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Penetration of Recommended Procedures for Lung Cancer Staging and Management in the United States over 10 Years: A Quality Research in Radiation Oncology Survey

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Abstract

Purpose—To document the penetration of clinical trial results, practice guidelines, and appropriateness criteria into national practice, we compared the use of components of staging and treatment for lung cancer among patients treated in 2006–2007 versus in 1998–1999.

Methods—Patient, staging work-up, and treatment characteristics were extracted from the process survey database of the Quality Research in Radiation Oncology (QRRO), comprising records from 340 patients with locally advanced non-small cell lung cancer (LA-NSCLC) at 44 institutions and 144 patients with limited-stage small cell lung cancer (LS-SCLC) at 39 institutions. Data were compared for patients treated in 2006–2007 versus patients treated in 1998–1999.

Results—Use of all recommended procedures for staging and treatment was more common in 2006–2007. Specifically, disease was staged with brain imaging (magnetic resonance imaging or computed tomography) and whole-body imaging (positron emission tomography or bone scanning) in 66% of patients with LA-NSCLC in 2006–2007 (vs. 42% in 1998–1999, $p=0.0001$) and in 84% of patients with LS-SCLC in 2006–2007 (vs. 58.3% in 1998–1999, $p=0.0011$). Concurrent chemoradiation was used for 77% of LA-NSCLC patients (vs. 45% in 1998–1999, $p<0.0001$) and for 90% of LS-SCLC patients (vs. 62.5% in 1998–1999, $p<0.0001$). Use of the recommended radiation dose (59–74 Gy for NSCLC and 60–70 Gy as once-daily therapy for

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SCLC) did not change appreciably, being 88% for NSCLC in both periods and 51% (2006–2007) vs. 43% (1998–1999) for SCLC. Twice-daily radiation for SCLC was used for 21% of patients in 2006–2007 vs. 8% in 1998–1999. Finally, 49% of patients with LS-SCLC received prophylactic cranial irradiation (PCI) in 2006–2007 (vs. 21% in 1998–1999).

Conclusion—Although adherence to all quality indicators improved over time, brain imaging and recommended radiation doses for stage III NSCLC were used in <90% of cases. Use of full thoracic doses and PCI for LS-SCLC also require improvement.

Keywords

lung cancer; QRRO; quality indicators; clinical performance measures; healthcare management; standard of care; patterns of care

Introduction

Donabedian posited in the late 20th century that assessments of the quality of medical care must consider structure, process, and outcome.¹ The Quality Research in Radiation Oncology (QRRO) effort (formerly known as the Patterns of Care Study) focuses on process measures that correlate with differences in outcome, as indicated by evidence from randomized clinical trials or other high-level-of-evidence research.² During the past four decades, scientifically rigorous surveys have been undertaken to assess aspects of radiation oncology structures, processes, and outcomes for the purpose of establishing benchmarks and as a basis for quality improvement.^{3–5} The quality of pretreatment evaluation and treatment of common forms of cancer has received particular emphasis in the past few years, particularly in light of a series of articles on radiation therapy–related injuries in the New York Times (http://topics.nytimes.com/top/news/us/series/radiation_boom/index.html?ref=health).

Lung cancer is the most lethal type of cancer for both men and women in the United States. Periodic assessments of the quality of care and its evolution are essential for improving outcome for patients with lung cancer.^{6,7} Large numbers of clinical investigations of various treatment options and delivery methods have been completed throughout the world during the past two decades. We report here the results of a survey that measured how well treatment results and methodologies from these clinical trials have been incorporated into clinical practice in treating lung cancer in the United States. Results from the current survey period (patients treated in 2006–2007) are compared with results from a similar survey conducted in 1998–1999 to assess improvements over time and to establish benchmarks for pretreatment evaluation and treatment.

METHODS

The two-stage sampling procedures used were similar to those used for the previous survey.⁸ Briefly, a stratified two-step cluster sampling method was used to select radiation oncology facilities from a master list of 1,879 radiation oncology facilities operating in the United States in 2007. This Facilities Master List, maintained by the American College of Radiology, was updated with information obtained from state radiation control officers and from a list of monitored facilities of the Radiological Physics Center. The lists were cross-checked to avoid including facilities more than once. Before selection, facilities in the master list had been stratified by type as *academic* (teaching hospital of a medical school or National Cancer Institute–designated Comprehensive Cancer Center); *large nonacademic* (other facility with ≥ 3 linear accelerators actively treating patients); *medium nonacademic* (other facility with 2 linear accelerators actively treating patients), and *small nonacademic*

(other facility with 1 linear accelerator actively treating patients). In all, 106 facilities were randomly selected by stratum and invited to participate in a survey of radiation therapy practices. Of those 106 facilities, 45 (42%) participated: 14 (of 25) academic, 13 (of 27) large nonacademic, 7 (of 27) medium nonacademic, and 11 (of 27) small nonacademic facilities. All facilities invited to participate were sent a package to be reviewed by their institutional review boards (IRBs) (http://www.qrro.org/intro_to_surveys.html) that included relevant information on the QRRO Process Survey, waivers of consent, and patient confidentiality.

In the second stage of sampling, individual lung cancer cases were randomly selected for review and data abstraction based on lists of all eligible patients provided by the treating facilities. QRRO research associates randomly selected 8 eligible patients with non-small cell lung cancer (NSCLC) and 5 eligible patients with limited-stage small cell lung cancer (LS-SCLC) at each facility (or all eligible patients if fewer than the required number had been treated during the study period). Eligibility criteria were having been treated with external-beam thoracic radiation for stage I-III NSCLC or for LS-SCLC from 2006 through 2007 and having had a Karnofsky performance score of 60 or higher. Disease was staged according to the 6th (2002) edition of the American Joint Committee on Cancer staging system. Exclusion criteria were prior thoracic radiotherapy, concurrent second malignancies or prior malignancy within the previous 5 years (other than in situ or non-melanoma skin cancers), distant metastases, or malignant pleural effusion. Information about patient characteristics, tumor characteristics, staging, and treatment was extracted from the medical records of the randomly selected patients by trained research associates and recorded in an online database. Specific questions considered included the procedures used in the disease-staging workup, use of computed tomography (CT)-based treatment simulation and planning, radiation doses used, use of dose-volume histogram (DVH) analysis to evaluate the doses delivered to the planning target volume and to the spinal cord and lung, and use of concurrent chemotherapy. Data were collected from 484 eligible patients (340 with NSCLC from 44 institutions and 144 with LS-SCLC from 39 institutions). One facility (2%) had had no eligible NSCLC patients and 6 facilities (13%) had had no eligible LS-SCLC patients.

Benchmarks (called “current performance measures” or “emerging performance measures” in the analysis) were derived from widely reviewed and disseminated evidence-based standards of practice and guidelines, including recommendations from National Cancer Institute Consensus Conferences, American College of Radiology Guidelines and Technical Standards and Appropriateness Criteria, and recommendations of the National Comprehensive Cancer Care Network. Each clinical performance measure was specified for a defined subpopulation of patients, e.g., patients with stage III NSCLC receiving external-beam radiation to the thorax with concurrent chemotherapy. Further exclusions were made when necessary to account for conditions that might lead to modifications in treatment.² Detailed specifications for eligibility for each performance measure are at http://www.qrro.org/Lung%20NSCLC_SCLC_CPM.pdf (Appendix). Briefly, pretreatment disease-staging procedures for patients with stage III NSCLC or LS-SCLC were to include, in addition to plain chest films and CT of the chest and upper abdomen, brain scanning (with CT or magnetic resonance imaging [MRI]) and whole-body scanning (with positron emission tomography [PET] or bone scans). CT-based treatment planning was required. For patients with stage III NSCLC receiving chemoradiation, the recommended radiation therapy dose was to be 59–74 Gy. The recommended dose range for patients with LS-SCLC, in 1998–1999 was 45–60 Gy depending on whether radiation was given once or twice a day; the range in 2006–2007 for patients receiving once-daily radiation was 60–70 Gy. DVHs were to be generated and evaluated in terms of doses to normal lungs and spinal cord. Results were compared with those from a previous Patterns of Care Study in 1998–1999.⁸

National averages were computed using weights reflecting the relative contribution of each institution and each patient in the sample (Table 1). The weights were derived from the estimated number of eligible patients in each stratum based on the number of facilities in each stratum and the average number of patients per facility. This approach allows estimates of national averages to be made even though the probability of a case being included in our sample differed by stratum. Demographic and disease factors were not used in computing weights. Results comparing small subsets of patients are reported as unweighted case counts for the surveyed sample (Table 2).

Statistical Analysis

National estimates were calculated from the survey data by using SUDAAN statistical software V10.0 (Research Triangle Institute, NC), which incorporates design elements and weights reflecting the relative contribution of each patient in the analysis of this complex survey. The weights for each case in a stratum were the product of the following 2 factors:

$$\frac{\text{Estimated no. of eligible cases in population}}{\text{No. of eligible cases in sample}} \times \frac{\text{Proportion of eligible cases in the population}}{\text{Proportion of eligible cases in sample}}$$

All figures calculated with SUDAAN were national estimates for the patient population defined by the eligibility criteria discussed above. Two SUDAAN procedures were used for this analysis: one for percentages and tests on categorical variables (PROC CROSSTAB) and the other for descriptive statistics and tests on continuous variables (PROC DESCRIPT). Association was tested with Pearson chi-square tests with SAS V9.2 for Windows (SAS Institute, Cary, NC). Differences were deemed significant if the associated *p* values were <0.05.

RESULTS

Patient and tumor characteristics are shown in Table 1. Numbers of men and women were roughly equivalent in both groups, although slightly more patients with SCLC were female. Most patients in both groups were white/non-Hispanic (77% NSCLC, 82% SCLC); most (84%) had been treated in nonacademic facilities; and most had good performance status (78% of NSCLC patients and 82% of SCLC patients had Karnofsky scores 80–100). Sixty-two percent of patients with NSCLC had stage III disease. Results of the 2006–2007 versus 1998–1999 comparison are shown in Table 2 and discussed further below.

Pretreatment Staging Evaluations

Specific criteria for patients selected for the pretreatment staging evaluations (current performance measures 3A and 3B) are shown in the Appendix. The QRRO survey revealed that 66% of patients with locally advanced (stage III) NSCLC received brain MRI or CT plus PET or bone scan (120 of 181 patients); this represents a substantial improvement over 42% in the 1998–1999 survey (*p*=0.0001). The corresponding results for patients with SCLC were 84% in 2006–2007 versus 58% in the 1998–1999 survey (*p*=0.0011). Much of this change came from an increase in use of brain MRI (for NSCLC, 40% in 2006–2007 vs. 18% in 1998–1999 [*p*=0.0482]; for SCLC, 65% in 2006–2007 vs. 24% in 1998–1999 [*p*=0.0002]) and perhaps an increase in PET, although apparent differences between survey periods could not be assessed because only 1 patient had had PET in 1998–1999. Use of bone scanning was less common during the later survey period (for NSCLC, 25% in 2006–2007 vs. 58% in 1998–1999 [*p*=0.0004]; for SCLC, 50% in 2006–2007 vs. 68% in 1998–1999 [*p*=0.0757]).

We further examined potential associations between use of brain MRI, brain CT, PET or PET/CT scanning, and bone scanning with age at start of radiation therapy (<70 vs. ≥70 years), Karnofsky score (<80 vs. ≥80), and type of facility (academic vs. non-academic). For patients with NSCLC, use of brain MRI was not associated with age, performance status, or type of facility; use of brain CT was associated with age ($p=0.0005$) and performance status ($p=0.0042$) but not type of facility; use of PET or PET/CT was not associated with age or performance status but was associated with type of facility, with academic facilities more likely to use these modalities ($p=0.0433$); and use of bone scans did not differ by age or type of facility but was associated with performance status ($p=0.0103$). For patients with SCLC, use of brain MRI was not associated with age or performance status, but academic facilities may have been more likely to have used brain MRI than non-academic facilities ($p=0.654$); use of brain CT was not associated with age, performance status, or type of facility; use of PET or PET/CT was not associated with age or performance status but academic facilities were more likely to use PET or PET/CT than non-academic facilities ($p=0.0252$); and use of bone scans was not associated with age, performance status, or type of facility.

Use of CT-Based Treatment Simulation

Specific criteria for patients selected for this measure (emerging measures 1A, 1B [Appendix]) included receipt of external-beam radiation therapy to the thorax. CT-based simulation was used in nearly all cases (100% of patients with NSCLC and 99% of patients with SCLC); this compares favorably with the 49% reported for the 1998–1999 period.⁸

DVH Evaluation of Treatment Plans

Specific criteria for patients selected for this measure (emerging measures 2A, 2B [Appendix]) included receipt of external-beam radiation therapy to the thorax. DVH analysis of treatment plans was not used during the earlier survey period, but by 2006–2007 it was used for 95% of patients with NSCLC and 96% of patients with SCLC.

Total Radiation Dose Received (59–74 Gy NSCLC; 45–70 Gy SCLC)

For this measure (current performance measure 1 [Appendix]), patients must have received concurrent chemotherapy (defined as both chemotherapy and radiation therapy occurring during the same interval) but were excluded if they had had conditions that could have mediated the total dose delivered (e.g., if radiation therapy was stopped early owing to complications, noncompliance, or death; or if treatment included surgery; or for participation in a separate IRB-approved protocol). This measure was originally defined for the dose range 60–74 Gy but was adjusted computationally to include the large number of patients who had received 59.4 Gy. The proportion of patients with NSCLC receiving the full recommended dose did not change during the survey periods, being 88% in 2006–2007 (104 of 118 eligible patients) and 88% in 1998–1999 (64 of 73 eligible patients) ($p=n.s.$). The recommended dose for patients with SCLC who received once-daily radiation was 60–70 Gy in 2006–2007 and 45–60 Gy in 1998–1999; the corresponding proportions were 51% in 2006–2007 versus 43% in 1998–1999 ($p=n.s.$).

Receipt of Concurrent Chemoradiation

The current standard of care for both locally advanced NSCLC and limited-stage SCLC is concurrent chemoradiation therapy. When this survey was done, this measure (current performance measure 2) was defined only for patients with SCLC (see Appendix). During the 2006–2007 period, 90% of patients with SCLC versus 62% in 1998–1999 received chemoradiation ($p<0.0001$). Further recommendations for SCLC involve the use of twice-daily (as opposed to once-daily) radiation and prophylactic cranial irradiation. Considerably fewer data were available for these comparisons; nevertheless, 21% of patients with SCLC

received twice-daily irradiation in 2006–2007 (vs. 8% in 1998–1999.) ($p=n.s.$) and 49% of patients with SCLC received prophylactic cranial irradiation in 2006–2007 (vs. 21% in 1998–1999) ($p=n.s.$). For all patients with SCLC in the 2007–2008 study, use of concurrent chemoradiation was not associated with patient age, performance status, or type of facility (academic vs. nonacademic). Use of twice-daily radiation was not associated with patient age or performance status but was more likely to be given at academic institutions ($p<0.0001$). Prophylactic cranial irradiation may have been given preferentially to younger and higher-functioning patients ($p=$ not significant) but was more likely to have been given at academic institutions ($p=0.0073$).

A subsequent analysis of 211 patients with NSCLC revealed that 77% during 2006–2007 received concurrent chemoradiation versus 45% in 1998–1999 ($p<0.0001$).

DISCUSSION

The periodic QRRO surveys are an important resource for assessing the evolution of cancer care over time. Indeed, this quality improvement process has appropriately been described as creating a much-needed “environment of watchful concern” by documenting whether or not evidence-based findings have actually been implemented in the community.⁹ The results of this latest QRRO survey suggest that the radiation oncology community and their collaborators from other disciplines are responding positively to the level 1 data from published studies showing improvements in outcomes for patients with locally advanced lung cancer.

Data from a large number of clinical trials, especially by national and international cooperative groups, form the basis for incremental but steady improvements in pretreatment evaluation (staging) and treatment of cancer. The Patterns of Care studies and their successor, the QRRO surveys, have been important for documenting the evolving processes of care over time. Other efforts to assess quality of cancer care include the National Initiative on Cancer Care Quality^{4,10} and the Quality Oncology Practice Initiative, a practice-based system of quality self-assessment.¹¹

The quality indicators (i.e., current performance measures) for this QRRO survey included the appropriate use of CT or MRI of the brain for the assessment of intracranial metastasis, and PET or bone scanning to evaluate thoracic and extrathoracic metastasis. The conduct of radiation therapy was assessed by whether CT-based treatment planning and DVH analysis were used in treatment planning and the total dose of radiation delivered [Appendix]. Fractionation patterns and administration of prophylactic cranial irradiation for patients with SCLC were also evaluated.

Substantial progress was evident in the use of brain scanning (MRI or CT) and whole-body scanning (PET or bone scanning) in staging of both locally advanced (stage III) NSCLC and LS-SCLC; the ultimate purpose of these tests in practice, of course, is to identify patients with stage IV disease. The ability to identify and exclude patients with stage IV disease from clinical trials of treatments for advanced lung cancer has reduced the heterogeneity of such populations and as such has resulted in improved survival rates in studies of stage III NSCLC and LS-SCLC.

Use of CT-based treatment planning represents a significant quality improvement for treatment simulation. Information on exposure of proximal normal tissues and the resultant risks of toxic effects such as pneumonitis and esophagitis has contributed to positive outcomes in locally advanced NSCLC.¹² The ability to use higher doses of radiation by using more sophisticated treatment planning techniques (e.g., three-dimensional conformal

radiation therapy, intensity-modulated radiation therapy, and potentially proton therapy) also has important therapeutic implications for local control.¹³ It would be interesting to compare local control and survival for patients treated in 1998–1999 and for those treated with the recommended 59–74 Gy in 2006–2007; unfortunately data on survival could not be collected for this study.

Other notable findings are that the use of concurrent chemoradiation increased for both locally advanced NSCLC and LS-SCLC and that the use of twice-daily irradiation and prophylactic cranial irradiation for LS-SCLC increased as well. The evidence in support of concurrent therapy is strong for both stage III NSCLC^{14,15} and LS-SCLC.^{7,16–18} Twice-daily fractionation for thoracic irradiation and prophylactic cranial irradiation can improve outcome in SCLC,^{19,20} but these practices have yet to be more uniformly adopted. The fact that nearly half of all patients with LS-SCLC had received prophylactic cranial irradiation may account for improvements in outcome noted elsewhere.²¹ Although the extent of change in practice over time was encouraging, clearly there is room for improvement, particularly in the use of prophylactic cranial irradiation for LS-SCLC. On the other hand, the issue of whether to use twice-daily radiation or a higher dose of once-daily radiation for LS-SCLC is the subject of an ongoing randomized trial.

This study had several weaknesses, chief among them its retrospective nature. Notably, this survey by definition included only patients who were treated with radiation, and thus its findings may not be applicable to all patients who present with stage I–III lung cancer. Conversely, the strengths of this study included its random sampling of a variety of radiation oncology facilities in the United States, including both academic and nonacademic centers of various sizes. Moreover, the QRRO survey method included extraction and evaluation of individual patient records rather than relying on claims forms or other indirect measures of diagnosis, treatment, and follow-up.

It is incumbent upon the oncology community to strive for ongoing improvements in all aspects of patient care: prevention, screening and early diagnosis, pretreatment assessment, treatment, and follow-up. The QRRO surveys can evaluate only a portion of this continuum. QRRO efforts will continue to seek improvements in cancer care. This is all the more important for diseases as common and lethal as lung cancer.

Conclusions

Adherence to all of the performance measures surveyed had improved for treatments given in 2006–2007 versus in 1998–1999. Use of CT-based simulation and planning and DVH analysis of dose to critical structures is particularly important for patients receiving radiation therapy for lung cancer. Factors needing further improvement include the use of brain imaging and delivery of the full recommended radiation dose for patients with locally advanced NSCLC receiving concurrent chemotherapy, and the appropriate use of prophylactic cranial irradiation for patients with limited-stage SCLC.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Patient Characteristics in the 2006-2007 QRR Lung Survey

	Non-Small Cell Lung Cancer		Small Cell Lung Cancer	
	Weighted Patients (n = 31,864)	Unweighted Patients (n = 340)	Weighted Patients (n = 6,288)	Unweighted Patients (n = 144)
	No.	%	No.	%
Age at start of RT (years)				
Mean	67		63	
Median	66		63	
Interquartile range	59–75		59–66	
Sex				
Male	16,210	50.9	3,053	48.6
Female	15,654	49.1	3,235	51.5
Race				
White	24,823	77.9	5,378	85.5
Black/African-American	5,313	16.7	730	11.6
Asian	665	2.1	—	—
Other/Unspecified	1,063	3.3	180	2.9
Ethnicity				
Hispanic	1,512	4.8	189	3.0
Not Hispanic/Unspecified	30,352	95.2	6,099	97.0
Marital Status				
Married	16,458	51.6	3,730	59.3
Single	10,762	33.8	2,088	33.2
Not specified / Unknown	4,643	14.6	469	7.5
Primary payment method				
Medicare	17,418	54.7	2,266	36.0
Private Insurance	5,998	18.8	2,208	35.1
Health Maintenance Organization	3,944	12.4	880	14.0
Medicaid	2,154	6.8	597	9.5
Government Insurance	1,345	4.2	295	4.7
Self-Pay	232	0.7	42	0.7

	Non-Small Cell Lung Cancer		Small Cell Lung Cancer	
	Weighted Patients (n = 31,864)	Unweighted Patients (n = 340)	Weighted Patients (n = 6,288)	Unweighted Patients (n = 144)
	No.	%	No.	%
Not specified	773	2.4	13	
Stratum				
Academic	5,192	16.3	112	11.6
Large Nonacademic (>3 linacs)	6,838	21.5	104	18.3
Medium Nonacademic (2 linacs)	9,255	29.0	52	39.7
Small Nonacademic (1 linac)	10,580	33.2	72	30.4
Census Region				
Northeast	5,043	15.8	48	12.6
Midwest	8,012	25.1	92	30.5
South	11,748	36.9	125	32.6
West	7,061	22.2	75	24.4
Karnofsky Performance Score				
60	1,728	5.4	18	2.1
70	5,166	16.2	54	15.5
80	9,620	30.2	108	32.1
90	10,542	33.1	111	37.9
100	4,760	14.9	48	12.4
Unknown (>=60)	46	0.1	1	
Smoking Status				
Never smoked	1,879	5.9	16	0.2
Current smoker	14,010	44.0	149	55.5
Former smoker (quit 1 year ago)	3,650	11.5	41	16.8
Former smoker (quit >1 year and 10 years ago)	4,253	13.3	50	17.3
Former smoker (quit >10 years ago)	7,383	23.2	73	9.2
Former smoker (quit period unknown)	464	1.5	7	
Unknown smoking status	224	0.7	4	3
Tumor Histology				

	Non-Small Cell Lung Cancer			Small Cell Lung Cancer		
	Weighted Patients		Unweighted	Weighted Patients		Unweighted
	(n = 31,864)		Patients	(n = 6,288)		Patients
	No.	%	(n = 340)	No.	%	(n = 144)
Squamous cell	11,094	34.8	120			
Adenocarcinoma	10,213	32.1	108			
Large-cell	967	3.0	11			
NSCLC, NOS	8,863	27.8	94			
Other	483	1.5	5			
Unknown	244	0.8	2			
Small-cell/oat cell				6,235	99.2	141
Mixed histology (SCLC and NSCLC)				53	0.8	3
Disease Stage						
I			53			n/a
II			39			n/a
III			211			n/a
Unknown			37			n/a

Abbreviations: QRRO, Quality Research in Radiation Oncology; RT, radiation therapy; linacs, linear accelerators; NSCLC, NOS, non-small cell lung cancer not otherwise specified; SCLC, small cell lung cancer; n/a, not applicable (all small cell lung cancer was considered limited stage);.

Table 2
Summary of Findings from the Current (2006–2007) Survey and Those from the 1998–1999 Patterns of Care Study

	Non-Small Cell Lung Cancer				Small Cell Lung Cancer			
	2006–2007	1998–1999			2006–2007	1998–1999		
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<i>P</i>								
<i>P</i>								
No. Cases Evaluable for Components of Staging	181 ^a		180 ^a		144 ^b		72 ^b	
Work-Up (Emerging Measure 3A/B) ^c								
Brain MRI or CT AND PET or bone scan	120	(66.3)	75	(41.7)	121	(84.0)	42	(58.3)
Brain MRI/CT scan	126	(69.6)	94	(52.2)	137	(95.1)	54	(75.0)
Brain MRI	73	(40.3)	32	(17.8)	94	(65.3)	17	(23.6)
Brain CT scan	69	(38.1)	70	(38.9)	61	(42.4)	38	(52.8)
PET/ bone scan	168	(92.8)	109	(60.6)	126	(87.5)	49	(68.1)
PET only	38	(21.0)	8	(4.4)	NS		1	(1.4)
PET only or PET/CT (2007 data) ^d	160	(88.4)	n/a	n/a	82	(57.0)	n/a	n/a
Bone scan	45	(24.9)	105	(58.3)	72	(50.0)	49	(68.1)
No. Cases Evaluable for Elements of Treatment	313 ^e				143 ^f			
Planning (Emerging Measure 1A/B) ^c								
CT-based simulation and planning	313	(100)			142	(99.3)		
DVH evaluation: dose to PTV, lung, spinal cord	299	(95.5)			137	(95.8)		
No. Cases Evaluable for Elements of Treatment								
Delivery								
Total radiation dose (Current Measure 1) ^c	118 ^g		73 ^g		85 ^g		28 ^g	
Total dose (59–74 Gy NSCLC, 45–70 GySCLC [see text])	104	88.1%	64	(87.7)	43	(50.6)	12	(42.9)
Use of concurrent chemoradiation					62 ^h			
(Current Measure 2) ^c					59	(95.2)		
No. Cases Evaluable for Elements of Concurrent								
Chemoradiation (expanded analysis)	211 ⁱ		295		144 ^b		72	
Concurrent chemoradiation	163	(77.3)	132	(44.8)	129	(89.6)	45	(62.5)
Twice-daily irradiation					31	(21.5)	6	(8.3)

Non-Small Cell Lung Cancer				Small Cell Lung Cancer			
2006–2007		1998–1999		2006–2007		1998–1999	
No.	(%)	No.	(%)	No.	(%)	No.	(%)
Prophylactic cranial irradiation				70	(48.6)	15	(20.8)
							0.0895

All *P* values were from chi-square tests. NS, not significant at the 5% level;

* *p* value could not be computed because *n*<5.

Abbreviations: MRI, magnetic resonance imaging; CT, computed tomography; PET, positron emission tomography; DVH, dose-volume histogram; PTV, planning target volume.

^aNumber represents patients with stage III non-small cell lung cancer who received combined-modality therapy (i.e., external-beam radiation therapy [EBRT] and chemotherapy).

^bPatients with small-cell lung cancer receiving EBRT.

^cDefinitions of Emerging or Current [Performance] Measures, with inclusion/exclusion criteria for eligibility in each subgroup, are given at [http://www.qtro.org/Lung%20NSCLC SCLC CPM.pdf](http://www.qtro.org/Lung%20NSCLC%20SCLC%20CPM.pdf).

^dIn the 2007 study, Q27. PET scan was expanded to two codes: 2=PET only & 3=PET/CT.

^ePatients with non-small cell lung cancer receiving EBRT.

^fPatients with small cell lung cancer receiving EBRT.

^gPatients receiving EBRT, excluding those who did not receive doses within the specified range because of participation on an IRB-approved protocol, incomplete treatment due to experiencing complications or death, or patient refusal; planned receipt of surgery; or receipt of hyperfractionated or split-course irradiation.

^hPatients with small cell lung cancer receiving EBRT, excluding those with significant weight loss, medical comorbid conditions, poor pulmonary function, or advanced age, or otherwise ineligible for chemotherapy (e.g., poor kidney function).

ⁱPatients with stage III non-small cell lung cancer receiving EBRT