

Lung Cancer Diagnosis: Hospitalization Costs

José Abal Arca,^a Manuel Ángel Blanco Ramos,^b Ramón García de la Infanta,^c Cristina Pérez López,^d Luisa González Pérez,^d and Joaquín Lamela López^a

^aServicio de Neumología, Complejo Hospitalario Ourense, Ourense, Spain.

^bUnidad de Investigación, Complejo Hospitalario Ourense, Ourense, Spain.

^cServicio de Documentación Clínica, Complejo Hospitalario Ourense, Ourense, Spain.

^dMedicina de Familia, Complejo Hospitalario Ourense, Ourense, Spain.

OBJECTIVE: To establish the direct costs of the process of diagnosing lung cancer in 2003. As a secondary objective, the cost of admissions defined as inappropriate was evaluated.

MATERIAL AND METHODS: A prospective cohort study of lung cancer cases diagnosed in 2003 was performed. Diagnosis was based on cytohistology or clinical and radiological criteria. The total cost was determined according to Decree 222/2003, governing Galician health service rates. A distinction was drawn between hospitalized patients and outpatients, and between small cell and non-small cell carcinomas. Inappropriate admissions were analyzed in accordance with the criteria established by our study team, and the savings that would have been made had these patients been treated as outpatients were calculated. The statistical analyses were performed using SPSS version 10.0.

RESULTS: A total of 160 patients were diagnosed with lung cancer; 76 (47.5%) of these were outpatients, and the remaining 84 (52.5%) were hospitalized patients. Admissions were considered inappropriate in 27 cases. Of the total of 160 patients, 108 were diagnosed as having non-small cell carcinomas, and 38 as having small cell carcinomas; the remaining 14 patients were diagnosed on the basis of clinical-radiological criteria. Total cost was €742847 (mean, €4643; 95% confidence interval, €4049-€5236), composed of €552614 (mean, €6579) for admitted patients, and €190233 (mean, €2503) for outpatients. Mean cost was €3692 for the small cell carcinomas, and €5070 for the non-small cell carcinomas. Comparing limited and extensive small cell carcinomas, the mean cost for the former was significantly lower than for the latter (€1894 compared to €4098); there was also a lower mean cost for early compared to advanced stages of non-small cell carcinomas (€3660 compared to €5494). The savings to be made from unnecessary admissions were calculated at €120258.

CONCLUSIONS: The mean cost for outpatient lung cancer treatment was 62% lower than for hospitalization. Non-small cell carcinomas were more costly on average than small cell carcinomas, and advanced stages of the small cell carcinomas involved a higher average cost than the initial stages of the disease. For our series, the savings to be made from unnecessary admissions were calculated at €120258.

Key words: Lung cancer. Diagnosis. Cost.

Correspondence: Dr. J. Abal Arca.
 Servicio de Neumología, Complejo Hospitalario Ourense.
 Ramón Puga, 52. 32005 Ourense, España.
 E-mail: jaa01o@saludalia.com

Manuscript received June 13, 2005. Accepted for publication May 30, 2006.

Coste hospitalario del diagnóstico del cáncer de pulmón

OBJETIVO: Conocer los costes directos del proceso de diagnóstico del cáncer de pulmón (CP) en el año 2003. Como objetivo secundario se evaluó el coste asociado a los ingresos definidos como inadecuados.

MATERIAL Y MÉTODOS: Se ha llevado a cabo un estudio de una cohorte prospectiva de casos de CP diagnosticado durante el año 2003 mediante citohistología o por criterios clinicorradiológicos. Se determinó el coste total, según Decreto 222/2003 de Tarifas de los Servicios Sanitarios de Galicia, diferenciando entre pacientes ingresados y ambulatorios, y entre carcinoma microcítico y no microcítico. Asimismo, se analizaron los ingresos inapropiados, según criterios establecidos por nuestro grupo, y se estimó el ahorro que supondría haberlos manejado de forma ambulatoria. Para el análisis estadístico se utilizó el programa estadístico SPSS 10.0.

RESULTADOS: Se diagnosticó de CP a 160 pacientes, 76 (47,5%) de forma ambulatoria y 84 (52,5%) mediante ingreso. Éste se consideró inapropiado en 27. El diagnóstico fue de carcinoma no microcítico en 108 pacientes y microcítico en 38, y en 14 se estableció por criterios clinicorradiológicos. El coste total fue de 742.847 € (media: 4.643 €; intervalo de confianza del 95%, 4.049-5.236), de 552.614 € (media: 6.579 €) en los ingresados y de 190.233 € (media: 2.503 €) en los ambulatorios. El coste medio en los carcinomas microcíticos fue de 3.692 € y en los no microcíticos de 5.070 €. En los primeros, el coste medio en la enfermedad limitada fue significativamente menor que en la enfermedad extendida (1.894 frente a 4.098 €), y en los segundos el coste medio en los estadios iniciales también fue significativamente menor que en los avanzados (3.660 frente a 5.494 €). El ahorro estimado por ingresos inapropiados sería de 120.258 €.

CONCLUSIONES: El coste medio del paciente con manejo ambulatorio es un 62% inferior al que ocasiona el ingreso. El coste medio en el carcinoma no microcítico es mayor que en el microcítico, y el de los estadios avanzados, mayor que el de los iniciales. En nuestra serie, el ahorro estimado por ingresos inapropiados sería de 120.258 € por año.

Palabras clave: Cáncer de pulmón. Diagnóstico. Coste.

TABLE 1
Test and Examination Costs*

Test	Cost, €	Test	Cost, €
Pulmonology visit (first)	128.35	Echocardiogram	222.63
Pulmonology visit(s) (successive)	42.79	Bone scintigraphy	99.17
A&E visit	250.27	Lung scintigraphy	99.17
Multidisciplinary consultations	70.00	PET	915.86
Blood tests	141.00	Gastroscopy-colonoscopy	222.63
Sputum microbiology	87.00	Spirometry	178.94
Sputum cytology	112.03	Bronchoscopy†	209.48
Biopsy pathology	215.10	Thoracocentesis†	80.00
Chest radiograph	24.95	Pleural biopsy†	140.00
Opaque enema	97.00	Lymph node FNA†	80.00
Ultrasound	119.63	Breast/liver FNA†	200.00
Mammography	100.00	CT-guided FNA†	500.00
CT	261.20	Adenopathic biopsy†	00.00
MRI	478.50	Mediastinoscopy-mediastinotomy‡	74.00
ECCG	9.00	Lobectomy-pulmonectomy‡	64.00

*A&E indicates accident and emergency department; CT, computed tomography; ECCG, electrocardiogram; FNA, fine-needle aspiration; MRI, magnetic resonance imaging; PET, positron emission tomography.

†The cost of sample studies (pathology, microbiology, cytometry) is not included in the test costs.

‡Tests for which the Galician Health Service (SERGAS) has not established costs. The values used are reference values for private clinics.

Introduction

In Europe, lung cancer is the first cause of death from cancer in men and the third in women, and over the next 3 decades it is expected to rise to occupy third place as an overall cause of mortality.¹ In Spain it is estimated that some 18800 new cases of lung cancer are recorded annually.² It has been calculated that the total annual cost of respiratory illnesses in Europe amounts to some €100 trillion (10¹²), most of which is accounted for by hospital care (€17.8 trillion), outpatient care (€20 trillion), and workdays lost due to illness (€48.3 trillion). In the European Union, lung cancer represents 11% of total hospital costs and 2% of all workdays lost due to illness.³ There is also a general consensus that in some cases hospital resource use is inappropriate, whether because the care provided fails to significantly benefit patients, or because a lower level of care could provide greater benefits at a lower cost.⁴

The data provided above in relation to incidence, morbidity and mortality are likely to be reflected in rising health care costs and increasingly complex diagnostic procedures involving a number of different medical specialists. Being aware of the direct costs implied by a lung cancer diagnosis, therefore, will undoubtedly assist in deciding how to allocate available

resources. The primary aim of our research was to establish the direct medical costs of the diagnostic process for lung cancer for the year 2003 in our hospital. A secondary aim was to evaluate the costs associated with admissions defined as inappropriate.

Materials and Methods

We conducted a prospective, observational, descriptive study of a cohort of patients, diagnosed with lung cancer on the basis of either cytohistologic criteria or clinical and radiologic criteria indicative of lung cancer. The study was carried out between January 1 and December 31, 2003 at the Complejo Hospitalario Ourense in Galicia, Spain. This center is a tertiary care hospital with a catchment area of 268 283 inhabitants. Information compilation was centralized in a specific lung cancer clinic, and data was stored in a customized database created using Data-Entry 3.0. The following information was collected for the patients in the study: demographic data, comorbidity, cytohistologic diagnosis, TNM staging, details of treatment in an outpatient or hospital setting, number of days admitted (hospitalized patients), clinical department responsible for the diagnostic study, number and type of diagnostic tests (laboratory tests and electrocardiograms), number of visits (outpatients), and finally, surgical procedures and corresponding number of days in hospital.

The direct medical cost of the diagnostic process for 2003 was calculated by taking the number of procedures and medical actions and multiplying each by the cost for each procedure/action (Table 1) established by Decree 222/2003, governing Galician health service rates.⁵ Distinctions were made between costs related to hospitalized patients and outpatients, and between small cell lung cancer (SCLC) and non-small cell lung cancer (NSCLC). Direct medical costs were defined as including hospital costs (for both outpatients and admitted patients), medical and nursing care, treatments, and medical procedures. The established daily hospitalization cost of €366.13 includes medical and nursing care, tests, electrocardiograms, and treatments administered during hospital stays. An admission was rated as inappropriate if the patient failed to comply with the specific criteria established for our study (Table 2). The savings that would have been

TABLE 2
Appropriate Admission Criteria

Moderate or severe hemoptysis
Superior vena cava obstruction
Massive pleural effusion
Pericardial effusion
Respiratory insufficiency (postobstructive pneumonia, lymphangitis carcinomatosa, tracheal obstruction, exacerbated chronic obstructive pulmonary disease, etc)
Signs of metastasis (motor deficiency due to cerebral metastasis, severe hyponatremia)
Advanced age and/or general deterioration in health
Social or psychiatric problems

made had these patients been treated as outpatients were also calculated.

A standard descriptive statistical study was performed using SPSS Version 10.0; the normality assumption was tested and costs were compared using the Student *t* test.

Results

Lung cancer was diagnosed in 160 patients, 130 of whom were men (81.2%) and 30 of whom were women (18.8%). The diagnostic study was conducted for 76 outpatients (47.5%) and for 84 admitted patients (52.5%). Of the 84 hospitalized patients, 27 were considered inappropriate admissions (32%). The pulmonology department conducted the diagnostic study in 83% of the cases; the remaining diagnoses were made by other departments, primarily internal medicine. The cytologic or histologic diagnosis was NSCLC for 108 patients (67.5%)—squamous cell in 57 (35.6%) cases, adenocarcinoma in 42 (26.2%), and other types in 5.6% (large cell in 5, undifferentiated in 3, and carcinoid in 1)—and SCLC for 38 patients

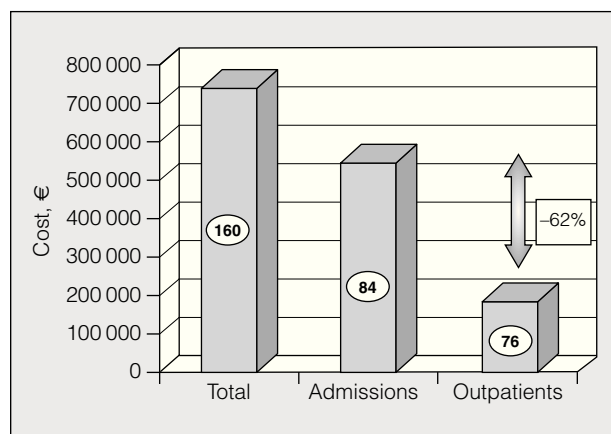


Figure 1. Overall cost of lung cancer diagnosis (n=160), broken down according to admitted patients (n=84) and outpatients (n=76).

(23.7%). The cytohistologic diagnosis was SCLC for 38 patients (23.7%). For 14 patients (8.7%) the diagnosis was based on clinical and radiologic criteria.

The mean hospital stay for admitted patients was 14 days (range, 1-55 days). In our hospital during 2003, the mean stay for patients in respiratory tumor diagnosis-related groups was 9.69 days. To a significant degree ($P<.05$), spirometry and bronchoscopy were more frequently performed on outpatients, whereas thoracentesis and pleural biopsy were more frequently performed on hospitalized patients (Table 3). Of the 76 patients studied as outpatients, 20 required computed tomography-guided thoracic fine-needle aspiration; in our hospital this procedure is done on admitted patients because of pneumothorax complications. The mean stay for these patients was 2 days (range, 1-10 days). One of the outpatients was admitted for 1 day for an ultrasound-guided liver biopsy, and another was hospitalized for 5 days due to an iatrogenic pneumothorax following a transbronchial biopsy procedure. Admission to the thoracic surgery department was necessary in order to diagnose 9 patients. Two of these patients (each hospitalized for 3 days) underwent mediastinoscopy; 1 patient (hospitalized for 12 days) underwent video-assisted thoracoscopy; 6 and 5 patients, respectively, underwent thoracotomies and lobectomies (mean hospitalization 12.4 days); finally, 1 patient (hospitalized for 19 days) underwent a pneumonectomy.

TABLE 3
Number (%) of Patients Who Underwent Diagnostic Tests Classified by Management Setting (Outpatient vs Hospital Admission)*

Tests	Outpatients	Admissions	P
Biochemistry/CBC	76 (100%)	84 (100%)	—
Electrocardiogram	71 (93.40%)	84 (100%)	.01
Sputum microbiology	5 (5.30%)	13 (15.47%)	.07
Sputum cytology	3 (3.90%)	7 (8.3%)	.25
Spirometry	60 (78.90%)	18 (21.4%)	.005
Chest radiograph	75 (98.70%)	84 (100%)	.29
CT	73 (96.10%)	84 (100%)	.06
MRI	5 (6.60%)	8 (9.5%)	.49
Ultrasound	10 (13.20%)	19 (22.6%)	.12
Mammography	2 (2.60%)	3 (3.6%)	.73
Bronchoscopy	74 (97.40%)	62 (73.8%)	.0005
Pleural biopsy	2 (2.60%)	7 (8.3%)	.11
Thoracentesis	4 (5.30%)	24 (28.6%)	.0001
PET	7 (9.20%)	2 (2.2%)	.06
Bone scintigraphy	7 (9.2%)	5 (6%)	.43
Lung scintigraphy	7 (9.2%)	8 (9.5%)	.94
Lymph node FNA	2 (2.6%)	9 (10.7%)	.044
Chest FNA	21 (27.6%)	10 (11.9%)	.012
Digestive endoscopy	3 (3.9%)	7 (8.3%)	.253
Echocardiogram	3 (3.9%)	7 (8.3)	.25

*CBC indicates complete blood count; CT, computed tomography; FNA, fine-needle aspiration; MRI, magnetic resonance imaging; PET, positron emission tomography.

TABLE 4
Characteristics of Outpatients and Appropriately and Inappropriately Admitted Patients with Lung Cancer*

	Outpatients	Appropriate Admissions	Inappropriate Admissions	P
Age, y	67.6 (10.9)	71.5 (12.1)	71.4 (9.7)	.108
Comorbidity	72 (94.7%)	49 (86%)	16 (59.3%)	.0001
Early stages (I & II)	31 (40.8%)	4 (7.1%)	2 (7.7%)	.0001
Advanced stages (III & IV)	49 (59.2%)	52 (92.3%)	24 (92.3%)	.0001
NSCLC	55 (72.4%)	38 (66.7%)	15 (55.6%)	.060
SCLC	18 (23.7%)	10 (17.5%)	10 (37%)	.060
Clinical/radiologic criteria	3 (3.9%)	9 (15.8%)	2 (7.4%)	.060

*Ages are given as mean (SD). NSCLC and SCLC indicate, respectively, non-small cell and small cell lung cancer.

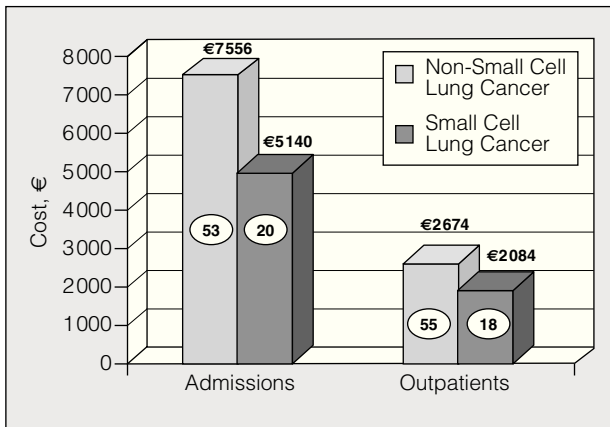


Figure 2. Mean diagnostic cost of non-small cell lung cancer in admitted patients (n=53), small cell lung cancer in admitted patients (n=20), non-small cell lung cancer in outpatients (n=55), and small cell lung cancer in outpatients (n=18).

The total cost to our hospital of lung cancer diagnostic studies during 2003 was €742 847 (mean: €4643; 95% confidence interval, €4049-€5236), with admitted patients and outpatients costing, respectively, totals of €552614 and €190233. The mean cost for outpatients (€2503) was 62% lower than that for admitted patients (€6579) (Figure 1). Table 4 describes differences in terms of age, comorbidity and tumor classification (type and staging) for outpatients, appropriate admissions, and inappropriate admissions. Hospitalization costs represented 64% of the total cost, with 78.2% of this cost corresponding to admitted patients and 22.7% to outpatients (Table 5).

The total costs of diagnosing NSCLC and SCLC were €547560 (mean €5070) and €140296 (mean

TABLE 5
Hospitalization Costs

	Cost, €	Total Cost, €	% of Total
Admissions			
Appropriate	280821.71		
Inappropriate	151211.69		
Total	432033.40	552614	78.2
Outpatients	43203.34	190233	22.7
Total patients	475536.74	742847	64.0

TABLA 6
Mean Cost of Diagnostic Testing According to Patient Type and Lung Cancer Type and Stage*

	Admissions €	P	Outpatients €	P
NSCLC		NS		<.05
Early stage	1402.84		2157.29	
Advanced stage	1454.31		1702.26	
SCLC		<.05		<.05
Limited stage	1615.39		1630.32	
Extensive stage	1341.34		1343.67	

*NS indicates not significant; NSCLC, non-small cell lung cancer; SCLC, small cell lung cancer.

€3692), respectively; the total cost of carcinomas diagnosed on the basis of clinical and radiologic criteria was €54991 (mean €3928). As can be observed, diagnosing NSCLC was considerably more costly. A comparison of NSCLC and SCLC costs for admitted and outpatients showed that the costs for the former were greater; this difference was even more marked for admitted patients than for outpatients (Figure 2).

NSCLC was diagnosed in 53 admitted patients (94.2% at advanced stages) and in 55 outpatients (56.4% at advanced stages) ($P<.05$). SCLC was diagnosed in 20 admitted patients (90% at advanced stages) and in 18 outpatients (66.6% at advanced stages) ($P<.05$). Mean hospital stays for the patients with NSCLC and with SCLC were 16 days and 10 days, respectively. There were significant differences in the mean costs for limited-stage stage and extensive-stage SCLC, which were, respectively, €1894 and €4098 ($P=.001$). The mean costs of early and advanced stage diseases were €3660 and €5494, respectively ($P=.02$). For both carcinoma types, the mean cost of diagnostic testing was significantly greater for outpatients at early stages of the disease (Table 6).

The mean cost of the 27 inappropriate admissions was €6957, compared to €2503 per patient studied in an outpatient setting. Thus a total of €120258 would have been saved in 2003 had inappropriately admitted patients been treated as outpatients.

Discussion

The costs of a disease can be analyzed by calculating direct medical costs, indirect costs, and intangible costs.⁶ As far as we are aware, ours is the first study that analyses the direct medical costs for the lung cancer diagnostic process in Spain. We analyzed direct costs by multiplying the number of procedures and medical actions by the officially established cost of each.⁵ Another approach would be by means of diagnosis-related groups, except that, to date, this approach excludes outpatient diagnoses. In our study, the fact that mean cost per outpatient was 62% lower than per admitted patient was mainly due to the reduced hospitalization cost (64% of the total cost) for the former. The fact that the mean cost of NSCLC diagnosis was substantially greater than that of SCLC diagnosis (€5070 compared to €3692) is due to a number of factors. First, the mean cost of diagnostic testing is significantly higher in earlier stages and in outpatients, given that a larger number of costlier tests must be performed in order to determine whether the patient can be treated surgically. Even so, the total cost is still greater for admitted patients at advanced stages of the disease, due mainly to the cost of hospitalization. Second, the mean cost of diagnostic tests for NSCLC also exceeded the cost of tests for SCLC, for both outpatients and admitted patients, and for both early and advanced stages. Furthermore, since mean stay is longer for NSCLC patients, hospitalization costs are consequently higher, and this logically raises mean

cost. This greater cost for hospitalized patients has been observed in other studies. Evans et al⁷ estimated the direct care costs associated with lung cancer cases diagnosed in Canada in 1988 by applying the Population Health Model (POHEM); this model is based on diagnosis and staging algorithms for 2 main histologic types of carcinomas. These authors arrived at a mean cost of €13984 for NSCLC and €18377 for SCLC—converted to euro at €0.707 per Canadian dollar. Unlike our study, both diagnosis and treatment were included in the estimates by these authors. The most important cost element, irrespective of cancer stage or cell type, was hospitalization. An underlying assumption in the POHEM model is that all patients are treated in accordance with appropriate practice guidelines, though this is not necessarily the case in practice. Moreover, the model underestimates costs because certain tests or complications are excluded, as also tests repeated a second time; and it also overestimates costs because of the assumption that all patients are managed identically even though some are untested because of age or refusal. Other studies have based costs on the actual tests performed on patients⁸⁻¹¹ and so provide more realistic estimates than those based on simulated costs. These studies found hospitalization costs to be between 61% and 80% of total cost.

Of the studies that have analyzed lung cancer diagnostic costs, that of Wolstenholme and Whyne¹⁰ found mean diagnostic costs of €4404 for NSCLC and of €4094 for SCLC—converted from British pounds sterling at a rate of €0.671 per pound. Herder et al¹² found the cost of diagnosing NSCLC in a teaching hospital and in a community hospital to be €1284 and €3064, respectively, with the cost difference attributable to the fact that the teaching hospital admitted 61% of patients, whereas the community hospital admitted 95% of patients. A study by Vergnenègre et al¹¹ reported a mean cost for NSCLC that ranged from €19543 for inoperable Stages I and II to €39424 for operable-stage disease, and a mean cost for SCLC ranging from €22420 for extensive-stage disease to €27098 for limited-stage disease. These authors also reported the cost of diagnosis as representing 6% to 14% of the total cost. Dedes et al¹³ observed mean diagnostic costs of €19 212 for NSCLC and of €20 992 for SCLC. The largest cost item corresponded to hospitalization (71% of the total cost), with the remaining costs referring to diagnosis and treatment. A detailed comparison of the results of our study with those of other studies is complicated by differences between the countries in which the studies were conducted, in terms of institutional frameworks, methods, and epidemiological and histologic distributions; moreover, in most cases the diagnoses were made on admitted patients. Nonetheless, despite this obstacle to drawing conclusions, there is a general consensus in regard to the fact that hospitalization accounts for high mean and total costs.¹³

One of the most important sources of inefficiency in hospital care is inappropriate admission^{4,14,15} and this is particularly marked in the case of suspected lung

tumors. The characteristics of patients hospitalized because of a suspected lung tumor indicate that a significant percentage of them are in stable condition at the time of admission, and many physicians acknowledge that diagnosis could be implemented mostly in an outpatient setting.¹⁶ Although a number of studies have been conducted in Spain on inappropriate hospitalization,¹⁷⁻¹⁹ only 2 studies have addressed the problem in patients with lung cancer.^{16,20} One of these studies, by Bañeres et al,²⁰ was based on a version of the Appropriateness Evaluation Protocol dating from 1987.²² The instrument, developed for the United States of America, was adapted and validated for use in Spain.²¹ In this study, the rates of inappropriate admission and inappropriate stays were 14% and 40%, respectively. A study by Carrasquer et al¹⁶ of 118 patients admitted with suspected lung cancer reported rates of inappropriate admission and stays of 64% and 74%, respectively, although those authors did not confirm how many of the studied patients actually had the disease. They defined a hospital stay of 7 days to be appropriate for lung cancer patients. López Encuentra et al²⁴ took a position that differed from that of other authors^{20,23} when they considered that suspected lung cancer was insufficient justification for admission. We would agree with them in that, if extraordinary admission criteria are no longer considered valid, the rates of inappropriate admissions and stays would increase significantly. We are of the opinion that patients should only be admitted if their general state of health is affected and/or if complications are detected. In their hospital, 43% of patients were admitted, given that even when transbronchial biopsies are performed, there are few risks that would indicate hospitalization to be needed a priori.²⁵

Although it may appear that there was a possible lack of thoroughness in our evaluation of inappropriate admissions, it should be pointed out that there are no standardized admission criteria for lung cancer, unlike for other diseases such as community-acquired pneumonia with very well defined procedures.²⁶ We considered 27 patients to have been inappropriately admitted to our hospital in 2003, at a mean cost of €6957. Accordingly, at a mean cost of €2503 for outpatient diagnosis, the savings would have been €120258 had the inappropriately admitted patients been treated as outpatients. Although another possible source of confounding in the estimation of costs in our study may be the inclusion of patients diagnosed on the basis of clinical and radiologic criteria, these patients, in fact were few in number, representing a mere 7.4% of the total cost.

In conclusion, we would like to point to the importance of studying patients in an outpatient setting whenever possible, given the significant savings that can be made when hospitalization is avoided. The departments and institutions responsible for making savings could be included in decisions as to earmarking funds for the resolution of some of the underlying problems that lead to delays in providing certain outpatient diagnostic tests (eg, computed tomography

and positron emission for tomography), for the funding of anti-smoking campaigns, or for other urgent department or hospital needs.

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