The Cost-Effectiveness of Low-Dose CT Screening for Lung Cancer*

Preliminary Results of Baseline Screening

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Background: **Low-dose CT scan screening greatly improves the likelihood of detecting small nodules and, thus, of detecting lung cancer at a potentially more curable stage.**
Methods: **To evaluate the cost-effectiveness of a single baseline low-dose CT scan for lung cancer screening in high-risk individuals, data from the Early Lung Cancer Action Project (ELCAP) was incorporated into a decision analysis model comparing low-dose CT scan screening of high-risk individuals (*ie*, those ≥ 60 years with at least 10 pack-years of cigarette smoking and no other malignancies) to observation without screening. Cost-effectiveness was expressed as the incremental cost per year of life saved. The analysis adopted the perspectives of the health-care system. The probability of the different outcomes following the decision either to screen or not to screen an individual at risk was based on data from ELCAP and the Surveillance, Epidemiology, and End Results Registry or published data, respectively. The cost of the screening and treatment of patients with lung cancer was established based on data from the New York Presbyterian Hospital's financial system. The base-case analysis was conducted under the assumption of similar aggressiveness of screen-detected and incidentally discovered lung cancers and then was followed by multiple sensitivity analyses to relax these assumptions.**
Results: **The incremental cost-effectiveness ratio of a single baseline low-dose CT scan was $2,500 per year of life saved. The base-case analysis showed that screening would be expected to increase survival by 0.1 year at an incremental cost of approximately $230. Only when the likelihood of overdiagnosis was > 50% did the cost effectiveness ratio exceed $50,000 per year of life saved. The cost-effectiveness ratios were also relatively insensitive to estimates of the potential lead-time bias.**
Conclusions: **A baseline low-dose CT scan for lung cancer screening is potentially highly cost-effective and compares favorably to the cost-effectiveness ratios of other screening programs.** ***(CHEST 2003; 124:614–621)***

Key words: cost-effectiveness; CT; lung cancer; screening

Abbreviations: ELCAP = Early Lung Cancer Action Project; FNA = fine needle aspiration; HRCT = high-resolution CT; SEER = Surveillance and End Results Registry; TSI = Transaction System, Inc

The Early Lung Cancer Action Project (ELCAP) was conducted to evaluate the usefulness of annual low-dose CT scan screening for lung cancer. The baseline and annual repeat results showed that > 80% of the screen-detected non-small cell malignancies were stage IA lung cancer and were typically < 10 mm in size on annual repeat screening.[1,2] The results of the ELCAP suggest that low-dose CT scanning can contribute substantially to the detection of early lung cancer, and thus potentially can decrease lung cancer mortality.

The purpose of this study was to evaluate the effectiveness and the economic consequences of low-dose CT scan screening compared to the current paradigm of care for lung cancer by which > 80% of lung cancers are diagnosed in the more advanced stages (*ie*, stages II to IV). To this end, we incorpo-

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rated data from the ELCAP into a decision-analytic model to assess the cost-effectiveness of a single baseline low-dose CT scan for the early detection of lung cancer compared with usual care.

For the purpose of this study, we assumed that low-dose CT scan screening for lung cancer improves survival. Although the ELCAP data suggested that an annual CT scan screening may translate into a reduction in lung cancer mortality, at minimum the long-term follow-up of individuals with screen-diagnosed malignancies is necessary to determine the potential benefits of screening on lung cancer survival.

Materials and Methods

Decision-Analytic Model

We evaluated the cost-effectiveness of a program consisting of a single baseline low-dose screening CT scan for the diagnosis of non-small cell lung cancer in persons aged ≥ 60 years with at least a 10-pack-year history of smoking, fit to undergo thoracic surgery, and with no prior history of cancer (except nonmelanoma cancer of the skin). The comparison program, used to represent the alternative base case, was *usual care*, under which lung cancer is detected by symptoms and/or signs or is incidentally found on a chest radiograph, CT scan, or other diagnostic test that is part of a person's ongoing medical care.

A decision tree model was constructed to describe and analyze the cascade of events emanating from the decision to screen or not to screen an individual at risk (Fig 1). Under usual care, patients either develop lung cancer or die of other causes, as reflected by age-specific survival probabilities. The stage distribution of malignancies of patients diagnosed under the usual-care strategy was assigned according to the distribution of lung cancers found in the National Cancer Institute Surveillance and End Results Registry (SEER).

Screening CT scans results in either negative or positive findings. If the result is positive, the subjects undergo further workup, typically consisting of serial high-resolution CT (HRCT) scans of the screen-detected nodules, as long as no growth is detected, or fine-needle aspiration (FNA) biopsy of a nodule showing growth. We assumed the same stage distribution of screen-detected malignancies as found in the ELCAP study. For simplicity, we assumed that patients with stage I and II lung cancer either can be cured or will progress and they will die, while all patients with stages IIIA, IIIB, and IV lung cancer will invariably die as a consequence of lung cancer dissemination. Years of life saved were used as the measure of health outcomes. The base-case analysis was performed under the assumption of similar aggressiveness for screen-detected and incidentally discovered lung cancers, and then multiple sensitivity analysis was conducted to test the stability of the cost-effectiveness ratio when these assumptions were relaxed. Analysis was performed using a software package (TreeAge; TreeAge Software Inc; Williamston, MA).

Data Sources

The ELCAP study was used to determine the probabilities of the different events following the screening CT scan. These included the following: (1) the probability of a positive result on baseline low-dose CT scan; (2) the probability of diagnosing a non-small cell lung cancer; and (3) the stage distribution of lung cancer detected by CT scan screening (Table 1).

A screening CT scan was considered to be positive if 1 to 6 noncalcified nodules were identified. The CT scan result was considered to be negative if either no noncalcified nodules were identified, more than six noncalcified nodules were present, or features of diffuse disease (*ie*, diffuse bronchiectasis, ground glass opacities, or any combination of these features) were present on the CT scan. The workup following a positive test result was based on the ELCAP guidelines, which recommended a standard-dose, diagnostic CT scan of the chest with an HRCT of the nodules. Noncalcified nodules found on the diagnostic CT scan were followed according to the size of the largest nodule, as follows:

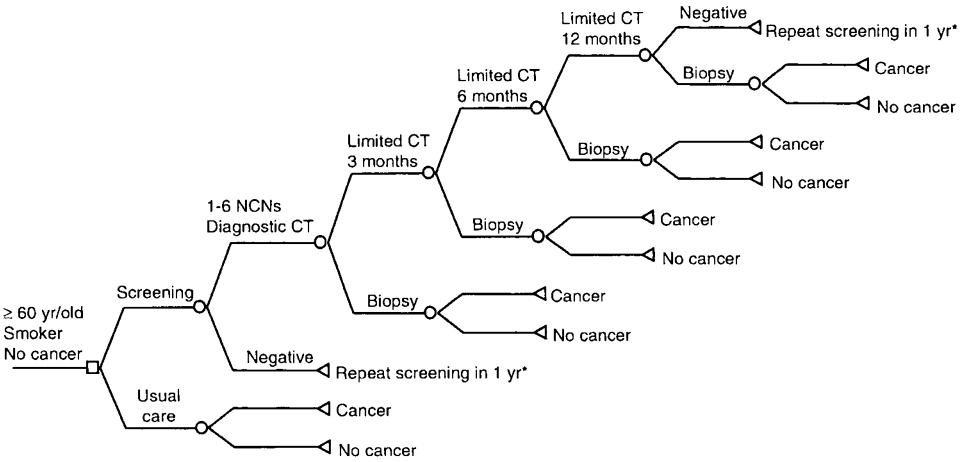

Figure 1. Decision tree showing the possible alternatives emanating from the decision to screen or not to screen a high-risk individual. Under usual care, patients either develop lung cancer or die of other causes. CT scan screening results in either negative or positive findings. If the result is positive, the subjects undergo further workup, typically consisting of serial HRCT scans of the screen-detected nodules as long as no growth is detected or an FNA biopsy of a nodule shows growth.[1] * = not included in the present analysis.

Table 1—*Selected Model Variables

Variable	Value	Source
Findings on prevalence screening		
Incidence of NCNs, %	23	ELCAP
HRCT per 1,000 individuals, No.	178	ELCAP
Limited CT per 1,000 individuals, No.	644	ELCAP
FNA per 1,000 individuals, No.	30	ELCAP
Lung cancer prevalence, %	2.7	ELCAP
Cure rate with standard therapy, %		
Stage I	70	SEER
Stage II	30	SEER
Stage IIIA–IV	0	SEER
Life expectancy, yr		
Mean	16.3	NCHS
Stage I/II, curative resection	16.3	NCHS
Stage I	4.5	SEER
Stage II	3.5	SEER
Stage IIIA	2.6	SEER
Stage IIIB	1.6	SEER
Stage IV	1.0	SEER
Lead time, yr		
Stage I	1.5	"Methods" section
Stage II	2.5	"Methods" section
Stage IIIA	3.5	"Methods" section
Stage IIIB	4.0	"Methods" section
Stage IV	4.5	"Methods" section

*NCN = noncalcified nodule; NCHS = National Center for Health Statistics.

1. If the nodule was ≤ 5 mm in size, a follow-up HRCT scan was performed 3 months after baseline screening, and, so long as no growth could be identified, repeat limited CT scans were performed at 6, 12, and 24 months. If no growth was noted for > 2 years, the nodule was classified as benign.
2. If the nodule was 6 to 10 mm in size, the decision about whether to perform an FNA (or other type of biopsy-video-assisted thoracotomy, bronchoscopy, or a combination of these methods) immediately or a follow-up HRCT scan was made on a case-by-case basis.
3. If the nodule was ≥ 11 mm in size, an FNA (or other type of biopsy) was performed immediately.

Lobar resection with complete mediastinal lymph node dissection was recommended for all the patients who had a potentially resectable lung cancer diagnosed.

We used data from SEER to estimate the stage distribution of lung cancer diagnosed under usual care.[3] Tumor stage was determined according to the 1997 American Joint Committee on Cancer classification using information in the SEER registry on size, tumor extension, and nodal involvement. Lung cancer stage-specific cure rates were estimated using the methodology described by Berkson and Gage[4] and later reaffirmed by Buell.[5] Thus, for each stage we constructed survival curves using SEER data, with the cure rate being defined by the point when cumulative survival no longer changed, that is, when the slope of the survival curve approached zero. The probability of lung cancer progression in each stage following initial treatment was defined as one minus the stage-specific cure rate.

Determination of Costs

The costs considered in the analysis included the physician-based and hospital-based direct medical costs incurred in the treatment of lung cancer that had been diagnosed either by CT scan screening or under usual care. Thus, the analysis adopted the perspective of the health-care system.[7,8] The analysis was also restricted to the costs incurred in the first year after the diagnosis of lung cancer. However, the costs of terminal care were added to the costs of the initial treatment of those individuals with advanced-stage lung cancer. These costs do not take into account other costs such as loss of days of work, and those incurred by patients and family members (both monetary and nonmonetary).

The cost of a low-dose screening CT scan, a diagnostic CT scan (*ie*, a complete study including HRCT scan of the nodules), follow-up CT scans, and FNA were based on the actual costs incurred by ELCAP volunteers, as recorded and determined by the New York-Presbyterian Hospital's financial system cost database (Transaction Systems, Inc [TSI]). This database maintains records of all the diagnostic and treatment procedures for both inpatients and outpatients. The actual costs within the radiology department divisions are estimated in TSI by establishing the total costs incurred during the fiscal year for each radiologic test to which a divisional cost/charge ratio is computed and are applied to determine the cost of the procedure.

To determine the stage-specific costs of treatment of lung cancer, we reviewed the hospital's tumor registry for the names of all the patients in whom lung cancer had been diagnosed at the New York-Presbyterian Hospital. From this log, we identified all the patients with newly diagnosed non-small cell lung cancer between January 1997 and December 1998, and obtained the costs of their entire hospital-based medical care from TSI. We obtained the specific physician charges from the Faculty Practice Plan database, and found that they varied between 25% and 40% of the hospital costs. Thus, for the analysis, we estimated the physician costs as being an additional 30% of the stage-specific hospital-based medical costs. The cost of terminal care was assumed to be the same as the cost of stage IV lung cancer. All costs were adjusted to 2000 US dollars using the medical consumer price index. Future costs were discounted to present value at an annual (real) rate of 3%.

Outcomes of the Analysis

Increased life expectancy was the outcome of interest in the analysis. Life expectancy for individuals without lung cancer was estimated based on the US age-specific death rates, as reported by the National Center for Health Statistics.[6] The average life expectancy of individuals in whom lung cancer is diagnosed was determined to be equal to the life expectancy of individuals without the disease if the patients had been cured. Otherwise, the average lung cancer stage-specific life expectancy was estimated using the declining exponential approximation of life expectancy method.[9,10] This method is based on the assumption that in a cohort of patients with cancer, survival can be approximately described by a declining exponential function. Based on the mathematical form of the declining exponential function, mortality can be estimated as follows:

$$m = (1/t) \times \ln(S/S_0)$$

where m is the average mortality rate, S is number of patients still surviving at time t, S_0 is the number of patients alive at the initial time ($t = 0$), t is the time at which fractional survival is measured, and ln is the natural logarithm. Using this method, life expectancy is estimated as the reciprocal of the average mortality rate (life expectancy = 1/m). The stage-specific fractional survival of patients who died of lung cancer was based on SEER data. As the mean age of individuals included in SEER was similar to the mean age of the ELCAP volunteers, life expectancy was not adjusted further.

Table 2—*Stage Distribution and Expected 5-Year Survival Rate of Lung Cancer Patients*

Stage	Screen Detected,* %	Usual Care,† %	5-yr Survival Rate,[13] %
I	85	20	67‡
II	4	6	55§
IIIA	7	16	23
IIIB	4	17	5
IV		41	1

*ELCAP.
†SEER.
‡Stage IA.
§Stage IIA.

For the purpose of the analysis, life expectancy was estimated as the stage-specific expected survival time following diagnosis. However, there is usually an interval of time between the diagnosis of lung cancer by screening CT scan and when it would have been detected due to the development of symptoms (*ie*, the lead time).[11] Thus, to compensate for this difference, lead time was incorporated into the model as a period of time added to the life expectancy of the unscreened individuals. To estimate the lead time introduced by CT scan screening for stage I tumors, we calculated, using doubling times, how long it would take for a malignant nodule to grow from the usual size of CT scan-detected stage I cancers to the usual size of symptom-detected stage I malignancies. We estimated, based on ELCAP and SEER data, a median size of 10 mm and 20 mm, respectively, for CT scan screen-detected tumors and symptom-detected stage I tumors. Thus, using the exponential growth model and a doubling time of 180 days (roughly corresponding to the doubling time for an average adenocarcinoma), we estimated that it would take three doubling times, or approximately 1.5 years, for a screen-detected malignancy to grow to the average size of a stage I symptom-detected tumor.[12,13] For advanced-stage tumors, given the lack of accurate information on the mean tumor size at diagnosis, we estimated the stage-specific lead time based on experts opinion and the current knowledge of the progression of lung cancer.

Sensitivity Analysis

We performed a one-way sensitivity analysis on the cost of low-dose CT scanning, diagnostic CT scanning, the treatment of stage I cancer and terminal care (*ie*, stage IV cancer), the probability of overdiagnosis, the prevalence of lung cancer on baseline screening, the stage-specific lead time, and the probability of a cure of stage I non-small cell lung cancer. We varied each within clinically plausible ranges to assess the effect on the results of the analysis.

Results

Based on the ELCAP results, we assumed that 233 of 1,000 subjects will have 1 to 6 noncalcified nodules, and that 27 individuals will receive diagnoses of non-small cell lung cancer on baseline CT scan screening. Table 1 shows the number of diagnostic CT scans and FNAs that were performed as part of the workup of subjects with a positive test result.

Table 3—*Costs Estimates**

Variable	Estimated Cost†
Low-dose CT scan	$165
HRCT	$300
Limited CT	$65
FNA	$500
Treatment of NSCLC‡	
Stage I	$20,100
Stage II	$23,300
Stage IIIA	$31,800
Stage IIIB	$32,700
Stage IV	$25,900

*NSCLC = non-small cell lung cancer.
†In 2000 US dollars.
‡Stage-specific costs represent lifetime costs.

The stage distribution of lung cancers diagnosed under usual care was significantly different from that identified by CT scan screening. As shown in Table 2, approximately 80% of the screening-detected malignancies were stage I tumors, whereas > 70% of the malignancies diagnosed under usual care were of an advanced stage (*ie*, stages IIIA, IIIB, or IV).[14] The diagnostic procedure costs and the average hospital and physician costs incurred in the first year after diagnosis for stage I, II, IIIA, IIIB, and IV malignancies were approximately $20,100, $23,300, $31,800, $32,700, and $25,900, respectively (Table 3).

The base-case analysis showed that screening would be expected to increase survival by 0.1 year at an incremental cost of approximately $230. The cost per life-year saved of a single baseline CT scan screening was $ 2,500 (Table 4).

Sensitivity Analysis on the Cost of Low-Dose CT Scan and the Cost of Lung Cancer Treatment

Although the cost assigned to a low-dose CT scan in the current study was a conservative estimate ($165), we used an upper bound of $300 to evaluate the effect of varying the cost of CT scanning on the cost-effectiveness ratio. As seen in Figure 2, the cost-effectiveness ratio remained under $50,000 as the cost of the low-dose CT scan changed. If the cost of a low-dose CT scan was increased to $300, the

Table 4—*Cost-Effectiveness Analysis Results Under Base-Case Scenario**

Strategy	Life Expectancy, yr	Costs†	Incremental CER‡
Screening	16.15	$1,174	$2,500
No screening	16.05	$942	

*CER = cost-effectiveness ratio.
†In 2000 US dollars.
‡Dollar cost per year of life saved.

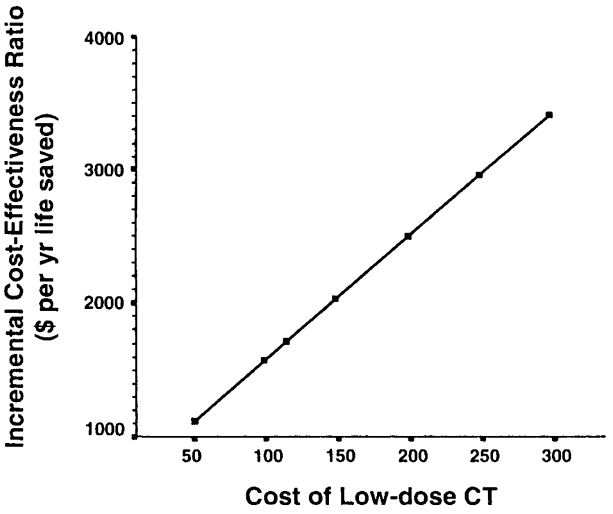

FIGURE 2. Sensitivity analysis of the cost of a low-dose CT scan. Results of the one-way sensitivity analysis of the cost of low-dose CT scans are shown. The cost of a low-dose CT scan varied from $50 to $300. The cost-effectiveness ratio of a baseline CT scan compared to usual care increased up to $4,000 per year of life saved.

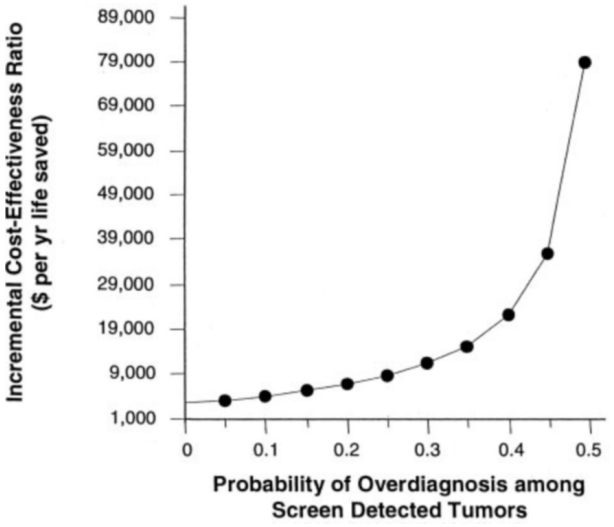

FIGURE 3. Sensitivity analysis of the probability of overdiagnosis among screen-detected tumors. Results of the one-way sensitivity analysis of the effect of the probability of overdiagnosis among screen-detected tumors on the incremental cost-effectiveness of low-dose CT scan screening. The probability of overdiagnosis among screen-detected malignancies varied from 0 to 0.5. As the probability of overdiagnosis increased, the incremental life expectancy of individuals undergoing screening decreased compared to usual care. As a consequence, the marginal cost-effectiveness ratio increased. The cost-effectiveness ratio become $>$ $50,000 per year of life saved only when $>$ 50% of the screen-detected malignancies were considered to be overdiagnosed tumors.

cost-effectiveness ratio of a single baseline CT scan compared to usual care increased to $<$ $4,000 per year of life saved. Similarly, the cost-effectiveness ratio was not significantly modified (*ie*, did not approach the threshold value of $50,000) by reasonable assumptions regarding the cost of the diagnostic CT scan, the cost of treatment of stage I cancer, the cost of terminal care (*ie*, stage IV cancer), or the probability of a cure of stage I non-small cell lung cancer.

Effect of Overdiagnosis

Our baseline analysis did not consider the possibility that some of the malignancies detected under screening were not actual cancers but were cases of overdiagnosis, that is, the detection of lung cancers the growth of which is so slow that death is caused by diseases other than lung cancer.[15,16] Two studies conducted by Flehinger et al[17] and Sobue et al[18] in 1992 have provided convincing evidence against the overdiagnosis of lung cancer detected by screening with chest radiography. Additional evidence against overdiagnosis on CT scanning in the ELCAP protocol derived from the fact that resection was recommended only for lung cancers that showed growth by careful measurement techniques.[13] However, to assess for a potential effect of overdiagnosis on the cost-effectiveness of CT scan screening, we conducted a sensitivity analysis in which we varied the proportion of overdiagnosed cancers from 0% (*ie*, the baseline scenario) to $>$ 50% of the screen-detected malignancies. As shown in Figure 3, only when $>$ 50% of the screen-detected lung cancers were considered to have been overdiagnosed cases was the marginal cost-effectiveness ratio $>$ $50,000 per year of life saved.

Effect of the Prevalence of Lung Cancer on Baseline Screening

Individuals who choose to participate in screening programs are usually different from those who do not.[19] This self-selection of volunteers in screening studies might be associated with a higher prevalence of disease as reported in several studies.[20,21] Consequently, the prevalence of lung cancer on baseline screening among ELCAP volunteers might be different than in the general population. We used sensitivity analysis to evaluate the effect of different baseline prevalence rates on the cost-effectiveness ratio. As shown in Figure 4 the cost-effectiveness ratio exponentially increased as the prevalence of disease on baseline screening decreased. However, the cost-effectiveness ratio remained at $<$ $20,000 per year of life saved even when the baseline prevalence was considered to be as low as 1%, which is a highly unlikely scenario. It is important to point out that this analysis is relevant only for individuals of

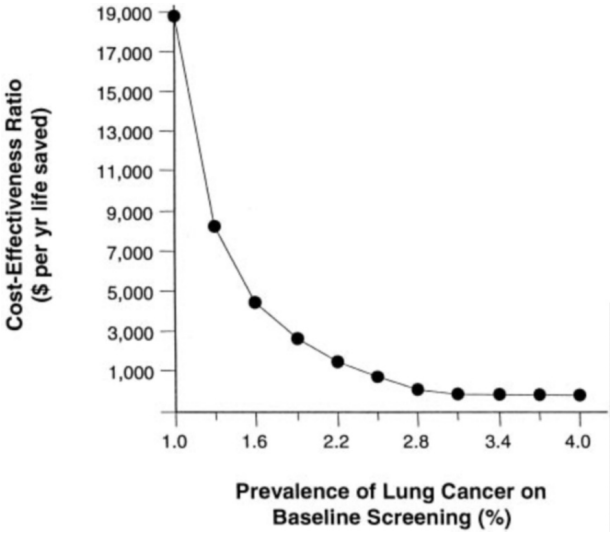

FIGURE 4. Sensitivity analysis of the effect of different prevalence rates on baseline screening on the cost-effectiveness ratio. As the prevalence of disease on baseline screening decreased, the cost-effectiveness ratio increased exponentially. The cost-effectiveness ratio remained at < $20,000 per year of life saved even when the baseline prevalence was considered to be as low as 1%, a highly unlikely scenario. The results of this analysis should not be extrapolated to individuals of other age groups or to those with a smoking history of < 10 pack-years. Although the prevalence of lung cancer is likely to be lower in younger individuals or lighter smokers, the expected survival of these individuals is probably longer. Consequently, their cost-effectiveness ratio will be also different.

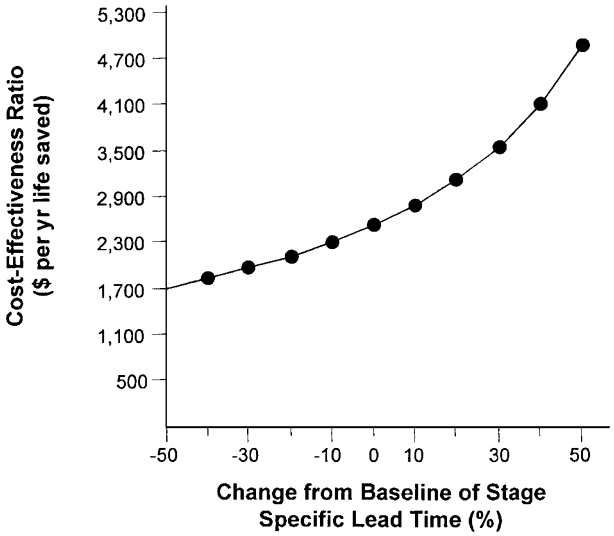

FIGURE 5. Sensitivity analysis of the effect of stage-specific lead time on the cost-effectiveness ratio. The cost-effectiveness ratio of a single screening CT scan was evaluated as the stage-specific estimates of lead time were varied in 10% increments over a wide range (*ie*, 50 to 150%) of the baseline estimates. Although the cost-effectiveness ratio varied as the lead time changed, it did not increase to > $6,000 per year of life saved.

60 years of age with a ≥ 10 pack-year history of smoking. Although the prevalence of lung cancer is likely to be lower if younger individuals or lighter smokers are included, the expected increase in the survival of these individuals is probably larger, and, consequently, the cost-effectiveness ratio will also be different.

Sensitivity Analysis on the Lead Time Introduced by CT Scan Screening

Our baseline estimates of the lead time associated with CT scan screening were obtained based on doubling times, and on the available information regarding the biology and progression of lung cancer. Although these estimates are consistent with the current knowledge and experts' opinions, there is a significant degree of uncertainty regarding these estimates. To evaluate the effect of different lead-time estimates on the cost-effectiveness ratio, we conducted a one-way sensitivity analysis. The stage-specific estimates of lead time were varied in 10% increments over a wide range (*ie*, 50 to 150%) of the baseline estimates. As shown in Figure 5, although the cost-effectiveness ratio varied as the lead time changed, it did not increase to > $6,000 per year of life saved.

DISCUSSION

Our analysis suggested that the cost-effectiveness ratio of a single baseline CT scan for the lung cancer screening of high-risk individuals is likely to be within the range of practice and policy acceptability, and compares favorably to the cost-effectiveness ratios of other screening programs.[22]

The costs and resource utilization used for the analysis were obtained from The New York-Presbyterian Hospital. Local and regional differences in the costs of medical care and treatment modalities for lung cancer may limit the generalizability of our results. Evans et al[23] created a model to estimate the cost of lung cancer diagnosis and treatment based on data from provincial cancer registries in Canada. While there are some differences in the costs of treatment of advanced-stage lung cancers, the overall distribution of the costs of lung cancer treatments by stage were similar in both countries.

There are several other limitations of our analysis. The source of data regarding the effectiveness of lung cancer screening was the ELCAP study. As this trial used a noncomparative design, the results of a survival analysis based on ELCAP data are subject to the effect of lead-time bias, selection bias, and the possibility of overdiagnosis. We compensated for the unadjusted increase in the expected survival of patients in the screening arm of the study by adding stage-specific lead times to the life expectancy of individuals diagnosed with lung cancer under the

usual-care scenario. Furthermore, we assessed the potential effects of these biases on the cost-effectiveness ratio using sensitivity analysis. Although the cost-effectiveness ratio remained well below $50,000 per year of life saved under all the different scenarios considered in our analysis, we cannot completely exclude the possibility that under certain conditions the effectiveness and cost-effectiveness of lung cancer screening might be significantly different. Furthermore, the probability of certain events in ELCAP was estimated based on a relatively small sample size.

The outcome of the study in terms of life-years saved was not adjusted for quality of life. The analysis, therefore, did not consider the detrimental effects of false-positive CT scan findings and the possible anxiety associated with screening. On the other hand, the analysis did not consider the potential positive effect on quality of life of the knowledge that one is free of lung cancer.[24] The costs of treatment of lung cancer did not include any expenses incurred by the patients outside the medical center or beyond the first year following diagnosis (except the costs of terminal care). Additionally, we estimated physician costs as a percentage of the total hospital costs. Although these figures were derived from actual data on physician charges obtained from the New York-Presbyterian Hospital's financial system, the true physician costs may be different and should be confirmed in the future.

Our estimated cost of screening with CT scans was based on the current cost of the test at the New York-Presbyterian Hospital. A more accurate estimation from a societal point of view, assuming nationwide screening, will require more detailed information and further assumptions, including the market purchase cost for CT scanners and production costs. For example, if the demand for CT scan screening increases in the future, the cost of the test eventually may fall due to the economics of scale, just as the cost of mammography screening for breast cancer decreased gradually over the last decade.

Our study evaluated the cost-effectiveness of a single baseline CT scan. Mass screening programs are likely to consist of a baseline CT scan, and, if the findings are negative, follow-up with annual repeat screenings for a period of 5 to 10 years, depending on the age, risk of lung cancer and the expected survival of the individual. The incidence of lung cancer and the diagnostic characteristics of the test are significantly different on annual repeat screening.[2] The cost-effectiveness on repeat screening also needs to be evaluated as the incidence of cancer is lower but the frequency of false-positive findings is also much lower.

The cost-effectiveness ratio of low-dose CT scan screening found in this study is a consequence of the significantly lower costs of treating early stage lung cancer. While > 80% of the screening-detected tumors were of stage I, 75% of the cancers diagnosed under usual care were of advanced stages (*ie*, stages IIIA to IV). Given that elective thoracotomy of stage I lung cancers is less costly than the treatment of later-stage cancers,[25,26] most of which require a combination of radiotherapy and chemotherapy, and even thoracotomy, the costs of the screening program are largely compensated by such savings.

The results of this study are preliminary and should be reevaluated as more accurate estimates of the outcomes and costs of CT scan screening become available. As part of the New York ELCAP, a large multicenter study that will include 10,000 individuals, we are collecting prospective economic data that will allow a more comprehensive and reliable estimation of the cost-effectiveness ratio.

In summary, our preliminary findings suggest that the implementation of low-dose CT scan screening for the early detection of non-small cell lung cancer would be economically efficient. The cost-effectiveness ratio of a baseline CT scan is within the range of clinical practice and health policy acceptability, and compares favorably to the cost-effectiveness ratios of screening programs for other malignancies.

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