

COMMUNICATION

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Ten-Year Survey of Lung Cancer Treatment and Survival in Hospitals in the United States

A National Cancer Data Base Report

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BACKGROUND. Primary lung cancer accounts for approximately 14% of all new cancers and 28% of cancer deaths in the U.S. Previous reviews have shown limited progress in the management or outcome of this devastating disease.

METHODS. Reports described in the current study were 713,043 primary lung malignancies diagnosed between 1985 and 1995 and submitted to the National Cancer Data Base. Demographic, tumor, and treatment patterns for 1995 were compared with those for 1985–1987, 1988–1991, and 1992–1994. Ten-year relative survival rates were presented for selected demographic and histologic groups and 5-year relative survival rates were presented by stage and dominant treatment modalities for major carcinoma histologies.

RESULTS. Previously observed demographic trends were evident, with increasing proportions of patients being older, female, and African American, and more cases reported to be adenocarcinomas. There was a substantial shift toward more complete staging but no change in the distribution of staged cases. Compared with earlier patients, fewer 1995 patients received cancer-directed treatment. More surgical patients underwent lymph node dissection, and radiation treatment was supplemented more often with chemotherapy. The overall 10-year relative survival rate was 7%. The 5-year survival for American Joint Committee on Cancer Stage I surgical patients was > 50% for all nonsmall cell histologic groups.

CONCLUSIONS. Recent shifts in treatment, although minimal, are consistent with current literature concerning the effectiveness of lung carcinoma treatment. The authors believe that the overall poor survival of lung carcinoma patients points to a continuing need for improved prevention and treatment measures. The comparatively superior survival of Stage I nonsmall cell lung carcinoma surgical patients indicates that a substantial number of patients have the potential to be treated successfully. *Cancer* 1999;86:1867–76. © 1999 American Cancer Society.

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Primarily cancer of the bronchus and lung will be diagnosed in an estimated 171,600 individuals in 1999, representing approximately 14% of all new cancers, and was expected to be responsible for 158,900 deaths (28%) in the U.S.¹

The high toll taken by lung cancer and the intractability of the disease have motivated previous reports using information from the National Cancer Data Base (NCDB). In an early survey of hospital lung cancer management practices, Humphrey et al.² documented evidence of a decreasing male:female gender ratio between 1981 and 1986 and a relative increase in adenocarcinoma cases. However, they found little change in treatment except for more tissue-sparing surgical excisions of lesions measuring < 1 cm in greatest dimension in 1986. A subsequent analysis of lung cancer cases in NCDB data files³ confirmed a similar decrease in the gender ratio between 1985 and 1988 and a relative increase in adenocarcinoma cases. The 3-year relative survival rate for the 16,514 patients diagnosed in 1985 was 17%. Fry et al.⁴ described management practices for small cell carcinoma and non-small cell lung carcinoma patients diagnosed in 1992 with reference to patients diagnosed between 1986–1987.

This report makes use of the mature NCDB data base to survey lung cancer management and survival rates in U.S. hospitals over the last decade.

METHODS

Source

The data were obtained from the NCDB, a large pool of case information routinely collected by hospital cancer registries. The methodology of the NCDB has been described elsewhere.^{5,6} Hospitals with cancer programs voluntarily submit reports for all cancers diagnosed or treated at the facility during the most recently completed year. They also submit long term follow-up information for cases originally diagnosed 5 and 10 years earlier.

Cases

The study reported here was based on the 713,043 primary lung (C34.x) malignancies submitted to the NCDB that were diagnosed between 1985 and 1995. Five-year follow-up information was available for patients diagnosed between 1985 and 1990 and part of 1991, and 10-year follow-up information was available for patients diagnosed in 1985 and part of 1986. Patients with prior malignancies were excluded. The very large number of cases permitted detailed analysis, including the calculation of 10-year survival rates for selected patient groups.

Histologic Grouping

Cases were grouped histologically following the recommendations published by the World Health Organization^{7,8}: squamous cell carcinoma, adenocarcinoma, small cell carcinoma, large cell carcinoma, other and unspecified carcinoma, sarcoma, and other or unspecified histologic types. Because lung carcinomas frequently are dichotomized as small cell and nonsmall cell, nonsmall cell carcinomas also were combined for presentation in some instances.

Stage Grouping

The combined American Joint Commission on Cancer (AJCC) stage⁹ at diagnosis for carcinomas was the pathologic stage when it was available (23%) or the clinical stage for nonsurgical patients and patients whose surgery did not support pathologic staging (65%). Twelve percent of the carcinoma patients had no stage recorded. The procedures for assigning AJCC stage changed substantially in 1988,¹⁰ and cases diagnosed prior to 1988 were excluded from all analyses based on disease stage at diagnosis. The lung carcinoma staging procedures do not apply to sarcoma cases or other histologic types.

Treatment

Categories of first course cancer-directed treatment were based on the definitions in the Data Acquisition Manual,¹¹ the coding manual in use by hospital registries when the cases were diagnosed. Treatment provided to the patients represents the real-world aggregate effect of clinical evaluation of the tumor and of the patient's overall health condition, mediated by patient preference. Cancer-directed surgery was categorized in terms of the amount of lung tissue removed, dissection of lymph nodes draining the lungs, and removal of tissue beyond the lung. Radiation treatment was identified as either beam radiation or any combination involving implants or radioisotopes. The sequence of surgery and radiation was identified for patients who were treated with both modalities. Chemotherapy was identified as single agent or multiagent. The use of hormone treatment and biologic response modifiers also was recorded.

Outcome

Survival rates are presented as relative survival rates. These rates adjust for competing causes of death that would be expected for persons of the same gender, age, and race or ethnicity as the lung cancer patients in the study. Case attrition was high between Year 5 and Year 10 of follow-up, and the majority of the surviving patients who could be included in the cal-

TABLE 1
Characteristics of Lung Cancer Patients by Period of Diagnosis in Cases Diagnosed 1985–1995

	Diagnosis period							
	1985–1987		1988–1991		1992–1994		1995	
All patients ^a	122,751	100%	271,599	100%	240,386	100%	78,307	100%
Gender								
Male	80,550	66%	171,659	63%	145,969	61%	46,993	60%
Female	41,885	34%	99,701	37%	94,231	39%	31,280	40%
M:F gender ratio	1.92		1.72		1.55		1.50	
< 50	1.50		1.45		1.41		1.37	
50–69	1.90		1.76		1.62		1.60	
≥ 70	2.07		1.72		1.49		1.30	
AJCC combined stage (carcinoma cases only)								
Unstaged	60,059	51%	66,577	25%	34,149	15%	8548	11%
Stage (percent of staged carcinoma cases)								
Stage 0	NA ^b		104	0%	24	0%	0	0%
Stage I	NA		40,813	21%	40,413	20%	13,772	20%
Stage II	NA		14,423	7%	12,127	6%	3937	6%
Stage III	NA		63,854	32%	64,504	32%	21,935	33%
Stage IV	NA		77,874	40%	82,134	41%	27,801	41%

M: male; F: female; AJCC: American Joint Commission on Cancer; NA: not applicable.

^a The subtable excludes 245 patients with unspecified gender.

^b Stage at diagnosis is not shown for cases diagnosed before 1988 because the rules for categorizing disease stage changed in 1988.

culations for the final 5 years originally were diagnosed in 1985.

RESULTS

Patient Characteristics

Patient characteristics (Table 1) were compared across four time periods (1985–1987, 1988–1991, 1992–1994, and 1995). Across those intervals, there was a proportionate increase in older patients (data not shown), with 35% of the patients age ≥ 70 years in 1985–1987 compared with 43% in 1995, and a continued decrease in the male:female gender ratio, from 1.92 in the earliest period to 1.50 in 1995. Although the gender ratio dropped in all age groups, it dropped most sharply among patients age ≥ 70 years. Throughout the period, 86% of the patients were non-Hispanic white, 2% were white Hispanic, 1% were Asian, and < 1% were Native American (data not shown). The percentage of patients who were African American increased from 8% in 1985–1987 to 10% in 1995.

The trend toward increased percentages of adenocarcinoma cases continued through the most recent time period, increasing from 28% in 1985–1987 to 33% in 1995 (data not shown). The percentage of unstaged cases decreased dramatically, from > 50% in 1985–1987 to 11% in 1995, but the distribution by AJCC stage of disease among staged cases did not change.

Treatment

Table 2 presents treatment patterns for the same four time periods. The percentage of patients treated surgically was the same in all four periods: 27%. The percentage of patients treated by nonsurgical means decreased slightly from 59% to 54%, and the percentage who did not receive cancer-directed treatment increased comparably from 14% to 19%. The only change in type of surgery was an increase in lymph node dissection for patients treated with lobectomies. There was no overall change in the use of adjuvant treatment for surgical patients. Chemotherapy, especially multiple agent chemotherapy, was used increasingly for nonsurgical patients over the 11 years studied, and radiotherapy use decreased.

Table 3 provides more detailed information regarding the treatment used for staged carcinoma patients in 1995 compared with patients diagnosed approximately 5 years earlier (1988–1991).

The proportion of untreated cases increased at all stages in all four histologic groups, reaching approximately 20% of Stage IV cases in each group. The treatment of small cell carcinoma shifted from chemotherapy alone toward chemotherapy in combination with radiation therapy.

Surgery without adjuvant therapy was used for approximately 75% of Stage I adenocarcinoma patients and approximately 50% of Stage I squamous cell

TABLE 2
Treatment Provided to Lung Cancer Patients by Period of Diagnosis in Cases Diagnosed 1985–1995

	Diagnosis period							
	1985–1987		1988–1991		1992–1994		1995	
All patients	122,751	100%	271,599	100%	240,386	100%	78,307	100%
Surgical treatment	33,311	27%	72,436	27%	65,266	27%	21,503	27%
Type of surgery								
Local excision	879	1%	2245	1%	1528	1%	407	1%
Wedge resection	3046	3%	6848	3%	6848	3%	2150	3%
Lobectomy								
No lymph node dissection	6644	6%	10,248	4%	7183	3%	2241	3%
With lymph node dissection	9113	8%	27,481	10%	28,848	12%	10,030	13%
Pneumonectomy with lymph node dissection								
Hilar, parabranchial	2824	2%	6049	2%	5061	2%	1505	2%
Mediastinal lymph nodes	1267	1%	2636	1%	2202	1%	700	1%
With surrounding tissue	154	0%	364	0%	297	0%	63	0%
Metastatic sites only	1240	1%	4364	2%	4804	2%	1723	2%
Unspecified type	4253	4%	4247	2%	1460	1%	370	0%
Adjuvant radiation	10,261	8%	21,444	8%	17,873	7%	5707	7%
Type of radiation								
Beam only	8510	7%	19,027	7%	16,824	7%	5477	7%
Implants or isotopes	248	0%	538	0%	406	0%	96	0%
Unspecified type	1503	1%	1879	1%	643	0%	134	0%
Surgery/radiation sequence, if specified								
Preoperative	1418	1%	2718	1%	1338	1%	510	1%
Postoperative	5269	4%	15,171	6%	14,869	6%	4709	6%
Preoperative and postoperative	114	0%	305	0%	214	0%	73	0%
Intraoperative	226	0%	182	0%	71	0%	19	0%
Intra- and pre- or postoperative	4	0%	40	0%	48	0%	5	0%
Adjuvant chemotherapy	2927	3%	7555	3%	7402	2%	2816	3%
Type of chemotherapy								
Single agent	57	0%	341	0%	512	0%	239	0%
Multiple agents	773	1%	5212	2%	5817	2%	2224	3%
Unspecified type	2097	2%	2002	1%	1073	0%	353	0%
Adjuvant hormone therapy	350	0%	931	0%	803	0%	149	0%
Biologic response modifier	15	0%	79	0%	128	0%	32	0%
Nonsurgical treatment	72,484	59%	159,188	59%	137,825	57%	42,674	54%
Radiation treatment	54,852	46%	118,603	45%	101,053	44%	32,024	42%
Type of radiation								
Beam only	41,959	35%	105,181	40%	94,789	41%	30,427	40%
Implants or isotopes	1139	1%	3182	1%	2483	1%	758	1%
Unspecified type	11,754	10%	10,240	4%	3781	2%	839	1%
Chemotherapy	27,705	23%	68,998	26%	63,035	27%	22,670	30%
Type of chemotherapy								
Single agent	464	0%	3155	1%	4497	2%	2111	3%
Multiple agents	7819	7%	51,256	19%	51,974	22%	18,388	24%
Unspecified type	19,422	16%	14,587	6%	6564	3%	2171	3%
Hormone therapy	2173	2%	5406	2%	4633	2%	1050	1%
Biologic response modifier	142	0%	435	0%	1101	0%	317	0%
No treatment	16,956	14%	39,975	15%	37,295	16%	14,130	19%

and large cell carcinoma patients, and it was used more frequently in 1995 for patients with Stage I and Stage II disease in all 3 of those histologic groups. Radiation therapy alone was used most frequently for patients with Stage III disease, especially Stage IIIB, to treat patients in those histologic groups, but it was used less often in 1995 compared with 5 years earlier. The use of combined surgery and radiation therapy

also decreased during the same interval, but chemotherapy use (alone or in combination with surgery) increased or remained constant at all stages of disease for patients with nonsmall cell carcinoma histologies.

Treatment of Sarcoma

Surgery was the most common form of treatment for lung sarcomas. Thirty-six percent of sarcoma patients

TABLE 3
Treatment Mode Combination by Histologic Group and Disease Stage, Carcinoma Patients Diagnosed 1988–1991 and 1995

	AJCC combined stage									
	I		II		IIIA		IIIB		IV	
					Year of diagnosis					
	1988–1991	1995	1988–1991	1995	1988–1991	1995	1988–1991	1995	1988–1991	1995
Small cell carcinoma										
Surgery	5%	8%	4%	3%	1%	1%	0%	0%	1%	1%
Radiation	5%	4%	6%	6%	6%	4%	6%	4%	8%	8%
Surg & Rad	1%	0%	1%	0%	1%	0%	0%	0%	1%	1%
Surg & Chem	7%	6%	7%	6%	2%	1%	1%	1%	1%	1%
Chem & Rad	33%	39%	34%	40%	42%	48%	40%	47%	28%	27%
Chemother	32%	26%	32%	23%	34%	27%	37%	31%	40%	40%
S+R+C	2%	3%	5%	5%	2%	2%	1%	1%	1%	1%
Other	5%	3%	5%	6%	6%	5%	6%	4%	7%	6%
None	10%	11%	7%	11%	7%	11%	9%	11%	13%	17%
Squamous cell carcinoma										
Surgery	53%	58%	33%	36%	11%	11%	4%	4%	3%	3%
Radiation	25%	20%	25%	19%	49%	38%	55%	43%	49%	41%
Surg & Rad	6%	4%	26%	24%	14%	12%	6%	4%	5%	4%
Surg & Chem	0%	1%	1%	2%	1%	1%	0%	0%	1%	1%
Chem & Rad	2%	2%	3%	4%	9%	17%	13%	25%	13%	15%
Chemother	1%	1%	1%	1%	2%	3%	4%	5%	7%	9%
S+R+C	0%	1%	2%	5%	2%	5%	1%	2%	1%	2%
Other	3%	2%	3%	1%	3%	2%	4%	3%	6%	4%
None	10%	11%	6%	7%	8%	10%	12%	13%	15%	21%
Adenocarcinoma										
Surgery	74%	77%	40%	42%	14%	14%	4%	4%	3%	3%
Radiation	10%	8%	11%	9%	30%	21%	34%	24%	36%	32%
Surg & Rad	4%	4%	31%	27%	21%	16%	5%	2%	6%	4%
Surg & Chem	1%	1%	3%	4%	3%	3%	1%	1%	1%	1%
Chem & Rad	1%	1%	2%	3%	10%	16%	15%	23%	16%	18%
Chemother	1%	1%	2%	1%	5%	5%	15%	16%	12%	14%
S+R+C	0%	1%	4%	8%	6%	10%	2%	3%	2%	2%
Other	2%	1%	2%	1%	3%	2%	6%	4%	7%	5%
None	6%	7%	5%	5%	8%	11%	19%	23%	16%	20%
Large cell carcinoma										
Surgery	49%	55%	27%	28%	8%	8%	2%	2%	2%	3%
Radiation	25%	20%	27%	18%	46%	34%	46%	33%	44%	37%
Surg & Rad	5%	4%	21%	22%	12%	11%	4%	3%	5%	4%
Surg & Chem	1%	1%	2%	5%	2%	2%	1%	1%	1%	1%
Chem & Rad	3%	3%	5%	6%	13%	20%	18%	29%	16%	18%
Chemother	2%	1%	3%	2%	4%	5%	8%	11%	9%	11%
S+R+C	1%	2%	3%	5%	4%	7%	2%	2%	2%	2%
Other	4%	2%	2%	3%	4%	4%	5%	3%	8%	6%
None	10%	12%	9%	11%	8%	9%	14%	17%	14%	19%

AJCC: American Joint Commission on Cancer; Surg & Rad: combined surgery and radiation therapy; Surg & Chem: combined surgery and chemotherapy; Chem & Rad: combined chemotherapy and radiation therapy; Chemother: chemotherapy; S+R+C: combined surgery, radiation therapy, and chemotherapy; Other: any combination that involves the use of hormone therapy or biologic response modifiers, or was coded as "other" on the report.

were treated with surgery alone and another 19% were treated with surgery in combination with radiation therapy (10%), chemotherapy (4%), or both (5%). Radiation therapy alone was used for 11% of the sarcoma patients and chemotherapy alone for 10%. Five percent of sarcoma patients received other treatment combinations, and 15% received no cancer-directed treatment.

Survival Outcome

Ten-year relative survival rates for major patient groups are presented in Table 4. The overall 10-year relative survival rate was 7%. Females had somewhat better survival prospects than males (data not shown) at 5 years (15% relative survival rate for females vs. 11% relative survival rate for males) and at 10 years

TABLE 4
Cumulative 10-Year Relative Survival Rates for Lung Cancer Patients by Patient Group

	N5 ^a	Years after diagnosis						
		1	3	5	N10 ^b	6	8	10
All patients	392,238	40%	17%	13%	25,497	11%	9%	7%
Race or ethnicity								
Non-Hispanic white	340,414	40%	17%	14%	22,853	11%	9%	8%
Hispanic white	6165	38%	16%	12%	315	11%	9%	8%
African American	34,921	37%	14%	10%	1694	9%	7%	6%
Native American	609	35%	14%	9%	27	7%	7%	8%
Asian/Pacific Islander	4224	44%	19%	15%	277	14%	12%	11%
Histologic group								
Small cell carcinoma	69,911	36%	8%	5%	1964	4%	3%	2%
Squamous cell	114,152	44%	19%	14%	8243	12%	9%	8%
Adenocarcinoma	115,862	44%	22%	17%	10,300	15%	12%	10%
Large cell carcinoma	43,597	33%	13%	10%	2227	9%	6%	6%
Sarcoma	481	46%	28%	23%	51	21%	22%	18%
All other/unknown	48,235	33%	16%	12%	2801	11%	9%	9%

^a N5 indicates the initial number of patients for the first 5 years of survival rates.

^b N10 indicates the initial number of patients for Years 6–10.

(9% vs. 7%), as did patients who were younger at diagnosis (5-year and 10-year relative survival rates for patients diagnosed at age < 50 years were 16% and 12%, respectively, 13% and 8%, respectively, for patients diagnosed at age 50–69 years, and 10% and 5%, respectively, for patients diagnosed at age ≥ 70 years) (data not shown). Patients of Asian/Pacific Island heritage also had slightly better survival rates at both 5 years and 10 years after diagnosis.

Survival rates varied more among the histologic categories. Small cell carcinoma patients had the poorest overall survival rates (5% relative survival rate 5 years after diagnosis and 2% relative survival rate 10 years after diagnosis). By contrast, the 10-year relative survival rate for patients with lung sarcomas was 18%. Adenocarcinoma patients had a better long term survival rate (10%) than other carcinoma patients.

To some extent, the survival differences among histologic groups may account for the demographic differences. Adenocarcinoma accounted for a larger proportion of cases among younger patients, females, and Asian/Pacific Islanders. Nearly 40% of patients ages 40–49 years were diagnosed with adenocarcinoma, with a steady decline to 25% for patients age > 90 years. Thirty-five percent of females were diagnosed with adenocarcinoma compared with 28% of males. Forty-one percent of Asian/Pacific Islander patients had adenocarcinoma compared with 25% of Native Americans and 29–33% of all other racial or ethnic groups.

Stage of disease at the time of diagnosis for patients diagnosed with lung carcinoma was predictive

of survival outcome (Fig. 1). The 5-year relative survival rate ranged from 42% for Stage I carcinoma patients to 1% for Stage IV patients. Patients diagnosed before 1988 were excluded from stage specific survival calculations because of the change in staging procedures. However, the overall relative survival rates for all lung cancer patients were the same for patients diagnosed between 1985–1987 and those diagnosed between 1988–1991. The overall 1-year through 5-year survival rates, respectively, for both periods were 40%, 23%, 17%, 15%, and 13%.

Overall 5-year and 10-year relative survival rates for treated patients were 14% and 8%, respectively, compared with 5% and 2%, respectively, for patients who received no cancer-directed treatment (data not shown). Survival rates for carcinoma patients by major histologic group, stage of disease at diagnosis, and most frequent treatment modes were calculated for patients diagnosed between 1988–1991 (Table 5). Survival was consistently better for patients who received cancer-directed treatment than untreated patients, but the treatment advantage was minimal or of short duration under some circumstances.

Surgical candidates diagnosed with Stage I squamous cell carcinoma, adenocarcinoma, and large cell carcinoma had 5-year relative survival rates of 55–63%. The prognosis for patients with small cell carcinoma of the lung was poor under any conditions, but patients treated with both chemotherapy and radiation therapy had higher survival rates than patients treated with chemotherapy alone at every stage level.

Cumulative Relative Survival Rates from Lung Carcinoma by AJCC Combined Stage at Diagnosis

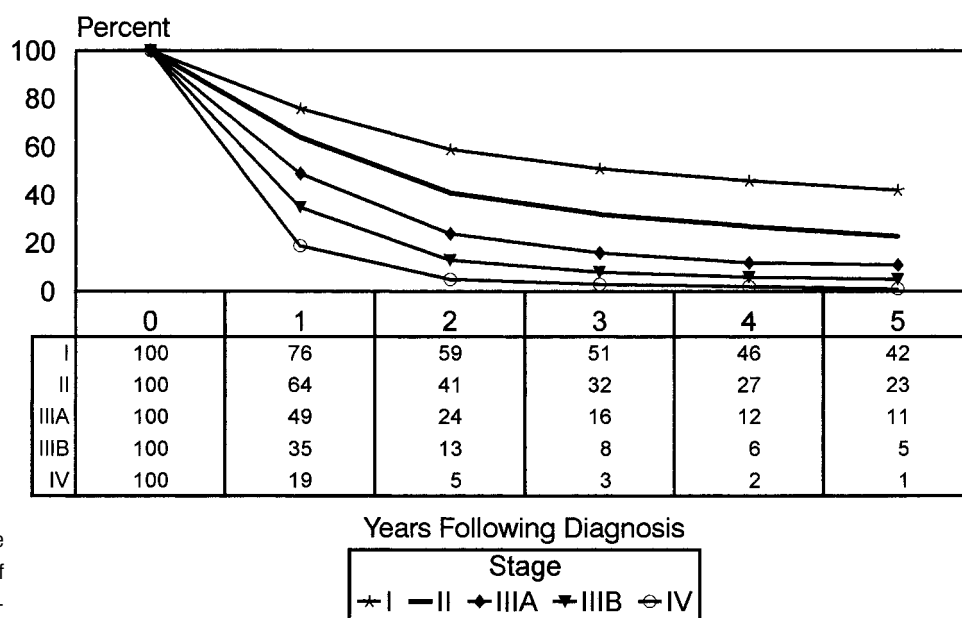


FIGURE 1. American Joint Committee on Cancer (AJCC) combined stage of disease at the time of diagnosis for carcinoma patients was found to be predictive of the relative survival rate.

Source: National Cancer Data Base, 1988 - 1991 Diagnoses

DISCUSSION

Demographic Trends

Some trends in the pattern of lung cancer observed in the current study are unchanged from prior reports^{2,3} such as the continuing decrease in the male:female gender ratio, signifying the marked increase in the incidence rate of lung cancer in American women, increasing numbers of African-American patients, and the increasing incidence of adenocarcinoma.

The increase in older patients carries some therapeutic implications because comorbidities tend to increase with age. Older patients often tolerate aggressive, multimodal therapy less well than younger patients. Although the percentage of patients who received no cancer-directed treatment increased across all age groups (data not shown), it increased most dramatically for older patients.

Treatment Trends

We were pleased to note that there were fewer unstaged patients and increased reporting of lymph node dissection in surgical patients, which we believe reflect an increasing interest in accurate staging to guide treatment in oncology training programs and in the actively practicing community. The AJCC stage classifications reported in this review first were used

in 1988.¹⁰ Comparison of staging data in the future must take into account the 1997 modification of AJCC lung carcinoma staging procedures.^{12,13}

The increased use of chemotherapy, at least in nonsurgical patients, is consistent with the minimal but real benefit that chemotherapy appears to have on lung carcinoma survival.¹⁴ We also noted a slight decrease in the use of radiation therapy alone and a related increase in the use of combined radiation therapy and chemotherapy.^{15,16} The use of adjuvant post-operative radiation therapy, although limited, was steady but may be expected to decrease in the future due to recent reports on the long term damaging effects of adjuvant radiation therapy after lung carcinoma resection with no survival benefit when the resection is completed.¹⁷

Survival Implications

It is encouraging to note that the 5-year relative survival rates for Stage I surgical patients were > 50% for all 3 nonsmall cell carcinoma histologic groups. However, overall survival remains poor. For the most common cause of cancer death in the U.S., the poor overall survival rates are a plea for more national public health emphasis on lung carcinoma prevention, im-

TABLE 5
Cumulative 5-Year Relative Survival: Carcinoma Histology, AJCC Combined Stage, and Major Treatment Combinations for Cases Diagnosed 1988–1991

	Cases at outset ^a	Years after diagnosis				
		1	2	3	4	5
Small cell carcinoma	48,034	36%	12%	8%	6%	5%
Stage I	3137	61%	30%	21%	17%	15%
Chemotherapy and radiation therapy	1028	69%	32%	20%	16%	14%
Chemotherapy	1017	53%	20%	10%	7%	6%
Untreated	313	31%	17%	10%	7%	7%
Stage II	1426	57%	23%	16%	14%	12%
Chemotherapy and radiation therapy	490	65%	28%	19%	15%	13%
Chemotherapy	450	49%	14%	8%	6%	4%
Untreated	99	21%	4%	5%	5%	5%
Stage IIIA	3275	54%	21%	13%	10%	8%
Chemotherapy and radiation therapy	1377	63%	27%	18%	14%	12%
Chemotherapy	1099	51%	15%	8%	5%	4%
Untreated	215	22%	9%	2%	2%	^b
Stage IIIB	3869	44%	14%	9%	7%	6%
Chemotherapy and radiation therapy	1559	55%	21%	14%	11%	10%
Chemotherapy	1427	40%	10%	5%	4%	3%
Untreated	336	16%	4%	3%	1%	1%
Stage IV	17,439	23%	5%	2%	2%	1%
Chemotherapy and radiation therapy	4945	28%	6%	3%	2%	2%
Chemotherapy	6910	26%	5%	2%	2%	1%
Untreated	2221	7%	2%	1%	1%	1%
Squamous cell carcinoma	76,618	44%	25%	19%	16%	14%
Stage I	13,006	73%	55%	47%	42%	38%
Surgery	6909	88%	77%	70%	64%	59%
Radiation therapy	3283	55%	24%	15%	11%	7%
Untreated	1237	46%	26%	18%	14%	13%
Stage II	4957	65%	43%	33%	29%	25%
Surgery	1650	72%	55%	44%	39%	36%
Radiation therapy	1227	50%	23%	13%	9%	7%
Surgery and radiation therapy	1278	78%	57%	46%	40%	35%
Untreated	279	31%	14%	9%	6%	4%
Stage IIIA	8658	48%	23%	15%	12%	10%
Surgery	907	59%	40%	34%	30%	29%
Radiation therapy	4229	41%	15%	8%	5%	4%
Surgery and radiation therapy	1242	70%	45%	33%	27%	23%
Chemotherapy and radiation therapy	801	53%	22%	13%	9%	6%
Untreated	722	27%	12%	5%	3%	3%
Stage IIIB	6388	35%	14%	8%	6%	5%
Radiation therapy	3525	32%	10%	5%	3%	2%
Chemotherapy and radiation therapy	820	47%	19%	11%	9%	7%
Untreated	742	18%	7%	4%	2%	2%
Stage IV	14,608	17%	5%	3%	2%	1%
Radiation therapy	7203	15%	4%	1%	1%	1%
Chemotherapy and radiation therapy	1837	21%	6%	2%	1%	1%
Untreated	2224	11%	4%	2%	1%	1%
Adenocarcinoma	81,132	44%	28%	22%	19%	17%
Stage I	14,123	84%	71%	63%	57%	53%
Surgery	10,468	92%	82%	74%	68%	63%
Radiation therapy	1379	56%	31%	21%	15%	12%
Untreated	836	48%	33%	25%	22%	22%
Stage II	4450	69%	47%	36%	29%	25%
Surgery	1772	76%	57%	45%	37%	32%
Radiation therapy	511	45%	18%	10%	7%	5%
Surgery and radiation therapy	1364	79%	56%	41%	34%	30%
Untreated	213	29%	11%	7%	6%	6%

(continued)

TABLE 5 (continued)

Cumulative 5-Year Relative Survival: Carcinoma Histology, AJCC Combined Stage, and Major Treatment Combinations for Cases Diagnosed 1988–1991

	Cases at outset ^a	Years after diagnosis				
		1	2	3	4	5
Stage IIIA	6149	52%	28%	19%	15%	13%
Surgery	852	59%	38%	30%	24%	21%
Radiation therapy	1844	41%	18%	11%	7%	5%
Surgery and radiation therapy	1316	70%	41%	31%	25%	22%
Chemotherapy and radiation therapy	598	50%	20%	11%	7%	5%
Untreated	508	27%	11%	6%	5%	4%
Stage IIIB	5591	32%	13%	7%	5%	4%
Radiation therapy	1910	29%	11%	6%	3%	2%
Chemotherapy and radiation therapy	818	41%	16%	9%	7%	6%
Chemotherapy	815	34%	10%	3%	2%	1%
Untreated	1034	15%	6%	3%	1%	1%
Stage IV	22,397	19%	6%	3%	2%	2%
Radiation therapy	8160	14%	4%	2%	1%	1%
Chemotherapy and radiation therapy	3595	20%	5%	3%	2%	1%
Chemotherapy	2731	25%	7%	3%	2%	1%
Untreated	3609	11%	3%	1%	1%	1%
Large cell carcinoma	29,859	33%	18%	13%	11%	9%
Stage I	3183	70%	52%	44%	39%	36%
Surgery	1570	85%	72%	64%	59%	55%
Radiation therapy	806	56%	30%	19%	12%	9%
Untreated	314	47%	25%	16%	11%	10%
Stage II	1157	56%	36%	29%	26%	23%
Surgery	310	68%	48%	42%	37%	35%
Radiation therapy	316	42%	19%	12%	9%	8%
Surgery and radiation therapy	242	72%	51%	45%	43%	35%
Untreated	101	22%	12%	8%	6%	5%
Stage IIIA	2736	44%	21%	15%	12%	11%
Radiation therapy	1267	38%	14%	9%	7%	5%
Surgery and radiation therapy	330	58%	38%	30%	27%	24%
Chemotherapy and radiation therapy	351	50%	24%	13%	10%	9%
Untreated	217	24%	13%	8%	3%	3%
Stage IIIB	2580	31%	13%	8%	6%	5%
Radiation therapy	1195	30%	12%	6%	4%	3%
Chemotherapy and radiation therapy	467	40%	16%	11%	8%	7%
Chemotherapy	202	34%	12%	9%	6%	5%
Untreated	351	15%	4%	3%	2%	2%
Stage IV	9370	15%	5%	3%	2%	1%
Radiation therapy	4108	12%	4%	2%	2%	1%
Chemotherapy and radiation therapy	1494	19%	5%	2%	1%	1%
Chemotherapy	849	20%	6%	3%	1%	> 0%
Untreated	1321	9%	3%	1%	> 0%	> 0%

AJCC: American Joint Commission on Cancer.

^a Because not all treatment combinations are shown and because disease stage and treatment information were not available for all cases, totals may be greater than the sums of the subtotals.^b No untreated Stage IIIA small cell lung carcinoma patients were followed beyond Year 4.

proved screening and early diagnosis, and better treatment.

These data raise questions regarding the cost-effectiveness of treatment for many forms of lung carcinoma, especially at later stages of disease, when the prognosis is so poor when compared with treatment for other forms of cancer. In fact, the observed increase in the percentage of patients who did not re-

ceive treatment was concentrated in later stage diagnoses for every age group (data not shown).

Finally, we noted that survival rates after cancer-directed treatment in this large group of patients may be lower than those in some smaller series from specialty groups.¹⁸ Specialty groups often are able to select patients who clearly meet specified qualifications for particular forms of treatment. The cases in this

report represent the combined total lung cancer case-loads of 1806 hospitals nationwide, and the treatment provided incorporates the diverse clinical considerations of the patients' overall condition as well as patient preference. This raises the possibility that the training background of the surgeon might have a significant effect on patient outcome, particularly survival outcome.¹⁹ In addition, it is not possible in these data to ascertain whether cancer-directed treatment was provided with curative intent.

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