,068	1,715	16.9	634	7,862	12.4	66	822	47
A-50-80-MLCDRAT-0.007	35.2	522,234	1,743	17.2	643	7,823	12.2	67	812	55
A-55-80-Bach-0.01	31.3	542,703	1,740	17.1	642	7,829	12.2	69	845	49
A-50-80-MPLCOm2012-0.006	28.3	548,639	1,700	16.8	629	8,080	12.8	68	872	45
A-50-80-Bach-0.011	30.6	550,280	1,746	17.3	647	8,132	12.6	68	851	47
A-55-80-MLCDRAT-0.006	38.0	558,573	1,783	17.5	654	7,817	12.0	71	854	58
A-50-80-Bach-0.01	31.6	581,188	1,773	17.7	663	8,395	12.7	69	877	48

Appendix C Table 15. Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs.

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 16. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-50-80-MLCDRAT-0.015	134,898	151,711	7.0	1.0	470	74	1.5	6.8	11.4
B-50-80-Bach-0.025	141,428	158,768	6.8	1.0	490	76	1.6	6.7	11.6
B-50-80-MPLCOm2012-0.014	143,839	160,954	7.7	1.1	485	72	1.5	6.4	12.6
B-55-80-Bach-0.024	145,782	163,326	6.8	1.0	491	71	1.5	6.3	12.3
B-50-80-MLCDRAT-0.014	146,532	164,104	7.2	1.0	493	76	1.6	6.7	12.7
B-50-80-Bach-0.024	148,445	166,232	6.9	1.0	504	76	1.6	6.5	12.6
B-55-80-MPLCOm2012-0.013	149,511	166,964	7.7	1.1	488	70	1.5	6.2	13.4
B-50-80-MPLCOm2012-0.013	154,244	172,003	8.0	1.1	503	74	1.5	6.4	14.5
B-50-80-Bach-0.023	155,703	173,936	7.0	1.0	516	78	1.6	6.6	12.9
A-55-80-MLCDRAT-0.023	160,079	177,286	11.1	1.4	465	78	1.6	7.3	11.5
A-55-80-MPLCOm2012-0.023	161,887	179,022	12.0	1.5	473	77	1.6	7.0	11.8
A-50-80-MPLCOm2012-0.023	161,919	179,054	12.0	1.5	472	76	1.6	6.9	11.9
B-50-80-Bach-0.022	162,947	181,642	7.2	1.0	528	79	1.6	6.6	13.7
B-50-80-MPLCOm2012-0.012	166,180	184,676	8.2	1.1	522	75	1.6	6.3	14.7
B-55-80-Bach-0.021	167,330	186,225	7.2	1.0	526	74	1.5	6.2	13.8
A-55-80-MPLCOm2012-0.022	170,819	188,449	12.3	1.5	487	79	1.6	7.0	13.0
A-50-80-MPLCOm2012-0.022	170,873	188,520	12.3	1.5	487	79	1.6	7.0	13.1
B-50-80-Bach-0.021	170,970	190,166	7.4	1.0	540	79	1.6	6.5	14.4
B-55-80-Bach-0.02	175,191	194,603	7.4	1.0	539	75	1.5	6.2	14.9
A-55-80-Bach-0.034	177,346	195,699	10.8	1.3	506	84	1.7	7.3	13.2
A-50-80-Bach-0.034	177,398	195,737	10.8	1.3	505	83	1.7	7.2	13.2
B-50-80-Bach-0.02	179,470	199,187	7.5	1.1	554	80	1.7	6.4	15.4
A-55-80-MPLCOm2012-0.021	180,223	198,413	12.5	1.5	502	81	1.7	7.0	14.0
B-50-80-MPLCOm2012-0.011	180,282	199,651	8.4	1.2	545	76	1.6	6.2	16.3
A-50-80-MPLCOm2012-0.021	180,349	198,537	12.5	1.5	502	81	1.7	7.0	14.1
B-55-80-Bach-0.019	183,071	202,948	7.5	1.1	551	76	1.6	6.2	15.7
A-55-80-Bach-0.033	186,164	205,023	11.1	1.4	520	84	1.7	7.1	14.1
A-50-80-Bach-0.033	186,235	205,095	11.1	1.4	519	84	1.7	7.1	14.1
B-50-80-Bach-0.019	188,246	208,514	7.7	1.1	568	81	1.7	6.4	16.3
A-50-80-MLCDRAT-0.02	188,813	207,708	11.7	1.4	513	83	1.7	7.2	14.1
A-55-80-MPLCOm2012-0.02	190,436	209,193	12.8	1.5	518	83	1.7	7.1	15.0
A-50-80-MPLCOm2012-0.02	190,654	209,417	12.8	1.5	518	82	1.7	7.0	15.1
A-55-80-Bach-0.032	195,037	214,409	11.3	1.4	533	86	1.8	7.1	14.6
A-50-80-Bach-0.032	195,135	214,505	11.3	1.4	534	85	1.7	7.0	14.6
B-50-80-MPLCOm2012-0.01	195,180	215,443	8.7	1.2	567	78	1.6	6.2	18.7
B-50-80-Bach-0.018	197,502	218,311	7.9	1.1	583	83	1.7	6.4	17.0
A-55-80-MPLCOm2012-0.019	201,751	221,166	13.1	1.6	535	84	1.7	7.0	16.3

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Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-MPLCOm2012-0.019	202,181	221,613	13.1	1.6	535	83	1.7	6.9	16.5
A-50-80-MLCDRAT-0.019	202,754	222,456	12.1	1.5	535	87	1.8	7.3	15.4
A-55-80-Bach-0.031	204,408	224,326	11.5	1.4	548	88	1.8	7.1	15.3
A-50-80-Bach-0.031	204,573	224,490	11.5	1.4	548	87	1.8	7.1	15.4
A-55-80-30-15	**204,815**	**223,834**	**16.5**	**2.0**	**467**	**64**	**1.3**	**6.4**	**22.0**
B-50-80-MPLCOm2012-0.009	212,574	233,902	9.0	1.2	591	79	1.6	6.1	20.2
A-55-80-MLCDRAT-0.018	213,736	234,055	12.4	1.5	553	88	1.8	7.2	16.6
A-50-80-MLCDRAT-0.018	213,737	234,074	12.4	1.5	553	88	1.8	7.2	16.6
A-55-80-MPLCOm2012-0.018	213,742	233,843	13.4	1.6	552	85	1.7	6.9	16.9
A-55-80-Bach-0.03	214,301	234,779	11.7	1.4	564	90	1.8	7.1	16.0
A-50-80-MPLCOm2012-0.018	214,512	234,651	13.4	1.6	554	86	1.8	7.0	17.3
A-50-80-Bach-0.03	214,518	235,010	11.7	1.4	564	88	1.8	7.0	16.2
B-50-80-Bach-0.016	218,146	240,223	8.3	1.1	610	84	1.7	6.3	19.8
A-55-80-Bach-0.029	224,497	245,573	11.9	1.5	579	91	1.9	7.1	16.9
A-50-80-Bach-0.029	224,848	245,938	12.0	1.5	579	89	1.8	6.9	17.1
A-55-80-MPLCOm2012-0.017	227,059	247,910	13.7	1.6	571	86	1.8	6.8	18.3
A-50-80-MPLCOm2012-0.017	228,322	249,238	13.8	1.6	574	88	1.8	6.9	18.6
A-50-80-MLCDRAT-0.017	229,798	251,041	12.8	1.5	575	90	1.9	7.1	18.1
B-50-80-MPLCOm2012-0.008	232,698	255,245	9.3	1.3	620	83	1.7	6.2	21.6
A-55-80-Bach-0.028	235,410	257,111	12.2	1.5	595	92	1.9	7.0	17.7
A-50-80-Bach-0.028	235,837	257,565	12.2	1.5	595	90	1.8	6.9	18.0
B-50-80-Bach-0.014	241,059	264,500	8.6	1.2	643	87	1.8	6.3	21.1
A-55-80-MPLCOm2012-0.016	241,064	262,706	13.9	1.7	591	87	1.8	6.7	19.6
A-50-80-MPLCOm2012-0.016	243,063	264,803	14.0	1.7	594	89	1.8	6.8	20.2
A-50-80-MLCDRAT-0.016	243,477	265,489	13.1	1.6	596	93	1.9	7.2	19.2
A-55-80-Bach-0.027	246,980	269,339	12.4	1.5	611	94	1.9	7.0	19.0
A-50-80-Bach-0.027	247,655	270,039	12.4	1.5	611	92	1.9	6.9	19.3
B-50-80-Bach-0.013	253,866	278,073	8.8	1.2	660	86	1.8	6.2	23.1
B-50-80-MPLCOm2012-0.007	256,519	280,518	9.7	1.3	654	86	1.8	6.2	24.2
A-55-80-MPLCOm2012-0.015	256,832	279,377	14.3	1.7	612	89	1.8	6.7	21.3
A-55-80-Bach-0.026	258,376	281,394	12.7	1.5	626	96	2.0	7.1	20.0
A-50-80-Bach-0.026	259,208	282,261	12.6	1.5	626	93	1.9	6.9	20.3
A-50-80-MPLCOm2012-0.015	259,891	282,583	14.4	1.7	617	90	1.9	6.7	21.9
A-50-77-MPLCOm2012-0.013	260,403	283,193	14.1	1.7	564	67	1.4	5.8	24.1
A-50-80-MLCDRAT-0.015	260,844	283,874	13.4	1.6	621	95	1.9	7.1	20.5
B-50-80-Bach-0.012	268,148	293,208	9.1	1.2	677	87	1.8	6.1	24.7
A-55-80-Bach-0.025	271,125	294,855	12.9	1.6	643	97	2.0	7.0	21.1
A-50-80-Bach-0.025	272,333	296,131	13.0	1.6	644	95	1.9	6.9	21.5

Appendix C Table 16. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-MPLCOm2012-0.014	274,089	297,615	14.7	1.7	636	91	1.9	6.7	22.3
A-50-80-MPLCOm2012-0.014	278,533	302,287	14.9	1.8	641	93	1.9	6.8	23.1
A-55-80-MLCDRAT-0.014	279,935	304,056	13.7	1.6	646	97	2.0	7.0	21.8
A-50-80-MLCDRAT-0.014	281,138	305,319	13.7	1.6	648	96	2.0	6.9	22.2
A-50-77-MPLCOm2012-0.012	282,250	306,270	14.5	1.8	591	70	1.4	5.8	25.9
B-50-80-MPLCOm2012-0.006	282,713	308,306	10.0	1.4	687	87	1.8	6.1	26.5
B-50-80-Bach-0.011	282,984	308,924	9.3	1.3	697	88	1.8	6.1	25.5
A-55-80-Bach-0.024	284,191	308,672	13.2	1.6	660	99	2.0	7.0	22.0
A-50-80-Bach-0.024	285,840	310,383	13.2	1.6	662	96	2.0	6.8	22.4
A-55-80-MPLCOm2012-0.013	292,670	317,231	15.0	1.8	657	92	1.9	6.6	24.0
A-55-80-MLCDRAT-0.013	297,479	322,614	13.8	1.7	669	99	2.0	7.0	23.0
A-55-80-Bach-0.023	297,926	323,169	13.5	1.6	678	100	2.1	7.0	22.8
B-50-80-Bach-0.01	298,689	325,572	9.5	1.3	719	91	1.9	6.2	27.7
A-50-80-MPLCOm2012-0.013	299,050	323,922	15.3	1.8	665	94	1.9	6.7	25.2
A-50-80-MLCDRAT-0.013	299,330	324,552	13.9	1.7	671	99	2.0	7.0	23.5
A-50-80-Bach-0.023	299,941	325,273	13.5	1.6	681	98	2.0	6.8	23.2
A-50-77-MPLCOm2012-0.011	306,772	332,150	15.1	1.8	619	71	1.5	5.8	28.1
A-55-80-Bach-0.022	311,728	337,749	13.7	1.6	696	101	2.1	6.9	24.4
B-50-80-MPLCOm2012-0.005	312,927	340,332	10.3	1.4	723	88	1.8	6.0	28.3
A-55-80-MPLCOm2012-0.012	313,442	339,169	15.4	1.8	683	95	1.9	6.6	25.5
A-50-80-Bach-0.022	314,475	340,625	13.9	1.7	697	99	2.0	6.8	25.0
B-50-80-Bach-0.009	316,758	344,723	9.7	1.3	740	91	1.9	6.1	29.3
A-55-80-MLCDRAT-0.012	320,284	346,735	14.0	1.7	698	102	2.1	7.0	25.2
A-55-80-20-15	**321,376**	**347,227**	**16.7**	**2.0**	**633**	**80**	**1.6**	**6.4**	**32.4**
A-50-80-MPLCOm2012-0.012	322,767	348,967	15.8	1.8	694	95	2.0	6.6	27.2
A-50-80-MLCDRAT-0.012	323,741	350,374	14.2	1.7	702	101	2.1	6.9	25.9
A-55-80-Bach-0.021	326,829	353,690	14.0	1.7	712	103	2.1	6.9	25.4
A-50-80-Bach-0.021	330,309	357,346	14.2	1.7	716	101	2.1	6.8	26.1
A-50-77-MPLCOm2012-0.01	334,311	361,183	15.6	1.9	649	73	1.5	5.7	31.1
A-55-80-MPLCOm2012-0.011	335,019	361,976	15.7	1.8	709	96	2.0	6.6	27.1
A-55-80-Bach-0.02	342,391	370,144	14.3	1.7	730	103	2.1	6.8	26.8
A-55-80-MLCDRAT-0.011	346,694	374,691	14.3	1.7	731	103	2.1	6.9	27.5
A-50-80-Bach-0.02	346,979	374,945	14.5	1.7	735	101	2.1	6.7	27.7
A-50-80-MPLCOm2012-0.011	349,310	376,967	16.2	1.9	724	98	2.0	6.6	29.4
A-50-80-MLCDRAT-0.011	351,744	380,005	14.4	1.7	737	102	2.1	6.8	28.5
A-55-80-Bach-0.019	358,013	386,594	14.6	1.7	748	104	2.1	6.8	28.0
A-55-80-20-20	**358,302**	**386,201**	**17.6**	**2.1**	**686**	**87**	**1.8**	**6.5**	**34.2**
A-55-80-MPLCOm2012-0.01	358,348	386,610	16.0	1.9	735	98	2.0	6.5	29.3

Appendix C Table 16. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-Bach-0.019	364,037	392,918	14.9	1.8	753	102	2.1	6.6	29.2
A-55-80-Bach-0.018	375,520	405,056	15.0	1.8	767	106	2.2	6.8	29.5
A-55-80-MLCDRAT-0.01	375,679	405,427	14.2	1.7	767	107	2.2	6.9	29.6
A-50-80-MPLCOm2012-0.01	379,066	408,341	16.8	2.0	757	100	2.0	6.6	32.4
A-50-80-MLCDRAT-0.01	382,462	412,538	14.4	1.7	775	106	2.2	6.8	31.0
A-50-80-Bach-0.018	382,696	412,618	15.2	1.8	775	104	2.1	6.7	30.9
A-55-80-20-25	**389,551**	**419,022**	**18.6**	**2.2**	**726**	**91**	**1.9**	**6.4**	**35.8**
A-55-80-Bach-0.017	393,075	423,595	15.3	1.8	786	107	2.2	6.8	31.1
A-50-80-20-15	**399,813**	**429,762**	**19.1**	**2.3**	**703**	**82**	**1.7**	**6.3**	**42.4**
A-50-80-Bach-0.017	402,336	433,313	15.6	1.8	797	104	2.1	6.5	32.9
A-55-80-MLCDRAT-0.009	411,379	443,267	14.1	1.7	809	110	2.3	6.9	32.1
A-55-80-Bach-0.016	411,443	442,996	15.6	1.8	805	108	2.2	6.8	32.4
A-50-80-MPLCOm2012-0.009	413,285	444,451	17.4	2.0	793	101	2.1	6.4	35.7
A-55-80-MPLCOm2012-0.008	415,073	446,515	16.7	1.9	798	102	2.1	6.5	34.0
A-50-80-MLCDRAT-0.009	420,863	453,220	14.4	1.7	819	109	2.2	6.8	33.7
A-50-80-Bach-0.016	423,398	455,546	16.0	1.9	819	106	2.2	6.6	34.5
A-55-80-Bach-0.015	430,085	462,676	15.9	1.9	826	110	2.2	6.8	34.1
A-50-80-20-20	**440,469**	**472,498**	**20.6**	**2.4**	**754**	**86**	**1.8**	**6.2**	**44.6**
A-50-80-Bach-0.015	445,160	478,502	16.4	1.9	839	107	2.2	6.5	36.8
A-55-80-Bach-0.014	450,056	483,739	16.2	1.9	846	111	2.3	6.8	36.0
A-50-80-MPLCOm2012-0.008	453,251	486,593	18.1	2.1	834	104	2.1	6.5	38.9
A-55-80-MLCDRAT-0.008	454,135	488,599	14.1	1.7	860	113	2.3	6.8	35.1
A-50-80-MLCDRAT-0.008	467,154	502,246	14.5	1.7	873	112	2.3	6.7	37.3
A-50-80-Bach-0.014	468,455	503,045	16.7	1.9	863	108	2.2	6.5	39.2
A-55-80-Bach-0.013	471,061	505,895	16.5	1.9	867	112	2.3	6.7	37.8
A-50-80-20-25	**473,059**	**506,693**	**22.0**	**2.5**	**796**	**90**	**1.9**	**6.2**	**46.7**
A-50-80-Bach-0.013	493,477	529,419	17.1	2.0	888	109	2.2	6.5	41.4
A-55-80-Bach-0.012	494,075	530,177	16.7	1.9	890	113	2.3	6.7	39.4
A-50-80-MPLCOm2012-0.007	498,159	533,954	18.7	2.1	878	106	2.2	6.4	42.7
A-55-80-MLCDRAT-0.007	501,028	538,246	14.3	1.7	911	116	2.4	6.8	38.1
A-55-80-Bach-0.011	517,897	555,310	17.0	2.0	914	114	2.3	6.6	41.3
A-50-80-Bach-0.012	521,068	558,508	17.5	2.0	915	111	2.3	6.5	43.7
A-50-80-MLCDRAT-0.007	522,234	560,489	14.8	1.7	932	114	2.3	6.5	41.2
A-55-80-Bach-0.01	542,703	581,498	17.3	2.0	939	115	2.4	6.6	43.2
A-50-80-MPLCOm2012-0.006	548,639	587,157	19.4	2.2	925	108	2.2	6.4	47.0
A-50-80-Bach-0.011	550,280	589,315	18.0	2.1	944	112	2.3	6.4	46.1
A-55-80-MLCDRAT-0.006	558,573	599,071	14.7	1.7	972	119	2.4	6.7	42.6
A-50-80-Bach-0.01	581,188	621,883	18.4	2.1	973	113	2.3	6.4	49.0

Appendix C Table 16. Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort Women

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 17. Comparison of the A-55-80-20-15 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-55-80-20-15	A-55-80-MPLCOm2012-0.012	A-55-80-MLCDRAT-0.012	A-55-80-Bach-0.022
% eligible	20.6%	21.6%	23.8%	23.4%
# LDCT screens*	330,095	330,347	343,713	327,719
Avg. # of LDCT screens per person screened	16.0	15.3	14.4	14.0
Avg. age at first screen	55.7	62.0	62.8	63.4
Avg. age at last screen	70.7	76.3	76.4	76.6
Avg. age at screening	65.1	68.5	69.1	69.3
LC deaths averted*	469	520	532	527
Mortality reduction	12.1%	13.4%	13.7%	13.6%
Difference in LC deaths averted vs. A-55-80-20-15 strategy	NA	10.9%	13.4%	12.4%
Avg. # screens per LC deaths averted	704	635	646	622
LYG*	6,018	6,146	6,126	6,024
Difference in LYG vs. A-55-80-20-15 strategy	NA	2.1%	1.0%	0.1%
Avg. # screens per LYG	55	54	56	54
NNS	44	42	45	44
False-positive screens per person screened	1.9	1.8	1.7	1.7
Biopsies	667	723	745	732
Overdiagnosed cases*	83	98	104	103
Overdiagnosis rate per screen-detected cancers	6.2%	6.5%	6.6%	6.7%
Radiation-related lung cancer deaths*	29.0	23.3	23.0	22.3

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 18. Comparison of the A-55-80-20-20 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-55-80-20-20	A-55-80-MPLCOm2012-0.010	A-55-80-MLCDRAT-0.011	A-55-80-Bach-0.019
% eligible	22.0%	23.7%	25.5%	25.2%
# LDCT screens*	369,610	375,484	369,025	372,598
Avg. # of LDCT screens per person screened	16.8	15.8	14.5	14.8
Avg. age at first screen	55.6	61.5	62.8	62.6
Avg. age at last screen	71.4	76.3	76.5	76.5
Avg. age at screening	65.3	68.2	68.9	68.9
LC deaths averted*	500	548	549	554
Mortality reduction	12.9%	14.1%	14.2%	14.3%
Difference in LC deaths averted vs. A-55-80-20-20 strategy	NA	9.6%	9.8%	10.8%
Avg. # screens per LC deaths averted	739	685	672	673
LYG*	6,379	6,519	6,384	6,458
Difference in LYG vs. A-55-80-20-20 strategy	NA	2.2%	0.1%	1.2%
Avg. # screens per LYG	58	58	58	58
NNS	44	43	46	45
False-positive screens per person screened	2.0	1.9	1.7	1.7
Biopsies	722	776	777	784
Overdiagnosed cases*	89	102	105	106
Overdiagnosis rate per screen-detected cancers	6.3%	6.4%	6.6%	6.6%
Radiation-related lung cancer deaths*	30.6	26.5	24.6	25.2

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 19. Comparison of the A-55-80-20-25 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-55-80-20-25	A-55-80-MPLCOm2012-0.008	A-55-80-MLCDRAT-0.010	A-55-80-Bach-0.017
% eligible	22.7%	26.2%	27.7%	26.5%
# LDCT screens*	404,596	432,557	398,180	406,323
Avg. # of LDCT screens per person screened	17.8	16.5	14.4	15.3
Avg. age at first screen	55.6	60.8	63.0	62.0
Avg. age at last screen	72.5	76.3	76.6	76.4
Avg. age at screening	65.5	68.1	68.8	68.7
LC deaths averted*	523	579	564	575
Mortality reduction	13.5%	14.9%	14.6%	14.9%
Difference in LC deaths averted vs. A-55-80-20-25 strategy	NA	10.7%	7.8%	9.9%
Avg. # screens per LC deaths averted	774	747	706	707
LYG*	6,654	6,975	6,605	6,774
Difference in LYG vs. A-55-80-20-25 strategy	NA	4.8%	-0.7%	1.8%
Avg. # screens per LYG	61	62	60	60
NNS	43	45	49	46
False-positive screens per person screened	2.1	1.9	1.7	1.8
Biopsies	765	839	813	822
Overdiagnosed cases*	94	106	108	109
Overdiagnosis rate per screen-detected cancers	6.3%	6.4%	6.6%	6.6%
Radiation-related lung cancer deaths*	31.9	30.0	26.5	28.0

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 20. Comparison of the A-50-80-20-15 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-50-80-20-15	A-50-80-MPLCOm2012-0.010	A-50-80-MLCDRAT-0.010	A-50-80-Bach-0.017
% eligible	22.6%	23.9%	27.9%	26.6%
# LDCT screens*	419,030	401,856	409,804	420,352
Avg. # of LDCT screens per person screened	18.5	16.8	14.7	15.8
Avg. age at first screen	51.5	60.3	62.6	61.4
Avg. age at last screen	69.0	76.0	76.5	76.3
Avg. age at screening	59.0	63.3	64.0	64.0
LC deaths averted*	503	564	575	586
Mortality reduction	13.0%	14.6%	14.8%	15.1%
Difference in LC deaths averted vs. A-50-80-20-15 strategy	NA	12.1%	14.3%	16.5%
Avg. # screens per LC deaths averted	833	713	713	717
LYG*	6,918	6,957	6,871	7,039
Difference in LYG vs. A-50-80-20-15 strategy	NA	0.6%	-0.7%	1.7%
Avg. # screens per LYG	61	58	60	60
NNS	45	42	49	45
False-positive screens per person screened	2.2	2.0	1.7	1.8
Biopsies	750	804	827	837
Overdiagnosed cases*	84	104	108	108
Overdiagnosis rate per screen-detected cancers	6.0%	6.4%	6.5%	6.4%
Radiation-related lung cancer deaths*	38.6	29.8	28.2	30.1

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 21. Comparison of the A-50-80-20-20 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-50-80-20-20	A-50-80-MPLCOm2012-0.008	A-50-80-MLCDRAT-0.009	A-50-80-Bach-0.015
% eligible	23.3%	26.6%	30.6%	28.1%
# LDCT screens*	463,457	478,349	449,030	463,301
Avg. # of LDCT screens per person screened	19.9	18.0	14.7	16.5
Avg. age at first screen	51.5	59.0	62.7	60.6
Avg. age at last screen	70.3	76.0	76.6	76.2
Avg. age at screening	59.4	62.9	63.7	63.8
LC deaths averted*	534	601	596	605
Mortality reduction	13.8%	15.5%	15.4%	15.6%
Difference in LC deaths averted vs. A-50-80-20-20 strategy	NA	12.5%	11.6%	13.3%
Avg. # screens per LC deaths averted	868	796	753	766
LYG*	7,301	7,564	7,168	7,391
Difference in LYG vs. A-50-80-20-20 strategy	NA	3.6%	-1.8%	1.2%
Avg. # screens per LYG	63	63	63	63
NNS	44	44	51	46
False-positive screens per person screened	2.3	2.1	1.7	1.9
Biopsies	804	883	872	882
Overdiagnosed cases*	89	108	111	110
Overdiagnosis rate per screen-detected cancers	6.0%	6.3%	6.5%	6.4%
Radiation-related lung cancer deaths*	40.6	35.4	31.4	33.3

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 22. Comparison of the A-50-80-20-25 and Equivalent Risk Model–Based Screening Scenarios

Outcome	A-50-80-20-25	A-50-80-MPLCOm2012-0.008	A-50-80-MLCDRAT-0.008	A-50-80-Bach-0.013
% eligible	23.6%	26.6%	33.5%	29.7%
# LDCT screens*	500,430	478,349	495,424	511,462
Avg. # of LDCT screens per person screened	21.2	18.0	14.8	17.2
Avg. age at first screen	51.5	59.0	62.7	59.9
Avg. age at last screen	71.6	76.0	76.6	76.1
Avg. age at screening	59.9	62.9	63.6	63.5
LC deaths averted*	558	601	619	627
Mortality reduction	14.4%	15.5%	16.0%	16.2
Difference in LC deaths averted vs. A-50-80-20-25 strategy	NA	7.7%	10.9%	12.4%
Avg. # screens per LC deaths averted	897	796	800	816
LYG*	7,596	7,564	7,508	7,746
Difference in LYG vs. A-50-80-20-25 strategy	NA	-0.4%	-1.2%	2.0%
Avg. # screens per LYG	66	63	66	66
NNS	42	44	54	47
False-positive screens per person screened	2.5	2.1	1.7	2.0
Biopsies	849	883	925	930
Overdiagnosed cases*	94	108	114	112
Overdiagnosis rate per screen-detected cancers	6.0%	6.3%	6.4%	6.3%
Radiation-related lung cancer deaths*	42.5	35.4	34.2	37.1

* Per 100,000 individuals.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force; vs.=versus.

Appendix C Table 23. Benefits of 41 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus Three Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1950 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
B-55-80-30-20	21.5	189,290	1,508	9.0	452	5,891	13.0	32	419	48
B-55-80-25-15	24.3	193,471	1,515	9.1	455	5,941	13.1	33	425	53
B-55-80-30-25	21.7	203,069	1,572	9.4	472	6,115	13.0	33	430	46
B-55-80-25-20	25.4	216,267	1,612	9.8	488	6,334	13.0	34	443	52
B-50-80-30-15	22.2	219,815	1,531	9.5	476	6,538	13.7	34	462	47
A-55-80-40-15	14.6	229,025	1,517	10.1	510	6,403	12.6	36	449	29
B-55-80-25-25	25.8	235,215	1,694	10.2	511	6,628	13.0	35	460	50
B-50-77-30-25	22.4	238,032	1,459	9.2	463	6,749	14.6	35	514	48
B-50-80-30-20	22.4	238,934	1,625	10.1	507	6,862	13.5	35	471	44
B-50-77-25-15	26.2	241,077	1,434	9.1	455	6,742	14.8	36	530	58
A-55-80-40-20	14.9	247,622	1,593	10.6	535	6,673	12.5	37	463	28
B-55-80-20-20	29.8	252,017	1,725	10.5	524	6,871	13.1	37	481	57
B-50-80-25-15	26.2	253,310	1,639	10.2	509	7,010	13.8	36	498	51
B-50-80-30-25	22.5	253,520	1,698	10.5	526	7,093	13.5	36	482	43
A-55-80-40-25	15.0	261,065	1,644	11.0	553	6,851	12.4	38	472	27
B-55-80-20-25	30.6	276,741	1,813	11.1	551	7,185	13.0	39	502	56
B-50-80-20-15	30.7	291,542	1,749	10.9	545	7,539	13.8	39	535	56
A-50-80-40-20	15.3	292,409	1,652	11.2	565	7,449	13.2	39	518	27
A-50-80-40-25	15.3	306,037	1,705	11.6	584	7,629	13.1	40	524	26
B-50-80-20-20	31.5	323,377	1,865	11.7	585	7,988	13.7	40	553	54
A-55-80-25-10	22.5	325,707	1,762	12.1	604	7,836	13.0	42	539	37
A-55-80-30-15	**20.8**	**333,300**	**1,788**	**12.2**	**612**	**7,956**	**13.0**	**42**	**545**	**34**
B-50-80-20-25	31.8	349,765	1,967	12.3	614	8,345	13.6	42	570	52
A-55-80-30-20	21.5	368,643	1,900	13.0	650	8,368	12.9	44	567	33
A-55-80-25-15	24.4	375,261	1,911	13.1	654	8,453	12.9	44	574	37
A-55-80-30-25	21.8	396,584	1,986	13.6	683	8,738	12.8	45	581	32
A-55-80-25-20	25.4	420,797	2,036	14.0	696	8,957	12.9	47	605	36
A-50-80-30-15	22.2	425,608	1,880	13.2	659	9,157	13.9	46	646	34
A-55-80-20-15	**27.9**	**433,993**	**2,035**	**14.1**	**701**	**9,125**	**13.0**	**48**	**619**	**40**
A-50-77-30-20	22.4	442,631	1,782	12.7	639	9,322	14.6	47	693	35
A-55-80-25-25	25.8	459,015	2,137	14.7	733	9,353	12.8	49	626	35
A-50-80-30-20	22.5	463,131	1,993	14.0	701	9,606	13.7	48	661	32
A-50-77-30-25	22.4	467,223	1,842	13.2	662	9,555	14.4	49	706	34
A-50-80-25-15	26.2	489,778	2,013	14.2	709	9,848	13.9	50	691	37
A-55-80-20-20	**29.8**	**490,380**	**2,174**	**15.1**	**754**	**9,732**	**12.9**	**50**	**650**	**40**
A-50-80-30-25	22.5	491,722	2,079	14.6	731	9,952	13.6	49	673	31
A-50-80-25-20	26.7	538,709	2,139	15.1	756	10,433	13.8	52	713	35
A-55-80-20-25	**30.6**	**540,046**	**2,286**	**15.9**	**794**	**10,208**	**12.9**	**53**	**680**	**39**

Appendix C Table 23. Benefits of 41 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus Three Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1950 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
A-50-77-25-25	26.8	550,504	1,986	14.3	716	10,375	14.5	53	769	37
A-50-80-20-15	**30.7**	**563,675**	**2,139**	**15.2**	**760**	**10,548**	**13.9**	**53**	**742**	**40**
A-45-80-30-25	22.9	569,665	2,119	15.0	755	10,637	14.1	54	755	30
A-50-80-25-25	26.8	578,099	2,238	15.8	791	10,785	13.6	54	731	34
A-50-80-20-20	**31.6**	**626,181**	**2,278**	**16.3**	**813**	**11,218**	**13.8**	**56**	**770**	**39**
A-50-80-20-25	**31.8**	**678,074**	**2,394**	**17.1**	**854**	**11,722**	**13.7**	**58**	**794**	**37**

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs.

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy is a consensus-efficient scenario. The 2013 USPSTF-recommended strategy and selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 24. Harms of 41 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus Three Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1950 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-30-20	189,290	208,996	8.8	1.3	646	92	1.4	6.1	17.9
B-55-80-25-15	193,471	213,824	8.0	1.2	657	91	1.4	6.0	18.8
B-55-80-30-25	203,069	223,505	9.4	1.3	676	96	1.5	6.1	18.3
B-55-80-25-20	216,267	237,943	8.5	1.2	704	98	1.5	6.1	20.0
B-50-80-30-15	219,815	241,090	9.9	1.4	678	92	1.4	6.0	23.1
A-55-80-40-15	229,025	249,429	15.7	1.9	653	101	1.6	6.7	19.5
B-55-80-25-25	235,215	257,921	9.1	1.3	743	104	1.6	6.1	20.6
B-50-77-30-25	238,032	260,214	10.6	1.5	667	74	1.2	5.1	24.2
B-50-80-30-20	238,934	261,235	10.7	1.5	720	98	1.5	6.0	23.7
B-50-77-25-15	241,077	264,005	9.2	1.3	670	74	1.2	5.2	26.0
A-55-80-40-20	247,622	269,000	16.6	2.0	689	106	1.6	6.7	19.9
B-55-80-20-20	252,017	276,201	8.5	1.2	772	105	1.6	6.1	23.3
B-50-80-25-15	253,310	276,900	9.7	1.4	743	99	1.5	6.0	25.9
B-50-80-30-25	253,520	276,553	11.3	1.5	752	102	1.6	6.0	24.1
A-55-80-40-25	261,065	283,124	17.4	2.0	712	110	1.7	6.7	20.2
B-55-80-20-25	276,741	302,299	9.0	1.3	817	110	1.7	6.1	24.0
B-50-80-20-15	291,542	317,766	9.5	1.4	812	106	1.6	6.1	30.0
A-50-80-40-20	292,409	315,999	19.1	2.2	736	107	1.7	6.5	25.4
A-50-80-40-25	306,037	330,313	20.0	2.3	760	111	1.7	6.5	25.7
B-50-80-20-20	323,377	351,346	10.3	1.4	871	113	1.8	6.1	31.3
A-55-80-25-10	325,707	352,179	14.5	1.8	809	115	1.8	6.5	29.5
A-55-80-30-15	**333,300**	**359,887**	**16.0**	**1.9**	**817**	**117**	**1.8**	**6.5**	**28.9**
B-50-80-20-25	349,765	379,113	11.0	1.5	920	119	1.9	6.0	32.2
A-55-80-30-20	368,643	397,092	17.1	2.0	874	125	1.9	6.6	30.3
A-55-80-25-15	375,261	404,492	15.4	1.9	889	126	2.0	6.6	32.0
A-55-80-30-25	396,584	426,463	18.2	2.1	917	130	2.0	6.5	30.8
A-55-80-25-20	420,797	452,456	16.6	2.0	957	134	2.1	6.6	33.9
A-50-80-30-15	425,608	456,861	19.2	2.3	907	119	1.8	6.3	39.8
A-55-80-20-15	**433,993**	**466,704**	**15.6**	**1.9**	**971**	**134**	**2.1**	**6.6**	**37.1**
A-50-77-30-20	442,631	474,740	19.8	2.3	886	100	1.5	5.6	41.0
A-55-80-25-25	459,015	492,649	17.8	2.1	1,012	142	2.2	6.6	34.8
A-50-80-30-20	463,131	496,293	20.6	2.4	965	128	2.0	6.4	41.2
A-50-77-30-25	467,223	500,557	20.9	2.4	918	102	1.6	5.5	41.6
A-50-80-25-15	489,778	524,822	18.7	2.2	998	128	2.0	6.4	44.8
A-55-80-20-20	**490,380**	**526,175**	**16.5**	**2.0**	**1,052**	**144**	**2.2**	**6.6**	**39.5**
A-50-80-30-25	491,722	526,318	21.9	2.5	1,007	133	2.1	6.4	41.8
A-50-80-25-20	538,709	576,271	20.2	2.4	1,067	136	2.1	6.4	46.7

Appendix C Table 24. Harms of 41 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus Three Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1950 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-20-25	**540,046**	**578,428**	**17.6**	**2.1**	**1,118**	**149**	**2.3**	**6.5**	**41.0**
A-50-77-25-25	550,504	588,614	20.5	2.4	1,025	111	1.7	5.6	47.6
A-50-80-20-15	**563,675**	**603,080**	**18.4**	**2.2**	**1,093**	**136**	**2.1**	**6.4**	**51.8**
A-45-80-30-25	569,665	607,977	24.9	2.8	1,071	131	2.0	6.2	53.1
A-50-80-25-25	578,099	617,612	21.6	2.5	1,120	144	2.2	6.4	47.9
A-50-80-20-20	**626,181**	**668,823**	**19.8**	**2.3**	**1,175**	**145**	**2.2**	**6.4**	**54.4**
A-50-80-20-25	**678,074**	**723,326**	**21.3**	**2.5**	**1,242**	**153**	**2.4**	**6.4**	**56.3**

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs. †Average of two models (MGH-HMS and University of Michigan).

The results are based on the US individuals who were born in 1950. Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy is a consensus-efficient scenario. The 2013 USPSTF-recommended strategy and selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 25. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
B-55-80-20-20	21.3	176,841	1,025	8.6	334	4,482	13.4	39	529	64
B-55-80-20-25	22.0	193,275	1,074	9.0	350	4,685	13.4	41	552	63
B-50-80-25-25	18.5	195,846	1,050	9.0	348	4,835	13.9	41	563	53
A-55-80-30-15	**13.6**	**211,055**	**992**	**9.4**	**364**	**4,864**	**13.4**	**43**	**580**	**37**
A-55-80-25-10	15.4	216,689	1,017	9.7	375	4,974	13.3	44	578	41
B-50-80-20-20	22.8	224,867	1,104	9.5	367	5,198	14.2	43	613	62
A-55-80-30-20	14.0	232,601	1,051	10.0	388	5,144	13.3	45	599	36
B-50-80-20-25	23.0	242,588	1,160	10.0	386	5,418	14.0	45	628	60
A-55-80-25-15	16.7	247,982	1,099	10.5	406	5,354	13.2	46	611	41
A-55-80-30-25	14.3	249,780	1,098	10.5	405	5,331	13.2	47	617	35
A-55-80-25-20	17.4	276,641	1,168	11.2	432	5,694	13.2	49	640	40
A-55-80-25-25	17.7	300,973	1,223	11.7	454	5,928	13.1	51	663	39
A-55-80-20-15	**19.9**	**306,810**	**1,203**	**11.7**	**452**	**6,019**	**13.3**	**51**	**679**	**44**
A-50-80-30-25	14.9	313,451	1,152	11.1	430	6,042	14.1	52	729	35
A-50-80-25-15	18.1	322,939	1,158	11.3	436	6,166	14.1	52	741	42
A-55-80-20-20	**21.3**	**343,972**	**1,285**	**12.4**	**479**	**6,366**	**13.3**	**54**	**718**	**44**
A-50-80-20-10	20.7	347,165	1,174	11.5	445	6,386	14.4	54	780	47
A-50-80-25-20	18.4	354,112	1,229	11.9	461	6,497	14.1	55	768	40
A-55-80-20-25	**22.0**	**376,912**	**1,349**	**13.1**	**505**	**6,656**	**13.2**	**57**	**746**	**44**
A-50-80-25-25	18.5	379,485	1,283	12.5	484	6,757	14.0	56	784	38
A-50-80-20-15	**22.1**	**393,642**	**1,270**	**12.5**	**482**	**6,888**	**14.3**	**57**	**817**	**46**
A-50-80-20-20	**22.8**	**435,612**	**1,351**	**13.3**	**513**	**7,257**	**14.1**	**60**	**849**	**44**
A-45-80-25-25	19.1	456,251	1,314	12.9	500	7,269	14.5	63	913	38
A-50-80-20-25	**23.0**	**470,506**	**1,414**	**13.8**	**535**	**7,533**	**14.1**	**62**	**879**	**43**
A-45-80-20-20	23.6	528,012	1,382	13.8	534	7,919	14.8	67	989	44
A-45-80-20-25	23.7	563,449	1,445	14.4	557	8,182	14.7	69	1,012	43

*Strategies with at least 9.0 percent lung cancer mortality reduction.

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 26. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Harms of 25 Selected* Consensus-Efficient Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-55-80-20-20	176,841	195,763	8.3	1.2	483	23	0.5	2.2	21.8
B-55-80-20-25	193,275	213,125	8.8	1.2	510	24	0.5	2.2	22.4
B-50-80-25-25	195,846	215,254	10.6	1.5	500	23	0.5	2.2	23.3
A-55-80-30-15	**211,055**	**230,291**	**15.5**	**1.9**	**473**	**23**	**0.5**	**2.3**	**23.4**
A-55-80-25-10	216,689	236,480	14.1	1.7	489	25	0.5	2.5	24.3
B-50-80-20-20	224,867	246,369	9.9	1.4	545	25	0.5	2.3	26.3
A-55-80-30-20	232,601	252,951	16.6	2.0	505	25	0.5	2.4	24.4
B-50-80-20-25	242,588	265,015	10.5	1.5	574	26	0.5	2.2	26.9
A-55-80-25-15	247,982	269,512	14.8	1.8	536	26	0.5	2.4	25.8
A-55-80-30-25	249,780	271,008	17.5	2.1	530	27	0.6	2.5	24.9
A-55-80-25-20	276,641	299,679	15.9	1.9	576	29	0.6	2.5	27.1
A-55-80-25-25	300,973	325,259	17.0	2.0	608	30	0.6	2.5	28.0
A-55-80-20-15	**306,810**	**331,730**	**15.4**	**1.9**	**611**	**29**	**0.6**	**2.4**	**30.1**
A-50-80-30-25	313,451	337,836	21.0	2.4	588	26	0.5	2.3	31.6
A-50-80-25-15	322,939	348,290	17.8	2.1	605	27	0.5	2.3	33.7
A-55-80-20-20	**343,972**	**370,941**	**16.1**	**1.9**	**662**	**32**	**0.7**	**2.5**	**31.6**
A-50-80-20-10	347,165	374,106	16.8	2.0	631	28	0.6	2.4	36.7
A-50-80-25-20	354,112	381,042	19.2	2.3	646	29	0.6	2.4	35.1
A-55-80-20-25	**376,912**	**405,586**	**17.1**	**2.0**	**702**	**34**	**0.7**	**2.5**	**32.9**
A-50-80-25-25	379,485	407,680	20.5	2.4	678	29	0.6	2.3	36.0
A-50-80-20-15	**393,642**	**423,074**	**17.8**	**2.1**	**692**	**30**	**0.6**	**2.4**	**38.9**
A-50-80-20-20	**435,612**	**467,198**	**19.1**	**2.3**	**744**	**33**	**0.7**	**2.4**	**40.7**
A-45-80-25-25	456,251	488,135	23.9	2.8	739	31	0.6	2.4	43.8
A-50-80-20-25	**470,506**	**503,852**	**20.5**	**2.4**	**784**	**34**	**0.7**	**2.4**	**42.0**
A-45-80-20-20	528,012	564,097	22.4	2.6	817	33	0.7	2.4	49.9
A-45-80-20-25	563,449	601,282	23.8	2.8	856	34	0.7	2.4	51.2

*Strategies with at least 9.0 percent lung cancer mortality reduction. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–minimum pack-years–maximum years since quitting. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; CT=computed tomography; LC=lung cancer; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 27. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
B-50-80-MLCDRAT-0.015	19.8	133,154	1,040	8.5	330	3,920	11.9	34	403	60
B-50-80-Bach-0.025	20.6	135,434	1,065	8.7	336	3,998	11.9	34	403	61
B-50-80-MPLCOm2012-0.014	18.9	138,947	1,058	8.8	339	4,162	12.3	33	410	56
B-55-80-Bach-0.024	20.9	139,022	1,058	8.6	333	4,009	12.0	35	417	63
B-50-80-Bach-0.024	21.1	141,852	1,086	8.9	345	4,114	11.9	34	411	61
B-50-80-MLCDRAT-0.014	20.7	142,739	1,074	8.8	341	4,080	12.0	35	419	61
B-55-80-MPLCOm2012-0.013	19.5	143,529	1,055	8.7	336	4,148	12.3	35	427	58
B-50-80-Bach-0.023	21.7	148,437	1,103	9.1	352	4,223	12.0	35	422	62
B-50-80-MPLCOm2012-0.013	19.7	149,217	1,087	9.0	348	4,331	12.4	34	429	57
A-55-80-MPLCOm2012-0.023	13.5	155,135	1,045	9.5	367	4,150	11.3	37	423	37
A-50-80-MPLCOm2012-0.023	13.5	155,203	1,044	9.5	366	4,143	11.3	37	424	37
B-50-80-Bach-0.022	22.3	155,387	1,121	9.3	358	4,328	12.1	36	434	62
A-55-80-MLCDRAT-0.023	14.8	157,918	1,038	9.4	365	4,056	11.1	39	433	41
B-55-80-Bach-0.021	22.7	158,593	1,111	9.1	352	4,290	12.2	37	451	64
B-50-80-MPLCOm2012-0.012	20.7	160,981	1,120	9.3	360	4,502	12.5	36	447	58
A-55-80-MPLCOm2012-0.022	13.9	163,721	1,069	9.8	379	4,313	11.4	38	432	37
A-50-80-MPLCOm2012-0.022	13.9	163,841	1,069	9.8	379	4,309	11.4	38	432	37
B-50-80-Bach-0.021	23.1	164,771	1,159	9.4	364	4,422	12.1	37	453	63
B-55-80-Bach-0.02	23.3	165,615	1,129	9.3	361	4,417	12.2	37	459	65
B-50-80-Bach-0.02	23.5	170,850	1,157	9.6	371	4,551	12.3	38	461	63
A-55-80-Bach-0.034	16.1	171,934	1,106	10.1	390	4,393	11.3	39	441	41
A-50-80-Bach-0.034	16.1	172,099	1,106	10.1	391	4,397	11.2	39	440	41
A-55-80-MPLCOm2012-0.021	14.4	172,750	1,095	10.0	388	4,452	11.5	39	445	37
B-55-80-Bach-0.019	23.9	172,895	1,143	9.5	367	4,519	12.3	38	471	65
A-50-80-MPLCOm2012-0.021	14.5	172,981	1,098	10.1	390	4,469	11.5	39	444	37
B-50-80-MPLCOm2012-0.011	21.8	174,712	1,151	9.6	372	4,718	12.7	37	470	59
A-55-80-Bach-0.033	16.5	180,029	1,127	10.3	397	4,503	11.3	40	453	42
A-50-80-Bach-0.033	16.5	180,254	1,128	10.4	401	4,532	11.3	40	450	41
B-50-80-Bach-0.019	24.3	180,905	1,202	9.9	382	4,678	12.2	39	474	64
A-55-80-MPLCOm2012-0.02	14.9	182,585	1,122	10.3	400	4,629	11.6	39	456	37
A-50-80-MPLCOm2012-0.02	15.0	182,997	1,123	10.3	399	4,623	11.6	40	459	38
A-50-80-MLCDRAT-0.02	16.5	186,517	1,124	10.3	400	4,537	11.3	41	466	41
A-55-80-Bach-0.032	17.0	188,493	1,150	10.5	407	4,631	11.4	41	463	42
A-50-80-Bach-0.032	17.0	188,809	1,151	10.6	408	4,654	11.4	41	463	42
B-50-80-MPLCOm2012-0.01	22.9	189,425	1,180	9.9	384	4,923	12.8	38	493	60
B-50-80-Bach-0.018	25.0	189,784	1,222	10.0	389	4,795	12.3	40	488	64
A-55-80-MPLCOm2012-0.019	15.5	193,387	1,149	10.6	412	4,817	11.7	40	469	38

Appendix C Table 27. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
A-50-80-MPLCOm2012-0.019	15.5	194,126	1,150	10.7	412	4,830	11.7	40	471	38
A-55-80-Bach-0.031	17.4	196,948	1,173	10.8	417	4,774	11.4	41	472	42
A-50-80-Bach-0.031	17.5	197,382	1,174	10.8	420	4,818	11.5	41	470	42
A-50-80-MLCDRAT-0.019	17.2	200,062	1,162	10.7	415	4,751	11.4	42	482	41
A-55-80-MPLCOm2012-0.018	16.1	204,873	1,174	10.9	422	4,956	11.7	41	485	38
A-50-80-MPLCOm2012-0.018	16.1	206,134	1,179	10.9	423	5,000	11.8	41	487	38
A-55-80-Bach-0.03	17.9	206,221	1,197	11.0	425	4,902	11.5	42	485	42
B-50-80-MPLCOm2012-0.009	24.1	206,519	1,218	10.3	397	5,144	13.0	40	520	61
A-50-80-Bach-0.03	18.0	206,796	1,197	11.0	425	4,929	11.6	42	487	42
B-50-80-Bach-0.016	26.2	207,372	1,237	10.3	400	5,040	12.6	41	518	66
A-55-80-MLCDRAT-0.018	17.7	210,294	1,189	11.0	425	4,893	11.5	43	495	42
A-50-80-MLCDRAT-0.018	17.7	210,318	1,188	11.0	425	4,903	11.5	43	495	42
A-55-80-30-15	**13.6**	**211,055**	**992**	**9.4**	**364**	**4,864**	**13.4**	**43**	**580**	**37**
A-55-80-Bach-0.029	18.4	215,368	1,217	11.3	436	5,035	11.5	43	494	42
A-50-80-Bach-0.029	18.5	216,161	1,221	11.2	435	5,036	11.6	43	497	43
A-55-80-MPLCOm2012-0.017	16.7	217,546	1,204	11.2	435	5,151	11.8	42	500	38
A-50-80-MPLCOm2012-0.017	16.8	219,544	1,211	11.3	436	5,212	12.0	42	504	39
A-55-80-Bach-0.028	19.0	225,598	1,240	11.5	443	5,144	11.6	44	509	43
B-50-80-MPLCOm2012-0.008	25.6	226,142	1,252	10.6	411	5,377	13.1	42	550	62
A-50-80-MLCDRAT-0.017	18.4	226,165	1,225	11.4	441	5,130	11.6	44	513	42
A-50-80-Bach-0.028	19.0	226,614	1,244	11.5	446	5,205	11.7	44	508	43
B-50-80-Bach-0.014	27.8	229,085	1,278	10.8	416	5,321	12.8	43	551	67
A-55-80-MPLCOm2012-0.016	17.4	230,908	1,234	11.5	446	5,339	12.0	43	518	39
A-50-80-MPLCOm2012-0.016	17.5	233,969	1,243	11.7	451	5,446	12.1	43	519	39
A-55-80-Bach-0.027	19.5	236,104	1,261	11.7	454	5,292	11.7	45	520	43
A-50-80-Bach-0.027	19.6	237,516	1,266	11.8	455	5,333	11.7	45	522	43
A-50-80-MLCDRAT-0.016	19.1	238,916	1,255	11.7	454	5,300	11.7	45	526	42
B-50-80-Bach-0.013	28.6	241,152	1,303	11.0	425	5,459	12.8	44	567	67
A-55-80-MPLCOm2012-0.015	18.1	245,890	1,265	11.9	460	5,556	12.1	44	535	39
A-55-80-Bach-0.026	20.0	246,562	1,286	11.9	462	5,419	11.7	45	534	43
A-50-80-Bach-0.026	20.1	248,267	1,290	12.0	465	5,491	11.8	45	534	43
B-50-80-MPLCOm2012-0.007	27.1	249,159	1,295	11.0	426	5,638	13.2	44	585	64
A-50-80-MPLCOm2012-0.015	18.2	250,423	1,275	12.0	464	5,661	12.2	44	540	39
B-50-80-Bach-0.012	29.5	254,312	1,326	11.2	434	5,579	12.9	46	586	68
A-50-80-MLCDRAT-0.015	19.9	256,318	1,292	12.1	467	5,514	11.8	46	549	43
A-50-77-MPLCOm2012-0.013	18.9	257,643	1,149	11.0	426	5,694	13.4	45	605	44
A-55-80-Bach-0.025	20.6	258,218	1,308	12.2	473	5,573	11.8	46	546	44
A-50-80-Bach-0.025	20.7	260,585	1,315	12.3	476	5,661	11.9	46	547	43

Appendix C Table 27. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
A-55-80-MPLCOm2012-0.014	18.9	262,322	1,296	12.2	473	5,729	12.1	46	555	40
B-50-80-Bach-0.011	30.5	268,617	1,343	11.4	442	5,770	13.1	47	608	69
A-50-80-MPLCOm2012-0.014	19.0	268,752	1,311	12.4	479	5,895	12.3	46	561	40
A-55-80-Bach-0.024	21.1	270,181	1,332	12.4	480	5,701	11.9	47	563	44
A-55-80-MLCDRAT-0.014	20.7	272,113	1,320	12.4	481	5,701	11.9	48	566	43
A-50-80-Bach-0.024	21.2	273,052	1,341	12.6	486	5,855	12.0	47	562	44
B-50-80-MPLCOm2012-0.006	28.9	274,258	1,332	11.4	442	5,871	13.3	47	620	65
A-50-80-MLCDRAT-0.014	20.8	274,909	1,327	12.5	483	5,794	12.0	47	569	43
A-50-77-MPLCOm2012-0.012	19.9	279,337	1,183	11.3	437	5,932	13.6	47	639	46
A-55-80-MPLCOm2012-0.013	19.7	279,923	1,327	12.5	483	5,894	12.2	47	580	41
A-55-80-Bach-0.023	21.7	282,290	1,356	12.7	490	5,850	11.9	48	576	44
B-50-80-Bach-0.01	31.5	283,740	1,371	11.6	449	5,889	13.1	48	632	70
A-50-80-Bach-0.023	21.8	285,981	1,366	12.8	496	5,964	12.0	48	577	44
A-55-80-MLCDRAT-0.013	21.6	288,408	1,352	12.7	493	5,897	12.0	49	585	44
A-50-80-MPLCOm2012-0.013	19.8	288,922	1,345	12.8	493	6,133	12.4	47	586	40
A-50-80-MLCDRAT-0.013	21.7	292,622	1,361	12.8	496	5,988	12.1	49	590	44
A-55-80-Bach-0.022	22.3	295,112	1,378	12.9	501	6,005	12.0	49	589	45
A-55-80-MPLCOm2012-0.012	20.6	299,594	1,362	12.9	498	6,124	12.3	49	602	41
A-50-80-Bach-0.022	22.4	299,744	1,388	13.1	507	6,147	12.1	49	591	44
B-50-80-Bach-0.009	32.7	300,632	1,397	12.0	465	6,116	13.2	49	647	70
B-50-80-MPLCOm2012-0.005	30.9	303,280	1,370	11.8	456	6,122	13.4	50	665	68
A-50-77-MPLCOm2012-0.011	20.8	303,627	1,215	11.7	452	6,190	13.7	49	672	46
A-55-80-20-15	**19.9**	**306,810**	**1,203**	**11.7**	**452**	**6,019**	**13.3**	**51**	**679**	**44**
A-55-80-Bach-0.021	22.9	308,714	1,400	13.2	513	6,166	12.0	50	602	45
A-55-80-MLCDRAT-0.012	22.7	309,691	1,388	13.1	507	6,106	12.0	51	611	45
A-50-80-MPLCOm2012-0.012	20.8	312,226	1,384	13.1	508	6,391	12.6	49	615	41
A-50-80-Bach-0.021	23.0	314,528	1,411	13.3	515	6,313	12.3	50	611	45
A-50-80-MLCDRAT-0.012	22.9	316,104	1,400	13.3	513	6,261	12.2	50	616	45
A-55-80-MPLCOm2012-0.011	21.6	319,813	1,391	13.2	512	6,313	12.3	51	625	42
A-55-80-Bach-0.02	23.5	322,574	1,418	13.5	521	6,318	12.1	51	619	45
A-50-80-Bach-0.02	23.6	329,953	1,434	13.6	527	6,493	12.3	51	626	45
A-50-77-MPLCOm2012-0.01	22.0	330,899	1,253	12.1	468	6,492	13.9	51	707	47
A-55-80-MLCDRAT-0.011	24.3	333,280	1,426	13.5	523	6,346	12.1	53	637	46
A-55-80-Bach-0.019	24.1	336,938	1,438	13.6	528	6,438	12.2	52	638	46
A-50-80-MPLCOm2012-0.011	21.9	338,238	1,420	13.6	526	6,644	12.6	51	643	42
A-55-80-MPLCOm2012-0.01	22.6	341,753	1,424	13.6	525	6,511	12.4	52	651	43
A-50-80-MLCDRAT-0.011	24.5	341,894	1,443	13.7	530	6,549	12.4	52	645	46
A-55-80-20-20	**21.3**	**343,972**	**1,285**	**12.4**	**479**	**6,366**	**13.3**	**54**	**718**	**44**

Appendix C Table 27. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	% Eligible	LDCT Screens	Screen-Detected LC Cases	LC Mortality Reduction (%)	LC Deaths Averted	LYG	LYG per LC Deaths Averted	LDCT Screens per LYG	LDCT Screens per LC Deaths Averted	NNS
A-50-80-Bach-0.019	24.3	345,891	1,458	13.9	536	6,643	12.4	52	645	45
A-55-80-Bach-0.018	24.7	352,513	1,463	13.9	537	6,581	12.3	54	656	46
A-55-80-MLCDRAT-0.01	26.5	360,405	1,470	13.9	538	6,566	12.2	55	670	49
A-50-80-Bach-0.018	24.9	363,441	1,483	14.1	547	6,815	12.5	53	664	46
A-50-80-MPLCOm2012-0.01	23.0	367,433	1,456	14.0	541	6,952	12.9	53	679	43
A-55-80-Bach-0.017	25.4	368,501	1,487	14.2	548	6,746	12.3	55	672	46
A-50-80-MLCDRAT-0.01	26.7	371,729	1,492	14.2	550	6,851	12.5	54	676	49
A-55-80-20-25	**22.0**	**376,912**	**1,349**	**13.1**	**505**	**6,656**	**13.2**	**57**	**746**	**44**
A-50-80-Bach-0.017	25.6	382,161	1,505	14.4	559	7,000	12.5	55	684	46
A-55-80-Bach-0.016	26.1	385,000	1,504	14.3	554	6,836	12.3	56	695	47
A-55-80-MLCDRAT-0.009	29.0	393,326	1,518	14.4	556	6,831	12.3	58	707	52
A-50-80-20-15	**22.1**	**393,642**	**1,270**	**12.5**	**482**	**6,888**	**14.3**	**57**	**817**	**46**
A-55-80-MPLCOm2012-0.008	25.1	395,223	1,494	14.4	556	6,990	12.6	57	711	45
A-50-80-MPLCOm2012-0.009	24.2	400,893	1,499	14.4	558	7,264	13.0	55	718	43
A-50-80-Bach-0.016	26.3	401,912	1,530	14.6	566	7,130	12.6	56	710	46
A-55-80-Bach-0.015	26.8	402,313	1,525	14.7	567	7,021	12.4	57	710	47
A-50-80-MLCDRAT-0.009	29.2	408,368	1,542	14.7	570	7,129	12.5	57	716	51
A-55-80-Bach-0.014	27.5	420,368	1,546	14.8	572	7,133	12.5	59	735	48
A-50-80-Bach-0.015	27.1	422,671	1,552	14.9	577	7,331	12.7	58	733	47
A-55-80-MLCDRAT-0.008	31.8	430,892	1,569	14.9	578	7,128	12.3	60	745	55
A-50-80-20-20	**22.8**	**435,612**	**1,351**	**13.3**	**513**	**7,257**	**14.1**	**60**	**849**	**44**
A-55-80-Bach-0.013	28.3	439,639	1,569	15.0	582	7,268	12.5	60	755	49
A-50-80-MPLCOm2012-0.008	25.7	439,765	1,540	14.9	577	7,578	13.1	58	762	45
A-50-80-Bach-0.014	27.9	444,572	1,577	15.2	588	7,539	12.8	59	756	47
A-50-80-MLCDRAT-0.008	32.1	451,693	1,599	15.3	591	7,486	12.7	60	764	54
A-55-80-Bach-0.012	29.2	460,155	1,590	15.2	588	7,391	12.6	62	783	50
A-50-80-Bach-0.013	28.7	468,214	1,602	15.5	599	7,729	12.9	61	782	48
A-50-80-20-25	**23.0**	**470,506**	**1,414**	**13.8**	**535**	**7,533**	**14.1**	**62**	**879**	**43**
A-55-80-MLCDRAT-0.007	34.6	474,378	1,625	15.6	602	7,432	12.3	64	788	57
A-55-80-Bach-0.011	30.1	482,190	1,614	15.6	601	7,574	12.6	64	802	50
A-50-80-MPLCOm2012-0.007	27.2	483,401	1,582	15.4	594	7,871	13.3	61	814	46
A-50-80-Bach-0.012	29.6	493,841	1,627	15.8	610	7,917	13.0	62	810	49
A-50-80-MLCDRAT-0.007	35.0	503,486	1,661	16.0	618	7,898	12.8	64	815	57
A-55-80-Bach-0.01	31.0	505,254	1,635	15.8	612	7,768	12.7	65	826	51
A-50-80-Bach-0.011	30.6	521,832	1,654	16.1	624	8,160	13.1	64	836	49
A-55-80-MLCDRAT-0.006	37.3	527,189	1,677	16.2	625	7,804	12.5	68	844	60
A-50-80-MPLCOm2012-0.006	29.0	531,812	1,625	15.8	612	8,187	13.4	65	869	47
A-50-80-Bach-0.01	31.6	551,363	1,681	16.4	634	8,327	13.1	66	870	50

Appendix C Table 27. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Benefits of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs.
Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.
Abbreviations: LC=lung cancer; LDCT=low-dose computed tomography; LYG=life-years gained; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; NNS=number (people) needed to screen (ever) to prevent one lung cancer death; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 28. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
B-50-80-MLCDRAT-0.015	133,154	149,692	6.7	1.0	451	25	0.5	2.4	11.1
B-50-80-Bach-0.025	135,434	152,193	6.6	1.0	462	25	0.5	2.3	11.1
B-50-80-MPLCOm2012-0.014	138,947	155,617	7.4	1.0	460	24	0.5	2.3	12.0
B-55-80-Bach-0.024	139,022	155,950	6.7	1.0	462	24	0.5	2.3	11.6
B-50-80-Bach-0.024	141,852	159,021	6.7	1.0	473	26	0.5	2.4	11.9
B-50-80-MLCDRAT-0.014	142,739	159,905	6.9	1.0	470	26	0.5	2.4	12.1
B-55-80-MPLCOm2012-0.013	143,529	160,485	7.4	1.0	463	24	0.5	2.3	12.6
B-50-80-Bach-0.023	148,437	166,018	6.8	1.0	484	26	0.6	2.4	12.4
B-50-80-MPLCOm2012-0.013	149,217	166,526	7.6	1.1	477	25	0.5	2.3	13.4
A-55-80-MPLCOm2012-0.023	155,135	171,724	11.5	1.4	452	27	0.6	2.6	11.3
A-50-80-MPLCOm2012-0.023	155,203	171,793	11.5	1.4	452	27	0.6	2.6	11.3
B-50-80-Bach-0.022	155,387	173,405	7.0	1.0	495	27	0.6	2.4	12.9
A-55-80-MLCDRAT-0.023	157,918	174,848	10.7	1.3	454	27	0.6	2.6	11.0
B-55-80-Bach-0.021	158,593	176,781	7.0	1.0	495	25	0.5	2.3	13.1
B-50-80-MPLCOm2012-0.012	160,981	179,029	7.8	1.1	498	25	0.5	2.2	13.8
A-55-80-MPLCOm2012-0.022	163,721	180,796	11.8	1.4	466	27	0.6	2.5	12.2
A-50-80-MPLCOm2012-0.022	163,841	180,936	11.8	1.4	466	27	0.6	2.5	12.2
B-50-80-Bach-0.021	164,771	183,392	7.1	1.0	515	34	0.7	2.9	13.7
B-55-80-Bach-0.02	165,615	184,256	7.1	1.0	506	25	0.5	2.2	14.0
B-50-80-Bach-0.02	170,850	189,841	7.3	1.0	519	27	0.6	2.3	14.6
A-55-80-Bach-0.034	171,934	189,747	10.7	1.3	486	29	0.6	2.6	12.9
A-50-80-Bach-0.034	172,099	189,921	10.7	1.3	486	29	0.6	2.6	12.9
A-55-80-MPLCOm2012-0.021	172,750	190,361	12.0	1.5	481	28	0.6	2.6	13.3
B-55-80-Bach-0.019	172,895	191,977	7.2	1.0	517	25	0.5	2.2	14.6
A-50-80-MPLCOm2012-0.021	172,981	190,597	11.9	1.5	481	28	0.6	2.6	13.3
B-50-80-MPLCOm2012-0.011	174,712	193,613	8.0	1.1	518	25	0.5	2.2	15.4
A-55-80-Bach-0.033	180,029	198,322	10.9	1.3	498	30	0.6	2.7	13.6
A-50-80-Bach-0.033	180,254	198,559	10.9	1.3	499	29	0.6	2.6	13.7
B-50-80-Bach-0.019	180,905	200,531	7.4	1.1	541	36	0.7	3.0	15.3
A-55-80-MPLCOm2012-0.02	182,585	200,757	12.3	1.5	496	29	0.6	2.6	14.2
A-50-80-MPLCOm2012-0.02	182,997	201,200	12.2	1.5	496	28	0.6	2.5	14.3
A-50-80-MLCDRAT-0.02	186,517	205,129	11.3	1.4	501	29	0.6	2.6	13.4
A-55-80-Bach-0.032	188,493	207,274	11.1	1.4	512	30	0.6	2.6	14.2
A-50-80-Bach-0.032	188,809	207,606	11.1	1.4	512	30	0.6	2.6	14.3
B-50-80-MPLCOm2012-0.01	189,425	209,223	8.3	1.2	540	26	0.6	2.2	17.0
B-50-80-Bach-0.018	189,784	209,956	7.6	1.1	555	37	0.7	3.0	16.1
A-55-80-MPLCOm2012-0.019	193,387	212,182	12.5	1.5	512	29	0.6	2.5	15.2

Appendix C Table 28. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-MPLCOm2012-0.019	194,126	212,958	12.5	1.5	513	28	0.6	2.4	15.3
A-55-80-Bach-0.031	196,948	216,222	11.3	1.4	525	30	0.6	2.6	15.0
A-50-80-Bach-0.031	197,382	216,684	11.3	1.4	525	30	0.6	2.6	15.1
A-50-80-MLCDRAT-0.019	200,062	219,459	11.6	1.4	523	31	0.6	2.7	14.7
A-55-80-MPLCOm2012-0.018	204,873	224,318	12.7	1.5	528	28	0.6	2.4	15.9
A-50-80-MPLCOm2012-0.018	206,134	225,653	12.8	1.5	531	29	0.6	2.5	16.1
A-55-80-Bach-0.03	206,221	226,038	11.5	1.4	539	30	0.6	2.5	15.7
B-50-80-MPLCOm2012-0.009	206,519	227,383	8.6	1.2	565	27	0.6	2.2	18.6
A-50-80-Bach-0.03	206,796	226,646	11.5	1.4	539	31	0.7	2.6	15.7
B-50-80-Bach-0.016	207,372	228,614	7.9	1.1	574	28	0.6	2.3	18.2
A-55-80-MLCDRAT-0.018	210,294	230,274	11.9	1.4	539	31	0.6	2.6	15.7
A-50-80-MLCDRAT-0.018	210,318	230,310	11.9	1.4	538	30	0.6	2.5	15.7
A-55-80-30-15	**211,055**	**230,291**	**15.5**	**1.9**	**473**	**23**	**0.5**	**2.3**	**23.4**
A-55-80-Bach-0.029	215,368	235,718	11.7	1.4	552	31	0.6	2.5	16.3
A-50-80-Bach-0.029	216,161	236,548	11.7	1.4	553	31	0.7	2.5	16.5
A-55-80-MPLCOm2012-0.017	217,546	237,736	13.0	1.6	547	30	0.6	2.5	17.2
A-50-80-MPLCOm2012-0.017	219,544	239,821	13.1	1.6	550	30	0.6	2.5	17.5
A-55-80-Bach-0.028	225,598	246,529	11.9	1.4	566	31	0.7	2.5	17.0
B-50-80-MPLCOm2012-0.008	226,142	248,190	8.8	1.2	591	28	0.6	2.2	20.1
A-50-80-MLCDRAT-0.017	226,165	247,053	12.3	1.5	561	31	0.7	2.5	17.1
A-50-80-Bach-0.028	226,614	247,607	11.9	1.4	568	32	0.7	2.6	17.2
B-50-80-Bach-0.014	229,085	251,648	8.2	1.1	604	29	0.6	2.3	19.6
A-55-80-MPLCOm2012-0.016	230,908	251,859	13.3	1.6	565	30	0.6	2.4	18.4
A-50-80-MPLCOm2012-0.016	233,969	255,066	13.4	1.6	570	30	0.6	2.4	19.0
A-55-80-Bach-0.027	236,104	257,636	12.1	1.5	580	31	0.7	2.5	18.1
A-50-80-Bach-0.027	237,516	259,138	12.1	1.5	583	32	0.7	2.5	18.3
A-50-80-MLCDRAT-0.016	238,916	260,542	12.5	1.5	580	32	0.7	2.5	18.2
B-50-80-Bach-0.013	241,152	264,441	8.4	1.2	622	29	0.6	2.2	20.9
A-55-80-MPLCOm2012-0.015	245,890	267,695	13.6	1.6	586	30	0.6	2.4	19.6
A-55-80-Bach-0.026	246,562	268,706	12.3	1.5	595	32	0.7	2.5	18.8
A-50-80-Bach-0.026	248,267	270,517	12.4	1.5	598	33	0.7	2.6	19.0
B-50-80-MPLCOm2012-0.007	249,159	272,629	9.2	1.3	623	28	0.6	2.2	21.9
A-50-80-MPLCOm2012-0.015	250,423	272,463	13.8	1.6	592	30	0.6	2.4	20.3
B-50-80-Bach-0.012	254,312	278,410	8.6	1.2	639	30	0.6	2.3	22.2
A-50-80-MLCDRAT-0.015	256,318	278,938	12.9	1.6	604	33	0.7	2.6	19.3
A-50-77-MPLCOm2012-0.013	257,643	280,134	13.6	1.6	559	25	0.5	2.2	22.2
A-55-80-Bach-0.025	258,218	281,020	12.5	1.5	611	33	0.7	2.5	19.7
A-50-80-Bach-0.025	260,585	283,517	12.6	1.5	614	34	0.7	2.6	20.1

Appendix C Table 28. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-55-80-MPLCOm2012-0.014	262,322	285,055	13.9	1.7	607	31	0.6	2.4	20.6
B-50-80-Bach-0.011	268,617	293,565	8.8	1.2	656	30	0.6	2.2	23.1
A-50-80-MPLCOm2012-0.014	268,752	291,812	14.1	1.7	616	30	0.6	2.3	21.4
A-55-80-Bach-0.024	270,181	293,673	12.8	1.5	627	33	0.7	2.5	20.4
A-55-80-MLCDRAT-0.014	272,113	295,649	13.1	1.6	623	33	0.7	2.5	20.4
A-50-80-Bach-0.024	273,052	296,691	12.9	1.5	631	34	0.7	2.5	20.7
B-50-80-MPLCOm2012-0.006	274,258	299,256	9.5	1.3	655	30	0.6	2.3	23.9
A-50-80-MLCDRAT-0.014	274,909	298,582	13.2	1.6	627	33	0.7	2.5	20.8
A-50-77-MPLCOm2012-0.012	279,337	303,049	14.0	1.7	585	26	0.5	2.2	24.2
A-55-80-MPLCOm2012-0.013	279,923	303,665	14.2	1.7	629	32	0.7	2.4	22.0
A-55-80-Bach-0.023	282,290	306,471	13.0	1.6	643	34	0.7	2.5	21.1
B-50-80-Bach-0.01	283,740	309,625	9.0	1.2	677	31	0.6	2.3	24.5
A-50-80-Bach-0.023	285,981	310,346	13.1	1.6	648	34	0.7	2.5	21.6
A-55-80-MLCDRAT-0.013	288,408	312,879	13.4	1.6	645	34	0.7	2.5	21.4
A-50-80-MPLCOm2012-0.013	288,922	313,117	14.6	1.7	640	32	0.7	2.4	23.2
A-50-80-MLCDRAT-0.013	292,622	317,310	13.5	1.6	651	34	0.7	2.5	21.9
A-55-80-Bach-0.022	295,112	320,012	13.2	1.6	658	34	0.7	2.5	22.4
A-55-80-MPLCOm2012-0.012	299,594	324,423	14.5	1.7	653	33	0.7	2.4	23.5
A-50-80-Bach-0.022	299,744	324,882	13.4	1.6	665	35	0.7	2.5	23.0
B-50-80-Bach-0.009	300,632	327,539	9.2	1.3	699	32	0.7	2.3	25.8
B-50-80-MPLCOm2012-0.005	303,280	330,029	9.8	1.3	690	30	0.6	2.2	25.4
A-50-77-MPLCOm2012-0.011	303,627	328,670	14.6	1.7	612	26	0.5	2.1	26.2
A-55-80-20-15	**306,810**	**331,730**	**15.4**	**1.9**	**611**	**29**	**0.6**	**2.4**	**30.1**
A-55-80-Bach-0.021	308,714	334,386	13.5	1.6	675	34	0.7	2.4	23.2
A-55-80-MLCDRAT-0.012	309,691	335,384	13.6	1.6	671	35	0.7	2.5	23.1
A-50-80-MPLCOm2012-0.012	312,226	337,721	15.0	1.8	669	33	0.7	2.4	25.3
A-50-80-Bach-0.021	314,528	340,506	13.7	1.6	682	35	0.7	2.5	24.1
A-50-80-MLCDRAT-0.012	316,104	342,142	13.8	1.6	679	35	0.7	2.5	24.0
A-55-80-MPLCOm2012-0.011	319,813	345,797	14.8	1.7	677	33	0.7	2.4	24.8
A-55-80-Bach-0.02	322,574	349,024	13.7	1.6	690	35	0.7	2.5	24.2
A-50-80-Bach-0.02	329,953	356,778	14.0	1.7	700	35	0.7	2.4	25.1
A-50-77-MPLCOm2012-0.01	330,899	357,465	15.0	1.8	643	27	0.6	2.2	28.8
A-55-80-MLCDRAT-0.011	333,280	360,355	13.7	1.6	700	36	0.7	2.5	24.7
A-55-80-Bach-0.019	336,938	364,174	14.0	1.7	706	35	0.7	2.4	25.3
A-50-80-MPLCOm2012-0.011	338,238	365,171	15.4	1.8	698	33	0.7	2.3	27.4
A-55-80-MPLCOm2012-0.01	341,753	368,990	15.1	1.8	702	34	0.7	2.4	26.6
A-50-80-MLCDRAT-0.011	341,894	369,425	14.0	1.7	711	36	0.7	2.5	25.9
A-55-80-20-20	**343,972**	**370,941**	**16.1**	**1.9**	**662**	**32**	**0.7**	**2.5**	**31.6**

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Scenario	LDCT Screens	LDCT Scans	Avg. LDCT Screens per Person Screened	Avg. False-Positive Results per Person Screened	Biopsies	Overdiagnosed Cases	Overdiagnosis: % of All LC Cases	Overdiagnosis: % of Screen-Detected LC Cases	Radiation-Related LC Deaths†
A-50-80-Bach-0.019	345,891	373,605	14.2	1.7	718	36	0.7	2.5	26.5
A-55-80-Bach-0.018	352,513	380,640	14.3	1.7	725	36	0.8	2.5	26.6
A-55-80-MLCDRAT-0.01	360,405	389,145	13.6	1.6	733	37	0.8	2.5	26.6
A-50-80-Bach-0.018	363,441	392,125	14.6	1.7	738	37	0.8	2.5	28.1
A-50-80-MPLCOm2012-0.01	367,433	395,967	16.0	1.9	729	34	0.7	2.3	30.0
A-55-80-Bach-0.017	368,501	397,510	14.5	1.7	743	37	0.8	2.5	28.2
A-50-80-MLCDRAT-0.01	371,729	401,058	13.9	1.7	748	37	0.8	2.5	28.3
A-55-80-20-25	**376,912**	**405,586**	**17.1**	**2.0**	**702**	**34**	**0.7**	**2.5**	**32.9**
A-50-80-Bach-0.017	382,161	411,883	14.9	1.8	758	37	0.8	2.5	30.3
A-55-80-Bach-0.016	385,000	414,941	14.8	1.7	760	37	0.8	2.5	29.3
A-55-80-MLCDRAT-0.009	393,326	424,082	13.6	1.6	773	38	0.8	2.5	29.5
A-50-80-20-15	**393,642**	**423,074**	**17.8**	**2.1**	**692**	**30**	**0.6**	**2.4**	**38.9**
A-55-80-MPLCOm2012-0.008	395,223	425,500	15.7	1.8	761	36	0.7	2.4	30.1
A-50-80-MPLCOm2012-0.009	400,893	431,266	16.6	1.9	765	35	0.7	2.3	32.5
A-50-80-Bach-0.016	401,912	432,726	15.3	1.8	779	38	0.8	2.5	31.8
A-55-80-Bach-0.015	402,313	433,217	15.0	1.8	778	38	0.8	2.5	30.5
A-50-80-MLCDRAT-0.009	408,368	439,889	14.0	1.7	790	38	0.8	2.5	31.6
A-55-80-Bach-0.014	420,368	452,275	15.3	1.8	797	38	0.8	2.5	31.9
A-50-80-Bach-0.015	422,671	454,637	15.6	1.8	800	38	0.8	2.4	33.5
A-55-80-MLCDRAT-0.008	430,892	463,909	13.6	1.6	816	39	0.8	2.5	31.6
A-50-80-20-20	**435,612**	**467,198**	**19.1**	**2.3**	**744**	**33**	**0.7**	**2.4**	**40.7**
A-55-80-Bach-0.013	439,639	472,634	15.5	1.8	817	38	0.8	2.4	33.5
A-50-80-MPLCOm2012-0.008	439,765	472,285	17.1	2.0	805	35	0.7	2.3	35.6
A-50-80-Bach-0.014	444,572	477,710	15.9	1.9	823	38	0.8	2.4	35.2
A-50-80-MLCDRAT-0.008	451,693	485,766	14.1	1.7	840	39	0.8	2.4	34.4
A-55-80-Bach-0.012	460,155	494,271	15.8	1.8	838	39	0.8	2.5	34.8
A-50-80-Bach-0.013	468,214	502,658	16.3	1.9	847	38	0.8	2.4	37.3
A-50-80-20-25	**470,506**	**503,852**	**20.5**	**2.4**	**784**	**34**	**0.7**	**2.4**	**42.0**
A-55-80-MLCDRAT-0.007	474,378	509,969	13.7	1.6	865	40	0.8	2.5	34.2
A-55-80-Bach-0.011	482,190	517,565	16.0	1.9	861	39	0.8	2.4	36.2
A-50-80-MPLCOm2012-0.007	483,401	518,318	17.8	2.1	848	36	0.8	2.3	38.8
A-50-80-Bach-0.012	493,841	529,690	16.7	1.9	872	39	0.8	2.4	39.4
A-50-80-MLCDRAT-0.007	503,486	540,551	14.4	1.7	896	40	0.8	2.4	37.9
A-55-80-Bach-0.01	505,254	541,900	16.3	1.9	883	40	0.8	2.4	37.7
A-50-80-Bach-0.011	521,832	559,192	17.1	2.0	899	40	0.8	2.4	41.4
A-55-80-MLCDRAT-0.006	527,189	565,798	14.1	1.7	919	42	0.9	2.5	37.4
A-50-80-MPLCOm2012-0.006	531,812	569,342	18.3	2.1	894	37	0.8	2.3	42.3
A-50-80-Bach-0.01	551,363	590,337	17.4	2.0	928	40	0.8	2.4	43.6

Appendix C Table 28. Sensitivity Analysis by Excluding Individuals With Life Expectancy of Less Than 5 Years From Screening: Harms of 144 Selected* Consensus-Efficient Risk Model–Based or Risk Factor–Based Screening Programs Plus the 2013 USPSTF-Recommended Criteria and Six Selected 20 Pack-Year Scenarios Ordered by LDCT Screens—1960 Birth Cohort

*Strategies with at least 9.0 percent lung cancer mortality reduction and fewer than 600,000 LDCTs. †Average of two models (MGH-HMS and University of Michigan).

Numbers are per a 100 000-person cohort followed from ages 45 to 90 years and are based on averaged estimates across the four models. The screening programs are labeled as follows: frequency (A–annual and B–biennial)–age start–age stop–lung cancer risk prediction model (MPLCOm2012, MLCDRAT, Bach)–risk threshold. The 2013 USPSTF-recommended (A-55-80-30-15) strategy and the six selected 20 pack-year strategies are shown in bold.

Abbreviations: avg.=average; LC=lung cancer; LDCT=low-dose computed tomography; MGH-HMS=Massachusetts General Hospital–Harvard Medical School; MLCDRAT=Lung Cancer Death Risk Assessment Tool–modified; MPLCOm2012=modified PLCOm2012 model; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 29. Screening Eligibility in the United States and Proportional Distribution of 100,000 LDCT Screens by Sex According to the 2015 National Health Interview Survey

Scenario		Men	Women	Total
2013 USPSTF (A-55-80-30-15)	Number eligible	4,691,054	3,414,939	8,095,274
	Percentage eligible*	4.2%	2.8%	3.5%
	Number of LDCTs	57,546	42,454	100,000
	Percentage of LDCTs	57.5%	42.5%	100.0%
A-55-80-20-15	Number eligible	6,400,415	5,321,359	11,711,857
	Percentage eligible*	5.7%	4.4%	5.0%
	Number of LDCTs	54,287	45,713	100,000
	Percentage of LDCTs	54.3%	45.7%	100.0%
A-55-80-20-20	Number eligible	7,488,322	5,818,536	13,286,967
	Percentage eligible*	6.7%	4.8%	5.7%
	Number of LDCTs	55,831	44,169	100,000
	Percentage of LDCTs	55.8%	44.2%	100.0%
A-55-80-20-25	Number eligible	8,143,360	6,292,519	14,411,807
	Percentage eligible*	7.3%	5.2%	6.2%
	Number of LDCTs	55,924	44,076	100,000
	Percentage of LDCTs	55.9%	44.1%	100.0%
A-50-80-20-15	Number eligible	8,460,913	6,698,602	15,136,661
	Percentage eligible*	7.6%	5.5%	6.5%
	Number of LDCTs	55,338	44,662	100,000
	Percentage of LDCTs	55.3%	44.7%	100.0%
A-50-80-20-20	Number eligible	9,629,964	7,255,481	16,847,872
	Percentage eligible*	8.6%	6.0%	7.2%
	Number of LDCTs	56,428	43,572	100,000
	Percentage of LDCTs	56.4%	43.6%	100.0%
A-50-80-20-25	Number eligible	10,318,296	7,756,939	18,031,876
	Percentage eligible*	9.2%	6.4%	7.7%
	Number of LDCTs	56,439	43,561	100,000
	Percentage of LDCTs	56.4%	43.6%	100.0%

*Of adults ages 18+

Abbreviation: LDCT=low-dose computed tomography; USPSTF=U.S. Preventive Services Task Force.

Appendix C Table 30. Screening Eligibility in the United States and Proportional Distribution of 100,000 LDCT Screens by Race/Ethnicity According to the 2015 National Health Interview Survey

Scenario		NHW	NHB	Hispanic	Asian	AI/AN	Total
2013 USPSTF (A-55-80-30-15)	Number eligible	6,808,288	534,109	283,030	157,602	43,201	8,095,274
	Percentage eligible*	4.5%	1.9%	0.8%	1.2%	2.5%	3.5%
	Number of LDCTs	87,003	6,815	3,618	2,012	552	100,000
	Percentage of LDCTs	87.0%	6.8%	3.6%	2.0%	0.6%	100%
A-55-80-20-15	Number eligible	9,449,171	952,962	463,140	221,459	63,832	11,711,857
	Percentage eligible*	6.2%	3.4%	1.3%	1.6%	3.6%	5.0%
	Number of LDCTs	84,730	8,548	4,162	1,988	573	100,000
	Percentage of LDCTs	84.7%	8.5%	4.2%	2.0%	0.6%	100%
A-55-80-20-20	Number eligible	10,685,654	1,028,862	558,708	237,762	63,832	13,286,967
	Percentage eligible*	7.0%	3.7%	1.5%	1.8%	3.6%	5.7%
	Number of LDCTs	84,960	8,192	4,448	1,892	508	100,000
	Percentage of LDCTs	85.0%	8.2%	4.4%	1.9%	0.5%	100%
A-55-80-20-25	Number eligible	11,555,772	1,082,273	610,168	254,066	69,298	14,411,807
	Percentage eligible*	7.6%	3.9%	1.7%	1.9%	3.9%	6.2%
	Number of LDCTs	85,139	7,977	4,500	1,874	510	100,000
	Percentage of LDCTs	85.1%	8.0%	4.5%	1.9%	0.5%	100%
A-50-80-20-15	Number eligible	12,135,850	1,104,761	599,141	254,066	115,496	15,136,661
	Percentage eligible*	8.0%	3.9%	1.6%	1.9%	6.6%	6.5%
	Number of LDCTs	85,416	7,780	4,207	1,784	813	100,000
	Percentage of LDCTs	85.4%	7.8%	4.2%	1.8%	0.8%	100%
A-50-80-20-20	Number eligible	13,418,128	1,191,905	713,088	270,370	115,496	16,847,872
	Percentage eligible*	8.8%	4.2%	1.9%	2.0%	6.6%	7.2%
	Number of LDCTs	85,429	7,582	4,537	1,717	735	100,000
	Percentage of LDCTs	85.4%	7.6%	4.5%	1.7%	0.7%	100%
A-50-80-20-25	Number eligible	14,318,776	1,245,316	771,899	286,673	120,963	18,031,876
	Percentage eligible*	9.4%	4.4%	2.1%	2.1%	6.9%	7.7%
	Number of LDCTs	85,531	7,434	4,602	1,710	722	100,000
	Percentage of LDCTs	85.5%	7.4%	4.6%	1.7%	0.7%	100%

*Of adults ages 18+

Abbreviations: AI/AN=American Indian and Alaska Native; LDCT=low-dose computed tomography; NHB=non-Hispanic black; NHW=non-Hispanic white; USPSTF=U.S. Preventive Services Task Force.