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DOI: 10.1377/hlthaff.2011.0814
HEALTH AFFAIRS 31,
NO. 4 (2012): 770–779

An Actuarial Analysis Shows That Offering Lung Cancer Screening As An Insurance Benefit Would Save Lives At Relatively Low Cost

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ABSTRACT **Lung cancer screening is not established as a public health practice, yet the results of a recent large randomized controlled trial showed that screening with low-dose spiral computed tomography reduces lung cancer mortality. Using actuarial models, this study estimated the costs and benefits of annual lung cancer screening offered as a commercial insurance benefit in the high-risk US population ages 50–64. Assuming current commercial reimbursement rates for treatment, we found that screening would cost about $1 per insured member per month in 2012 dollars. The cost per life-year saved would be below $19,000, an amount that compares favorably with screening for cervical, breast, and colorectal cancers. Our results suggest that commercial insurers should consider lung cancer screening of high-risk individuals to be high-value coverage and provide it as a benefit to people who are at least fifty years old and have a smoking history of thirty pack-years or more. We also believe that payers and patients should demand screening from high-quality, low-cost providers, thus helping set an example of efficient system innovation.**

Lung cancer is the most lethal cancer in the United States, with more than 150,000 deaths attributed to the disease annually[1] and a five-year survival rate of 16 percent.[2] In fact, more Americans die of lung cancer each year than of cervical, breast, colon, and prostate cancers combined.[1,3]

Currently, cancer screening—checking people for cancers or precancers before symptoms appear—is widely supported for only breast (mammography), colorectal (colonoscopy and other techniques), and cervical (Pap smears) cancers.[4] Lung cancer screening is not established as a public health practice. However, its value is being studied to identify the most efficacious and cost-effective screening procedure and the patients who might benefit.[5]

Low-dose spiral computed tomography (CT) is a rapidly evolving, commonly available, advanced imaging technology in which x-ray detectors rotate around the body to produce a three-dimensional image of internal structures (see the online Appendix for cost information).[6] The capability of low-dose spiral CT to visualize lung structure using low doses of radiation has greatly improved in the past two decades because of refinements in detector resolution, microprocessor performance, image acquisition speed, processing software, and file storage capacity.[7]

Over time, these refinements have improved the detection of potential malignancies and reduced the need for invasive procedures to determine the presence or absence of cancer.[8] Today, a full low-dose spiral CT lung cancer screening study can be completed in a few seconds.

In several studies of asymptomatic people at high risk of lung cancer, low-dose spiral CT has been shown to detect early-stage disease.[7–9]

Screening trials for people at high risk of lung cancer generally choose people who are at least fifty years old and have a history of heavy smoking for decades; they may specify the years since people last smoked. In the National Lung Screening Trial—a randomized US study of 53,454 people ages 55–74 who were at high risk of lung cancer—the use of three annual screens with low-dose spiral CT was associated with a 20 percent reduction in cancer-related mortality, compared with three annual chest x-ray screens.[9]

The clinical management of screening-detected lung cancer continues to evolve rapidly. Currently, early-stage lung cancer can usually be cured with surgical removal of the tumor alone.[10] Future improvements in lung cancer surgery might further reduce the risks and costs associated with surgical intervention.[11]

We estimated the cost and benefit of lung cancer screening in the high-risk US population who had private commercial health insurance (that is, they were insured but not covered by Medicare, Medicaid, or another form of public insurance). Our model consisted of two sequential steps, each containing distinct assumptions and methodologies that are important to payers.

In the first step, we determined the cost of screening to commercial payers—such as insurers, health maintenance organizations, and self-insured employers—given reasonable uptake rates, including the portion of eligible people who use the screening, and assuming that the clinicians and hospitals under contract to provide the screening services would do so efficiently.

In the second step, we performed a cost-benefit analysis of lung cancer screening to calculate how many life-years could be saved through screening because of early detection and treatment. We also determined cost changes associated with screening and subsequent treatment. We estimated costs of lung cancer screening assuming price levels toward the low end of observed managed care reimbursement for each component of the screening process. We used current commercial cost levels for lung cancer treatment.

Study Data And Methods

Our model was designed to estimate the cost and cost-benefit of lung cancer screening for US smokers and former smokers ages 50–64, with at least thirty pack-years of smoking each. (A *pack-year* is defined as smoking one pack of cigarettes each day for one year.) This group is estimated to consist of about eighteen million people, or about 30 percent of the US population ages 50–64. We applied standard actuarial methods that are often used when evaluating new insurance features or coverage.

The subject population consisted of these eighteen million people. Population details were derived from 2010 Census Bureau projections.[12]

DATA SOURCES AND METHODS FOR COST OF SCREENING We used published annual protocols for both low-dose spiral CT lung cancer screening[13] and follow-up visits during the year following the screening, until a diagnosis of either cancer or no cancer was made within the year following the screening. All patients received an initial screening and annual repeat screenings. Because the initial screening is likely to have different characteristics than repeat annual screenings, we show two protocols—one for an initial screening and one for an annual repeat screening. We depicted the protocols as decision trees, with branching that showed what happens to a screened patient at each step of the process (see Exhibit 1 for data on the initial screening and the online Appendix[6] for repeat annual screening).

We applied the 2011 national Medicare fee schedule[14] to most services because Medicare fees are widely used by commercial payers as a reference or benchmark. We also assumed that a thirty-minute counseling session on smoking cessation was part of each screening for both smokers and former smokers. However, our study did not model reductions in smoking rates or associated cost reductions resulting from the improved health of smokers who stopped smoking.

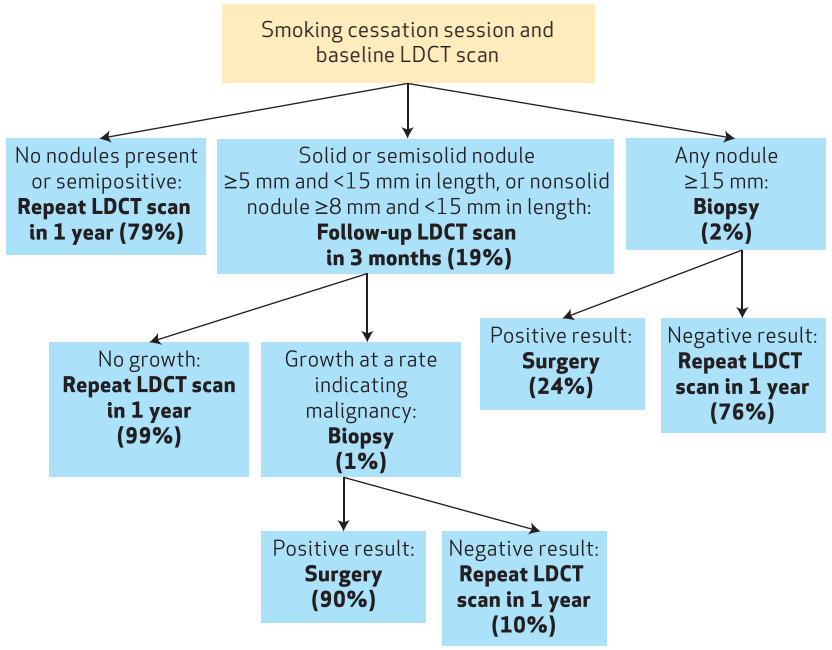
Based on published data,[15] initial low-dose spiral CT screenings of patients produce results that require near-term diagnostic evaluation 21 percent of the time, whereas repeat annual screening requires near-term diagnostic evaluation 7 percent of the time. We used near-term diagnostic evaluation rates that were about 50 percent and 30 percent higher, respectively, than the published rates to allow for worse-than-reported performance of the screening. Repeat screenings require less frequent near-term diagnostic evaluation than the initial screening because suspicious nodules—usually residual scars from prior infections—may be classified as nonmalignant during the near-term diagnostic evaluation after the initial screening.

Actual cancers are detected in 0.6 percent and 0.2 percent of initial and repeat screenings, respectively.[15] Clearly, most screenings and follow-ups detect no lung cancer. The cost of evaluation is not high because most cases do not require invasive procedures.

We built our estimates of annual episode cost per screened individual from the ground up. We assigned prices—that is, the amount payers

EXHIBIT 1

Baseline Decision Tree For Screening For And Diagnosis Of Lung Cancer



SOURCE Note 15 in text; personal communication with Claudia Henschke, Mt. Sinai School of Medicine, December 6, 2010. **NOTE** LDCT is low-dose spiral computed tomography.

would pay—and probability-weighted each service.[13] We started with low-dose spiral CT screening and included procedures for the near-term diagnostic evaluation that "rules in" or "rules out" lung cancer, to produce an average annual cost per screened patient.

Services beyond low-dose spiral CT screening might include an additional low-dose spiral CT scan or a biopsy of a suspicious lung nodule. There is neither a Current Procedural Terminology code nor a Medicare fee for a screening low-dose spiral CT of the thorax, but both exist for the similar diagnostic procedure.

Large-scale screening, such as that assumed in our study, would be consistent with a separate Current Procedural Terminology code and lower fee for screening. To approximate a lower-cost screening fee, we applied the ratio of fees for screening mammography and diagnostic mammography (with the former having much lower fees) to the fee for the diagnostic thorax CT scan.

We converted the annual cost per screened patient into a per member per month cost, which is typical for "insurance rider pricing." A rider, which is a modification to an insurance policy, is often used by insurers to add benefits to a core policy; pricing a rider is the process of developing the appropriate added cost of coverage. In our model, we assumed that 50 percent of the high-risk population ages 50–64 would actually use lung cancer screening, which is consistent with compliance with guidelines for colorectal cancer screening. We spread the annual cost across the entire insured commercial population, not only the high-risk population, and divided by twelve to convert the annual cost to a per member per month cost.

DATA SOURCES AND METHODS FOR COST-BENEFIT ANALYSIS Sources for the annual mortality rates used in our cost-benefit analysis included data from the Social Security Administration[16] and published lung cancer stage-specific mortality loads for cancer patients—which quantify the higher mortality in these patients compared with standard mortality—derived from the Surveillance, Epidemiology, and End Results (SEER) registry.[17] Medical costs were developed from the 2006–09 Thomson Reuters MarketScan, a large health insurance claims database.

Traditional stages of lung cancer are not apparent in claims data. Therefore, we defined three stages—A, B, and C—based on treatments received in the two years after diagnosis. These stages present a distribution of cases similar to the Surveillance, Epidemiology, and End Results categorization of localized, regional, and distant cancer, respectively.[18]

The core of our cost-benefit calculation was a stage-shift model, in which an intervention—in this case, lung cancer screening—shifted the distribution of stages of cancer. The consequence of the stage shift was that more lung cancers were detected at an earlier stage. This leads to treatment costs that are earlier and lower, and to more people cured of or living with cancer, both changes that are quantified by our calculation.

We created a status quo scenario, showing what happens without screening; a baseline scenario, showing what happens with screening; and other "sensitivity" scenarios that assumed screening took place but that had different key assumptions, such as number of people screened, percentage of early-stage cancers detected, and cost of treatment. These scenarios show the impact that varying the key model assumptions, including cost, life-years saved, and cost per life-year saved, has on the results. The sensitivity scenarios show that fairly large variations in assumptions do not greatly affect the results.

In the status quo scenario, cancers were distributed using historical stages, costs, and mortality. In the screening scenarios for the cost-benefit analysis, we assumed that 100 percent of the target population was screened each year, and that this population would generate 90 percent of cancer cases.[19] Because of the stage shift, the model calculated results as if the cancers had

been detected two years earlier, generally at less advanced stages, than if the screening had not taken place.

The 100 percent uptake assumption used in all screening scenarios for our cost-benefit analysis is not realistic. However, it makes the calculation of costs and benefits easier, and it enables direct comparisons among alternative protocols and across diseases. For the "rider pricing" of screening, we assumed a 50 percent uptake rate because our goal was to develop a realistic insurance cost.

The status quo scenario reproduced the current US distribution of new cancers by stage. Our stage shift for screening used a two-year offset for stage-related calculations including cost, as explained above. For example, the cancer diagnosed through screening when a person is age fifty-eight is an earlier stage of the same cancer that would have appeared two years later, when the person was age sixty.

In all screening scenarios, we annually advanced single-age and single-sex cohorts of high-risk people starting at age fifty to create a 2012 population of high-risk people ages 50–64, decreased by mortality rates specific to age and sex but including lung cancer survivors. In other words, the screening scenarios assumed that all high-risk people would have been screened starting at age fifty. Thus, in 2012 the surviving sixty-four-year-olds would have received annual screenings since 1998, when they were fifty, but the fifty-year-olds would have been screened only once, in 2012.

By detecting cancers earlier, we introduced a phantom survival improvement: Earlier detection produces longer apparent survival with cancer, even if no effective treatment exists. To reverse this "lead-time bias," we assumed a zero-year offset (with stage shift) for our calculations of life-years saved.

We varied assumptions used in the baseline model to create other "sensitivity" scenarios, all of which assumed screening. In all scenarios, we applied costs specific to cancer stage, as well as mortality rates specific to cancer stage and patient's age and sex.

The sensitivity scenarios tested these alternatives: Screening was less successful than assumed in the baseline scenario at identifying early-stage lung cancers; the high-risk population included more or fewer people; detected cancers included various portions of "pseudo-disease," a form of overdiagnosis; and the cost of treatment was more or less than we assumed.

We used 2012 cost levels throughout, which eliminated the need for discounting or trending (other than trending historical data to 2012). We believe that this approach is more transparent than forecasting future health care costs for fifteen years and discounting those results to the present time. The online Appendix presents additional details about our methodology.[6]

LIMITATIONS We acknowledge limitations in our methodology and modeling. First, we realize that no single source can provide all necessary data—a fact that is recognized in the actuarial literature.[20] However, relying on multiple sources can be confounding.

For example, the trial populations that produced our stage-shift assumptions could have been influenced by unknown socioeconomic characteristics that would not hold for the broader population. Screening costs could be much higher and benefits much lower than those shown in our analysis, if people other than those at high risk of lung cancer were screened or if follow-up care were not aligned with best practices. In particular, we did not address the process by which widespread screening could be implemented. Nevertheless, we feel that the cost per life-year saved of screening, compared with that of other services, is valid because such figures have often been calculated using assumptions from clinical trials.

Our rider pricing is appropriate for a benefit that is applied across a broad population. However, if screening is an optional benefit, adverse selection—the tendency for at-risk people to choose a wanted benefit while other people do not choose it—could mean that this pricing is too low. We did not reduce the rider price to account for the lower treatment cost of cancer at an earlier stage, because the earlier treatment would be covered through the core medical benefit rather than the rider.

Furthermore, we did not include in the rider price a possible initial surge of treatment from earlier detection, as screen-detected cancers appeared in addition to symptom-detected cancers. Any such surge would decline as screening reached a steady state. It would probably take several years to reach that state, with lower screening uptake and cost during the early years.

Our analysis did not consider the likely societal effects of lung cancer screening on productivity, tax contribution, disability, life insurance costs, or the cost of additional lung cancer survivors entering Medicare and Social Security programs. Further analysis is needed to quantify these effects. However, the magnitude of life-years saved in our projection suggests that some of these effects would further enhance the economic case for low-dose spiral CT screening.

We also did not consider the impact of the smoking cessation counseling that we assumed would be embedded in each annual screening.

Study Results

COST OF SCREENING The cost of lung cancer screening depends on several factors, including the number of people screened, prices charged for the various screening components, type of screening used, and screening quality. We estimated the average annual cost of lung cancer screening to be $247 per person screened, assuming that 75 percent of the screenings were repeat procedures (see the online Appendix for details).[6] That assumption is consistent with the ratio reported in a large collaborative study of low-dose spiral CT screening in people ages 50–59.[21]

The price of repeat screening plus follow-up is about one-third lower than that of initial screening because this follow-up is less intense than near-term diagnostic evaluation for initial screening. Assuming that 50 percent of the people ages 50–64 with thirty or more pack-years of smoking were screened, the insurer cost spread across the commercial population would be $0.76 per member per month, with no cost sharing. This is lower than the insurer cost for breast, colorectal, or cervical cancer screening (see the online Appendix for cost comparison).[6] In 2010 the average cost for an employer that provided health benefits to a single employee was $326 per month.[22]

The US Preventive Services Task Force (sponsored by the Agency for Healthcare Research and Quality) is responsible for determining whether particular preventive interventions should be covered without cost sharing in the insurance policies that, starting in 2014, will be sold through state exchanges established by the Affordable Care Act of 2010. A central focus of the task force's review is determining the benefits and harms of screening, including screening people at high risk of lung cancer. Our assumption that screening would not involve cost sharing is consistent with the Affordable Care Act's provision for preventive services that have a task force rating of A, for unequivocal benefit, or B, for objective benefit but some harm.[23]

As noted above, we assumed a 50 percent uptake rate for the lung cancer screening insurance rider, which is approximately equal to the current uptake rate for colorectal cancer screening. However, that rate would probably not be attained without widespread public health promotions to increase awareness among the high-risk population and primary care physicians, obtain reimbursement from insurers, and establish a sufficient level of provider expertise. The results of sensitivity testing on material assumptions, along with per member per month estimates for other cancer screenings, are shown in the Appendix.[6]

LUNG CANCER SURVIVORS AND CANCERS, BY STAGE The baseline screening scenario would lead to more than 130,000 additional lung cancer survivors in 2012 (Exhibit 2). This increase is attributable to screening. It does not include the more than 64,000 "lead-time people" who would be living with lung cancer (most of them at a less advanced stage) and would have first become symptomatic within two years of the screening. Some of these 64,000 people would avoid death from lung cancer in years beyond 2012 because of screening, but we did not include them in our 2012 figure of survivors, because—with or without screening—they would have been alive in 2012.

COST-BENEFIT ANALYSIS The costs and benefits of screening differed according to our sensitivity scenarios, described above (Exhibit 3). For

EXHIBIT 2

Number Of US Lung Cancer Survivors With Commercial Insurance, 2012, Baseline Scenario

		Lung cancer survivors				
Age (years)	Number of people screened in 2012	With no screening	With screening but no lead-time adjustment	Additional survivors with screening but no lead-time adjustment	Lead-time adjustment because of screening	Additional survivors with screening and lead-time adjustment
50–54	6,748,848	17,064	31,970	14,906	7,321	7,585
55–59	6,152,071	38,166	97,677	59,512	21,736	37,775
60–64	5,292,047	49,539	169,718	120,179	35,346	84,833
Total	18,192,966	104,769	299,365	194,597	64,402	130,195

SOURCE: Authors' analysis. **NOTES** The baseline scenario assumed screening people ages 50–64 with a smoking history of thirty or more pack-years. Numbers may not sum to total because of rounding. Lead-time adjustment corrects for the number of people who are diagnosed earlier because of screening.

EXHIBIT 3

Costs And Benefits Of Lung Cancer Screening Under Alternative Sensitivity Scenarios

Scenario	Lung cancer stage[a] (%)			Number of lung cancer patients		Cost per life-year saved ($)	Annual cost of care ($ billions)	
	A	B	C	Without screening	With screening		Without screening	With screening
DIFFERENT LEVELS OF SCREENING EFFECTIVENESS								
Baseline	79.3	16.2	4.5	104,768	299,365	18,862	11.00	15.40
Less effective than baseline	69.3	16.2	14.5	104,768	272,884	25,158	11.00	15.80
Some pseudodisease	84.3	16.2	4.5	104,768	316,028	20,559	11.00	15.90
Additional pseudodisease	99.3	16.2	4.5	104,768	366,016	25,649	11.00	17.40
DIFFERENT PERCENTAGES OF SCREENED SUBJECTS AGES 50–64								
30 (baseline)	79.3	16.2	4.5	104,768	299,365	18,862	11.00	15.40
40	—[b]	—[b]	—[b]	—[b]	—[b]	26,016	11.00	16.80
20	—[b]	—[b]	—[b]	—[b]	—[b]	11,708	11.00	13.90
DIFFERENT ANNUAL COST OF TREATMENT PER PATIENT, YEARS 1 AND 2 AFTER DIAGNOSIS								
Baseline	79.3	16.2	4.5	104,768	299,365	18,862	11.00	15.40
25% higher than baseline	—[b]	—[b]	—[b]	—[b]	—[b]	17,642	13.50	17.60
25% lower than baseline	—[b]	—[b]	—[b]	—[b]	—[b]	20,082	8.50	13.20
VATS[c] for stage A	—[b]	—[b]	—[b]	—[b]	—[b]	15,177	10.90	14.30

SOURCE Authors' analysis. [a]Stage A is early stage (patients receive surgery but no chemotherapy, radiation, hospice, or palliative care; they do not die during the study period). Stage B is intermediate stage (patients do not have chemotherapy or radiation; they may have surgery, hospice, or palliative care; and they may die during the study period). Stage C is late stage (patients do not have surgery; they may have chemotherapy or radiation; and they have hospice or palliative care or die during the study period). [b]The results are the same as for the baseline scenario. [c]VATS is video-assisted thoracoscopic surgery.

screening that was less effective at detecting early-stage cases than assumed in our baseline scenario, we assumed that there were 10 percent fewer patients with stage A (early stage) lung cancer and 10 percent more patients with stage C (late stage) cancer.

To test the effects of pseudodisease, or overdiagnosis, we assumed 5 percent and 20 percent more patients with stage A cancer, without any reduction in the number of patients with stages B or C cancers. People with pseudodisease incurred the same costs and mortality as other stage A patients.

The baseline scenario assumed that screening 30 percent of people ages 50–64 (about eighteen million people) would capture 90 percent of lung cancers. Exhibit 3 shows the changes in costs and benefits if we assumed that screening 40 percent or 20 percent (about twenty-four million or twelve million people, respectively) would capture 90 percent of lung cancers. Similarly, we made different assumptions about the annual cost of treatment.

With today's mix of treatments, lung cancer is somewhat less expensive to treat at an earlier stage than at a later one.[24] The video-assisted thoracoscopic surgery scenario assumed that all stage A patients were treated with this surgical technique, a form of "small incision" laparoscopic surgery,[11] rather than traditional open lobectomy, which further reduced treatment cost (Exhibit 3).

LUNG AND OTHER CANCER SCREENINGS Exhibit 4 compares the cost per life-year saved of well-established cancer screenings with that of lung cancer screening. We applied medical inflation adjustments to bring the published figures for cervical, colorectal, and breast cancer up to the much higher price levels associated with our 2012 estimate for lung cancer. This was necessary because prominent studies of the cost-effectiveness of cancer screening were conducted more than ten years ago.

For comparison purposes, we trended the published figures using both the Consumer Price Index medical care component and two times this component, which we believe is more reasonable, yet still conservative. The Consumer Price Index medical care component, a component of the more familiar Consumer Price Index, is known to understate medical trends because it does not capture utilization or intensity increases.[25,26]

As shown in Exhibit 4, the cost per life-year saved in 2012 dollars was considerably higher for cervical, colorectal, and breast cancer than for lung cancer in the baseline scenario. See the online Appendix for additional information on these results.[6]

EXHIBIT 4

Cost Of Cervical, Colorectal, Breast, And Lung Cancer Screening Per Life-Year Saved

Type of cancer	Screening technique	Cost per life-year saved (dollars, year of original study)	Date of original study	Cost per life-year saved (2012 dollars)
Cervical[a]	Pap smear	33,000	2000	50,162[b]–75,181[c]
Colorectal[d]	Colonoscopy	11,900	1999	18,705[b]–28,958[c]
Breast[e]	Mammography	18,800	1997	31,309[b]–51,274[c]
Lung[f]	LDCT (baseline scenario[g])	18,862	2012	18,862
	LDCT (lowest-cost scenario[h])	11,708	2012	11,708
	LDCT (highest-cost scenario[i])	26,016	2012	26,016

SOURCES See exhibit notes. **NOTE** LDCT is low-dose spiral computed tomography. [a]Kim JJ, Wright TC, Goldie SJ. Cost-effectiveness of alternative triage strategies for atypical squamous cells of undetermined significance. JAMA. 2002;287(18): 2382–90. [b]Using the Consumer Price Index for medical care (see Note 25 in text). [c]Using two times the Consumer Price Index for medical care (see Note 25 in text). [d]Sonnenberg A, Delco F, Inadomi JM. Cost-effectiveness of colonoscopy in screening for colorectal cancer. Ann Intern Med. 2000;133(8):573–84. [e]Rosenquist CJ, Lindfors KK. Screening mammography beginning at age 40 years. Cancer. 1998;82(11):2235–40. [f]Authors' analysis. [g]Screening 30 percent of people ages 50–64. [h]Screening 20 percent of people ages 50–64. [i]Screening 40 percent of people ages 50–64.

Discussion

We combined life and health actuarial techniques to present financial and outcomes information for covering a new approach to early detection of lung cancer using methods that would be familiar to private or government insurers. We found that low-dose spiral CT screening for lung cancer would cost insurers less than colorectal, breast, and cervical cancer screenings do and would also cost insurers less than these other screenings per life-year saved.

One reason the cost of lung cancer screening, when spread across the commercially insured population, is lower than that of other cancer screenings is that much of the evaluation of suspicious nodules occurs without a biopsy, by checking for changes in nodule volume between screenings. Another reason is that the target population for lung cancer screening—high-risk smokers and former smokers ages 50–64—is smaller than the much broader target populations for other screenings. Furthermore, lung cancer screening has a lower cost per life-year saved than other screenings because symptomatically detected lung cancer is frequently more quickly fatal than other cancers. This means that the number of life-years saved is higher.

Our analysis was completed before results of the National Lung Screening Trial were published.[9] Our estimates of the proportion of early-stage lung cancer that would be detected by screening and of mortality reduction as a result of screening are more optimistic than the results of the trial. We attribute these differences partly to the design of the trial, which required that it be terminated as soon as significant mortality differences of greater than 20 percent appeared, and partly to our assumptions based on the use of current, improved imaging and screening workup approaches that emerged after the trial began (see the Appendix for details).[6]

Participants in the National Lung Screening Trial were ages 55–74,[9] whereas our model and the International Early Lung Cancer Action Program, a lung cancer screening consortium, assumed that screening would begin at age fifty.[13] Starting at age fifty rather than fifty-five yields fewer cancers per screened individual because of the lower incidence rates at age fifty compared to age fifty-five, thereby producing both higher population screening costs, because more people were screened, and lower benefits, because fewer cancers were detected earlier than would have been the case had our model begun screening at age fifty-five.

In people younger than sixty-five, lung cancer accounts for 43,000 deaths per year, which is about 26 percent of the annual number of all lung cancer deaths.[12,27] Lung cancer incidence roughly doubles with each five-year age band from 45–49 to 60–64 years. It then increases more slowly until 75–79 years, after which it begins declining.[27] Ignoring treatment after age sixty-four, the point when Medicare begins to cover most people, affected both our status quo and screening scenarios. It also tended to understate the cost advantages of screening because it ignored savings after age sixty-five.

Our study suggests opportunities for the effi-

cient implementation of lung cancer screening, which would involve insurers' selection of high-quality providers and use of "best published practices" for managing clinical aspects of screening, along with rigorous tracking of outcomes. The goal would be to ensure achievable standards for quality and cost.

For low-dose spiral CT, we assumed low managed care reimbursement, which is consistent with our view that insurance coverage of lung cancer screening should be restricted to high-throughput, high-efficiency, and low-cost sites. Similarly, in one cost-benefit scenario, we showed the potential to reduce costs by using video-assisted thoracoscopic surgery. Recent studies have shown that this procedure, compared with open lobectomy, resulted in significantly shorter hospital stays, fewer blood transfusions, more rapid patient recovery,[11] and a major reduction in mortality during the procedure.[28]

The efficiency of lung cancer screening might also be enhanced by using what is known as "volume change analysis" as a filter for cancer. Implemented after the start of the National Lung Screening Trial by other major lung cancer trial groups,[8,29] this technique measures the volume growth rate of a suspicious clinical nodule in serial low-dose spiral CT scans across a defined time interval, such as three months. This technique has been reported to reduce the need for invasive diagnostic procedures, which in turn would reduce both the cost and the frequency of medical complications.[8]

We included tobacco cessation counseling in the screening cost calculation because tobacco use is the leading cause of lung cancer.[30] Millions of former smokers have successfully quit and improved their health. However, smokers who quit smoking decades ago continue to be at high risk of lung cancer.[31] Previous studies have found that low-dose spiral CT screening can provide a "teachable moment" that is associated with increased success in tobacco cessation efforts.[32] Integration of tobacco cessation with lung cancer screening can help meet public health imperatives.[7]

Lung cancer screening is low cost, and its cost per life-year saved is lower than that of other cancer screenings. Implemented with appropriate quality and standardization processes, the screening could serve as an example of system innovation that greatly improves health outcomes without feeding cost escalation (see the Appendix for additional information, including historical background on lung cancer screening and related trials).[6]

Conclusion

Lung cancer is a lethal disease associated with substantial medical and economic burden. Although lung cancer screening is not established as a public health practice, recent data show that such screening reduces lung cancer mortality. In our investigation of lung cancer screening as a commercial insurance benefit in the high-risk US population ages 50–64, we found that both the cost of screening and the cost per life-year saved compared favorably with published rates for other cancer screenings.

Our findings suggest that commercial insurers should consider lung cancer screening with low-dose spiral CT to be of substantial value in high-risk populations and should consider providing coverage that includes such screening. Further study is warranted to determine the optimal screening procedure and its use in various patient populations. ■

Initial results of the rider pricing section were presented at the 24th International Conference on Screening for Lung Cancer, at the Biodesign Institute, Tempe, Arizona, February 25–26, 2011. Bruce Pyenson, Marcia Sander, Yiding Jiang, and Howard Kahn received funding from the Lung Cancer Alliance and the American Legacy Foundation. James Mulshine is an inventor on twelve US and international patents that are related to lung cancer care but do not involve the use of low-dose spiral computed tomography. The authors acknowledge the editorial assistance provided by Kathleen Wildasin and the valuable comments provided by Nasser Altorki of Weill Cornell Medical College.

NOTES

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In this month's *Health Affairs*, Bruce Pyenson and coauthors report on their study of the costs and benefits of annual lung cancer screening with low-dose spiral computed tomography. The authors found that if screening were offered as a commercial insurance benefit to people ages 50–64 who are at high risk for lung cancer, the cost per life-year saved would compare favorably with that of screening routinely offered now for cervical, breast, and colorectal cancers. The authors suggest that commercial insurers consider providing the screening benefit but that in addition, payers and patients should seek screening only from high-quality, low-cost providers to help set an example of efficient delivery system innovation.

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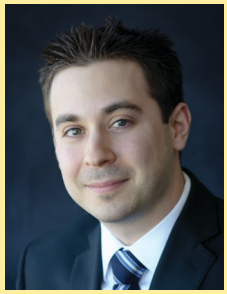

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