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Quality indicators in lung cancer: a review and analysis

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INTRODUCTION

Optimal management of patients diagnosed with lung cancer is rapidly evolving with updated evidence, and is often complex and involves multimodality treatment that requires a coordinated approach. Internationally, numerous clinical practice guidelines (CPGs) have been developed in order to provide a framework for evidence-based best practice care to guide clinician decision-making.[1] How CPGs and other standard of care are implemented into daily practice needs to be measured to be able to identify areas for quality improvement and address barriers to care, to ensure the delivery of high-quality care.

Quality indicators (QIs) are used to monitor and evaluate various aspects of the quality of healthcare services received by patients in daily practice. They are defined as 'measurable elements of practice performance for which there is evidence of consensus that they can be used to assess the quality of care'.[2] Evaluating the quality of care received in 'real-world' clinical practice is crucial for optimising health outcomes for patients with lung cancer. QIs provide a means to measure the receipt of best practice care as determined by evidence and expert consensus.

Determining the usefulness of QIs and how they should be used depends on what is intended to be achieved. There are a wide variety of lung cancer QIs that have been developed and are in use. QIs may be used as a measurement tool to document standards, identify variations in care between patient groups or over time, guide performance improvement (including informing policy making), as well as promote transparency and accountability.[3 4] There are differences in the methods employed to develop QIs, how data are collected and the ways they are used by healthcare providers and patients. The aim of this study was to review and analyse current QIs used in all aspects of lung cancer management.

MATERIALS AND METHODS

A literature review was conducted using the search terms 'quality indicators' and 'lung neoplasms' limited to English from the time period of 2001 to 2019 using the Medline database. Deploying these search terms in other databases yielded a large number of non-specific publications and so the decision was made to restrict the search to Medline. In addition, grey literature was also searched using a web search of government and relevant health organisation websites. References, abstracts and articles were managed using EndNote software.

Full-text review by a single oncology clinician reviewer was performed to include only articles that fulfilled inclusion criteria of original research that developed or applied QIs related to the care of adult patients with lung cancer. Data were collected for each individual indicator including the description, numerator, denominator, type of indicator, treatment modality, frequency, characteristics, data source authors used for measuring QIs, measured results, benchmarking, use in composite scores, detection of differences between variables, link to outcomes, assessment or practice testing and adjustments for confounding factors. The type of indicator was classified according to the Donabedian model of structure, process or outcome measures. Structure measures reflect the attributes of the whole service, process measures reflect what happens to the patient during care and outcome measures what the effects or end result of care provided to the patient.[2]

These data were analysed and synthesised using previously published characteristics for ideal QIs including method of development or selection process of indicator, measurability and potential to discriminate or detect differences (table 1).[3 5–8] An analysis of QIs classified an indicator as meeting all characteristics in a minimum set of desirable characteristics for QIs or not. The minimum set included (1) evidence-based or developed

Table 1 Characteristics of ideal quality indicators*

Characteristics	Explanation
Well defined	Explicitly defined inclusion and exclusion criteria
Specific	Few false positives
Sensitive	Few false negatives
Valid	Robust selection process or development
Reliable	Minimal interobserver or intraobserver variability
Able to discriminate	Ability to detect variation or change for comparisons
Based on evidence and clinically relevant	An acceptable identifiable event for user
Feasible or measurable	Can be measured with data that are available

*From Mainz and Campbell *et al.*[3 5]

by RAND-modified Delphi process[5]; (2) feasible or measurable (assessed by documented measurement with the QI); (3) were shown to be able to discriminate/detect variation in care. The capacity to discriminate was assessed as fulfilled if studies documented the QI had been used to detect statistically significant variations in care. This included, but was not limited to, patient characteristics such as age, treatment characteristics such as differences between facilities and changes detected over specified time periods. Validity and reliability, sensitivity and specificity, and relevance depend on the population being studied and type of data collected, so could not be assessed in our study.

RESULTS

Search results

A literature Medline search resulted in 75 abstracts. The full-text screening resulted in the exclusion of 26 articles that did not meet the inclusion criteria and 1 duplicate. Eight additional publications were identified through

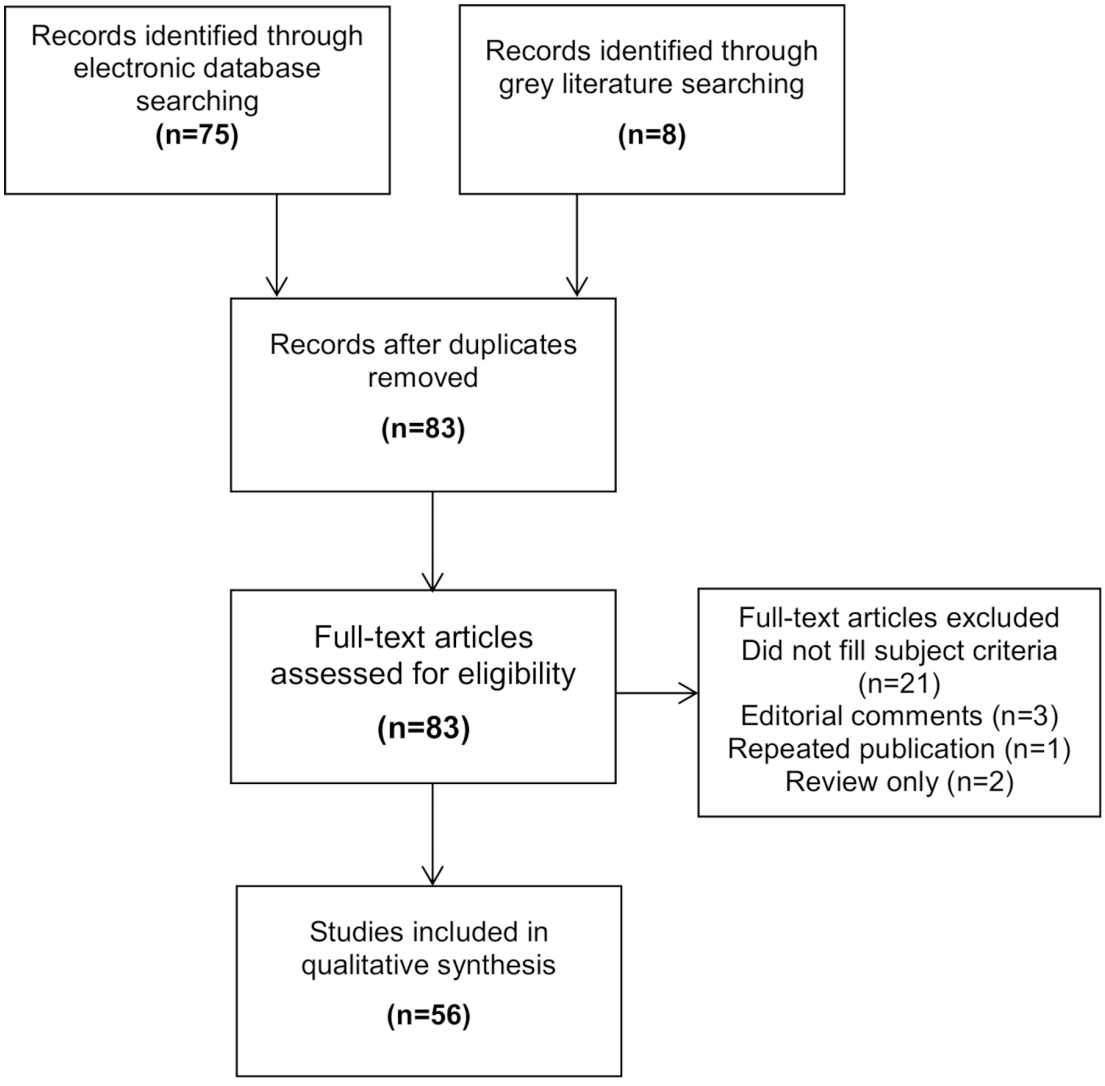

Figure 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram for selection of studies for review.

Table 2 Types of quality indicators for lung cancer

Management continuum of care in lung cancer		All QIs assessed (n, %)
Prevention	Prevention	1 (0.3)
Screening	Screening or early detection	3 (1.0)
Diagnosis	Diagnosis	21 (6.9)
Staging	Staging	18 (5.9)
Pretreatment assessment	General pretreatment assessment	4 (1.3)
	Preoperative assessment	22 (7.2)
Treatment	Surgery	71 (23.4)
	Systemic therapy	33 (10.9)
	Radiotherapy	18 (5.9)
	Combined treatment	10 (3.3)
	Non-specific treatment	11 (3.6)
	Symptom assessment	25 (8.2)
	Symptom management	18 (5.9)
	General outcomes	8 (2.6)
	Supportive care	25 (8.2)
	Palliative care	8 (2.6)
Follow-up	Follow-up	8 (2.6)
	Total	304 (100)

QIs, quality indicators.

grey literature searching, and a total of 56 articles were included (figure 1).[9–64]

Study characteristics

All of the studies included as part of the review either developed QIs, evaluated QIs or measured QIs in the management of patients with lung cancer. Varying techniques were used for developing or electing indicators between publications and within publications for individual indicators. These included evidence-based, literature review, consensus expert review and a structured review approach, such as a RAND-modified Delphi process.[5] The most robust method of developing indicators is by a structured panel review, such as the RAND-modified Delphi method. During this process, panel members independently rate indicators, traditionally on clinical face validity, and provide feedback over a number of rounds to provide an assessment of the indicators' utility.[6] Thirty-five studies reported using indicators for assessing quality of care in a patient population with varying data sources used. The included studies, study type, number of QIs published and data source for measurement of QIs are listed in online supplemental appendix A.

Quality indicators

We found a total of 304 unique QIs, of these indicators 42 (13.8%) were structural measures, 235 (77.3%) were process measures and 27 (8.9%) were outcome measures. The types of QIs are depicted in table 2 and are divided into the most relevant components of lung cancer management along the continuum of care, including prevention, screening, diagnosis, staging, pretreatment assessment, treatment and follow-up. The most frequently reported indicators were related to surgery (n=71, 23.4%), symptom assessment and management (n=43, 14.1%), and diagnosis and staging (n=40, 13.2%). There were fewer indicators related to systemic therapy (n=33, 10.9%), radiotherapy (n=18, 5.9%), combined treatments (n=10, 3.3%), supportive care (n=25, 8.2%) or palliative care (n=8, 2.6%). The remaining indicators measured screening or early detection (n=3, 1.0%), general pretreatment assessment (n=3, 1.0%), preoperative assessment (n=22, 7.2%), non-specific treatment (n=11, 3.6%), general outcomes (n=8, 2.6%), prevention (n=1, 0.3%) and follow-up (n=8, 2.6%).

Assessment of indicators

Those indicators that were measured were reported to be feasible indicators. Data sources that were used to measure indicators included administrative data, clinical registry data, medical records, prospectively collected clinical data, patient reported or questionnaires. These data were both retrospectively and prospectively collected. Of these indicators, 106 (34.9%) were also able to detect differences or discriminate between factors such as facilities, time periods, patient, disease or treatment characteristics. Examples of patient, disease or treatment characteristics included stage of disease, availability of multidisciplinary team, comorbidities, facility volume, treating clinician, patient residence location, marital status and gender.

Only 73 (24.0%) of the 304 QIs met the minimum criteria set for characteristics of an ideal QI. The QIs that met the minimum criteria can be found in online supplemental appendix B. Their characteristics are shown in table 3. These included 12 (16.4%) related to diagnosis and staging, 4 (5.5%) to pretreatment assessment, 13 (17.8%) to surgery, 12 (16.4%) to systemic treatment, 9 (12.3%) to radiotherapy or chemoradiotherapy treatment, 3 (4.1%) to general treatment, 3 (4.1%) to symptom assessment, 3 (4.1%) to general outcomes, 11 (15.1%) to supportive care and 1 to palliative care (1.4%).

DISCUSSION

A wide range of QIs have been developed and used in lung cancer. Most of these relate to surgery, which is only applicable to a small proportion of all patients with lung cancer. Only 10%–28% of all patients with lung cancer are managed with surgery in the USA and Europe, while utilisation studies show that optimally 61%–74% of all patients with lung cancer should be receiving radiotherapy and 73% receiving chemotherapy.[65–67] In addition, half of all patients with lung cancer present with incurable metastatic disease where palliative care is an important component of management. Yet, 87 of the identified QIs related to preoperative assessment or surgery compared with

Table 3 Assessment of lung cancer QIs that met the minimum criteria

Management along the continuum of care		Met minimum criteria for QI*			
		All QIs (n)	Process QIs (n)	Structural QIs (n)	Outcome measures (n)
Prevention	Prevention	0	0	0	0
Screening	Screening or early detection	0	0	0	0
Diagnosis	Diagnosis	5	4	1	0
Staging	Staging	7	7	0	0
Pretreatment assessment	General pretreatment assessment	2	2	0	0
	Preoperative assessment	2	2	0	0
Treatment	Surgery	13	4	1	8
	Systemic therapy	12	11	1	0
	Radiotherapy	6	5	1	0
	Combined treatment	3	3	0	0
	Non-specific treatment	3	2	1	0
	Symptom assessment	3	3	0	0
	Symptom management	0	0	0	0
	General outcomes	5	0	0	5
	Supportive care	11	11	0	0
	Palliative care	1	1	0	0
Follow-up	Follow-up	0	0	0	0
	Total	73	55	5	13

*Includes (1) evidence-based or developed by RAND-modified Delphi process, (2) feasible, (3) detect variation in care.
QIs, quality indicators.

30, 17 and 8 QIs specifically for systemic therapy, radiotherapy and palliative care, respectively. This is a disproportionate representation compared with the actual utilisation of treatment modalities in lung cancer. QIs should be relevant to the population and more work is needed in developing and implementing QIs in non-surgical therapies. Technical aspects of surgical management are examined in detail, while QIs for the technical aspects of radiotherapy are lacking and this is known to impact on lung cancer outcomes.[68] When considering the continuum of cancer care, there is also a gap where there are few QIs related to end-of-life and palliative care compared with diagnosis, staging and treatment.

The majority of QIs are related to process outcomes and appropriateness of care such as adhering to CPGs. Numerous indicators have also been developed in order to measure access to care, timeliness of care and delivery of coordinated or multidisciplinary care. Those indicators related to the technical aspects or safety and complications are largely surgical based. Modern radiotherapy clinical trials in lung cancer have shown that high quality in the technical treatment delivery of radiotherapy leads to lower rates of severe toxicity.[69] There is an apparent gap in measuring these domains in the delivery of both radiotherapy and systemic therapy. Both of these fields are rapidly evolving, and in particular new treatment standards in systemic therapy for lung cancer have been introduced in recent years. In this review, there were no QIs related to the use of immunotherapy, as this has only become standard practice recently. As treatment evolves with updated research and evidence, so do QIs need to be continually reassessed and implemented to reflect current clinical practice. There are also QIs that have been included which have been superseded by new evidence, investigations or procedures.

We identified 73 robust QIs that fulfilled characteristics of ideal QIs, that is, evidence-based, feasible and discriminating well. Of these, those that fulfilled the minimum ideal set of characteristics most were related to diagnosis and screening, treatment and supportive care. There were no or few indicators related to prevention, screening, pretreatment assessment or follow-up that met these criteria. Overall, although there are many published QIs related to lung cancer, only a relatively few number can be categorised as adhering to ideal characteristics of QIs (24%). Future development of QIs in lung cancer should focus on fulfilling ideal characteristics of QIs to ensure more useful measurement of care.

Previously developed QIs should be evaluated prior to being used in a real-world population that is to be measured. The selected indicators may fulfil the ideal characteristics but may be difficult or resource intensive to measure in real-world settings. These should be assessed with a practice test in the target population

being evaluated with the available database, records and resources. For indicators to be used successfully to improve quality of care in a patient population, they should not only be measurable but also detect variation, have the potential to improve and be applicable to a meaningful proportion of the target population.[49] For example, in a clinical setting where the number of patients in the numerator is small, the QI is unlikely to detect variation in that population.

We found relatively few QIs that address patient-centred outcomes, such as assessment of quality-of-life aspects of care. Patient-reported outcomes and patient-reported experience measures have emerged as particularly important components of patient-centred care in cancer management.[70] These can identify and refocus care on otherwise unmet issues or patient needs that are impacting their care. In the cancer setting, they have shown to improve aspects in quality of care including health-related quality of life, treatment outcomes and patient satisfaction.[58] Future efforts should continue to focus on this important aspect of care.

This review is limited due to the search being confined to a single database, exclusion of studies not published in English and having a single reviewer screening and assessing the publications. A more rigorous systematic review was not performed due to time constraints. Additionally, as QIs change over time, some of the indicators that may have met ideal characteristics when published may no longer be relevant to contemporary practice. For this reason, our aim is to provide an overview of the types and characteristics of QIs in lung cancer and identify current gaps for future development, rather than endorse a set of useable indicators. The QIs we have published may also become obsolete with time and changes in management. Which QIs, when and how they should used also depends on the purpose of measurement and the target population, and is beyond the scope of this review. To further develop a more comprehensive set of QIs, we would suggest the QIs reported undergo a structured expert panel review process for the specific purpose that is intended. Our future work will focus on radiotherapy-related QIs to be developed with this method.

CONCLUSIONS

We found a large number of published QIs in lung cancer but they focused on relatively few areas not reflective of patterns of contemporary practice. We identified gaps in lung cancer QIs especially for systemic therapies, radiotherapy, palliative care and patient-reported outcomes. In order to comprehensively assess the care of patients with lung cancer, future efforts should focus on developing readily measurable QIs in these areas where there are limited QIs and also where current QIs do not comply with ideal characteristics.

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Appendix A

Summary of characteristics of included studies

Studies included	Aim of study	Lung cancer specific	Number of QIs	Measurement reported	Data source	Benchmark reported
Beck et al, 2018	Measure QIs	Yes	1	Yes	Cancer registry	No
Belgian Healthcare Knowledge Centre, 2016	Develop QIs	Yes	27	Yes	Cancer registry, administrative data	No
Brunelli et al, 2011	Develop QIs, measure QIs	Yes	4	Yes	Prospective clinical data collected	No
Caldarella et al, 2012	Develop QIs, assess quality measurement	No	10	Yes	Cancer registry	No
Cancer System Quality Index, 2018	Develop QIs	No	13	Yes	Cancer registry	No
Cerfolio et al, 2011	Measure QIs	Yes	37	Yes	Prospective clinical data collected	Yes
Damhuis et al, 2015	Measure QIs	Yes	3	Yes	Cancer registry	No
Darling et al, 2014	Develop QIs	Yes	17	No	-	No
Dy et al, 2014	Assess quality measurement	No	20	Yes	Questionnaire, medical records	No
Falcoz et al, 2014	Measure QIs	Yes	1	Yes	Clinical registry	No
Farjah et al, 2015	Measure QIs	Yes	8	Yes	Clinical registry	No
Fasola et al, 2012	Develop QIs, measure QIs	Yes	11	Yes	Medical records	Yes
Freeman et al, 2013	Measure QIs	Yes	6	Yes	Cancer registry, administrative data	No
Freixinet et al, 2011	Measure QIs	Yes	4	Yes	Administrative data	Yes
Faris et al, 2017	Measure QIs	Yes	12	Yes	Medical records	No
Hermens et al, 2006	Develop QIs	Yes	15	No	-	No
Hu et al, 2014	Measure QIs, assess quality measurement	Yes	2	Yes	Cancer registry, administrative data	No
Husain et al, 2013	Measure QIs, assess quality measurement	Yes	4	Yes	Questionnaires	No

Jacobsen et al, 2011	Measure QIs	No	4	Yes	Medical records	Yes
Jacobsen et al, 2015	Measure QIs	No	2	Yes	Medical records	No
Jakobsen et al, 2013	Measure QIs	Yes	14	Yes	Cancer registry	Yes
Kazui & Osada, 2007	Measure QIs	No	1	Yes	Questionnaire	No
Kozower & Stukenborg, 2011	Measure QIs, assess quality measurement	Yes	1	Yes	Administrative data	No
Kozower et al, 2016	Develop QIs, assess quality measurement, measure QIs	Yes	2	Yes	Clinical registry data	No
Kim et al, 2019	Develop QIs, Measure QIs	Yes	6	Yes	Cancer registry	Yes
Largey et al, 2016	Measure QIs	Yes	3	Yes	Medical records	No
Li et al, 2013	Measure QIs	No	6	Yes	Cancer registry, medical records	No
Lin et al, 2017	Measure QIs	Yes	1	Yes	Cancer registry	No
Mainz et al, 2009	Measure QIs	Yes	9	Yes	Clinical registry	Yes
Mazzone et al, 2014	Develop QIs, assess quality measurement,	Yes	7	No	Medical records	No
Moore et al, 2019	Measure QIs	Yes	2	Yes	Cancer registry	No
National Institute for Health Care Excellence, 2013	Develop QIs	Yes	15	No	-	No
National Quality Forum, 2018	Develop QIs	No	3	No	-	No
Numan et al, 2016	Develop QIs	Yes	4	No	-	No
Odell et al, 2019	Measure QIs	Yes	4	Yes	Cancer registry	No
Ouwens et al , 2007	Measure QIs	Yes	14	Yes	Medical records, questionnaires	No
Pollack et al, 2015	Measure QIs	No	5	Yes	Medical records, questionnaire	No
Pezzi et al, 2014	Measure QIs	Yes	2	Yes	Cancer registry	Yes
The Quality Oncology Practice Initiative, 2017	Develop QIs	No	32	No	-	No

Queensland Cancer Quality Index, 2014	Develop QIs, measure QIs	No	7	Yes	Cancer registry, administrative data	No
Rao et al, 2019	Measure QIs	Yes	2	Yes	Medical records	No
Royal College of Physicians, 2017	Develop QIs	Yes	12	Yes	Medical records, administrative data	Yes
Ryoo et al, 2013	Assess quality measurement	Yes	6	Yes	Medical records	No
Ryoo et al, 2014	Measure QIs	Yes	23	Yes	Administrative data	No
Samuel et al, 2015	Develop QIs, measure QIs	No	4	Yes	Cancer registry, administrative data	No
Scotland Cancer Taskforce, 2017	Develop QIs, measure QIs	Yes	14	Yes	Prospective clinical data collected	Yes
Shelton et al, 2014	Measure QIs, assess quality measurement	No	11	Yes	Medical records, clinical registry data, administrative data	No
Steunenberg et al, 2016	Measure QIs	Yes	1	Yes	Medical records	No
Stirling et al, 2014	Develop QIs	Yes	58	No		No
Stokstad et al, 2017	Measure QIs	Yes	2	Yes	Medical records	Yes
Tanvetyanon et al, 2014	Measure QIs	Yes	16	Yes	Medical records	No
Treasure et al, 2003	Measure QIs, assess quality measurement	Yes	1	Yes	Medical records	No
Vrijens et al, 2018	Measure QIs	Yes	20	Yes	Cancer registry, administrative data	No
Walling et al, 2014	Measure QIs	No	21	Yes	Medical records	No
Walker et al, 2015	Measure QIs	Yes	1	Yes	Medical records	No
Wang et al, 2017	Develop QIs	Yes	21	No	-	No

Appendix B

QIs that met the minimum criteria

	Indicator Type	Description	Numerator	Denominator
		Diagnosis		
1	Structure	Timeliness of diagnostic course	Diagnostic course completed within specified number of days of visit to specialist or referral	Patients with NSCLC who underwent diagnostic procedures
2	Process	Adequate tissue for histologic subtyping	Nonsurgical biopsy that obtained adequate tissue for histological subtyping	Patients with stage III or IV NSCLC
3	Process	Adequate biopsy for molecular testing in nonsquamous stage III or IV NSCLC	Nonsurgical biopsy that obtained adequate tissue for molecular testing	Patients with stage III or IV nonsquamous NSCLC
4	Process	Pathologically confirmed diagnosis	Pathological confirmation of diagnosis	Patients with NSCLC
5	Process	CT scan prior to bronchoscopy	CT scan performed prior to bronchoscopy	All patients with lung cancer who underwent bronchoscopy
6	Process	Mediastinal evaluation for stage I or II NSCLC	Mediastinal evaluation with PET, EBUS or mediastinoscopy	Patients with stage I or II NSCLC with lobectomy or pneumonectomy
7	Process	Pathological staging of the mediastinum in stage I, II, III NSCLC	Pathological staging of the mediastinum	Patients with stage I, II or III NSCLC with curative intent therapy
8	Process	Lymph node sampling during mediastinoscopy for stage I, II, III NSCLC	Lymph node sampling of 3 stations during mediastinoscopy for stage I, II, III NSCLC	Patients with stage I, II or III NSCLC with mediastinoscopy
9	Process	Stage recorded prior to treatment	Clinical stage recorded before first treatment or decision not to treat	Patients with NSCLC
10	Process	PET/CT prior to potentially curative treatment	PET/CT available prior to potentially curative treatment	Patients with curative treatment for NSCLC
11	Process	Brain imaging in NSCLC	Brain imaging performed	Patient with Stage III or IV NSCLC or neurological symptoms
12	Process	Staging of stage III NSCLC	Skeletal scintigraphy and a CT or MRI brain performed prior to combination therapy	Patients with stage III NSCLC who received combination therapy
		Pre-treatment assessment		
13	Process	Documented ECOG status at diagnosis	Patients with documented ECOG status at diagnosis	All patients diagnosed with lung cancer
14	Process	MDT discussion	Discussed at multidisciplinary tumour board	All lung cancer prior to definitive treatment
15	Process	Lung function assessment prior to surgery	FEV1% recorded	NSCLC patients with curative surgery
16	Process	Lung function assessment prior to surgery	FEV1 absolute recorded	NSCLC patients with curative surgery
		Surgery		
17	Process	Pneumonectomy rates	Underwent pneumonectomy	All lung resections
18	Process	Surgical lymph node surgery at time of resection	Lymph node sampling of at least 3 stations at time of surgical resection	All resected stage I, II or III NSCLC
19	Process	Curative surgery for stage I or II NSCLC	Curative lung resection	Stage I or II NSCLC
20	Process	Resection rate	Underwent surgical resection	All NSCLC patients
21	Structure	Time to surgery	Operated within 42 days after referral	Patients with NSCLC with surgical resection

22	Outcome	30-day mortality after surgery	Death within same hospitalisation or 30 days after surgery	Patients with NSCLC and surgical resection
23	Outcome	Failure to rescue after surgery	Death within 30 days after complication	Patients with NSCLC and surgical resection
24	Outcome	Rate of major complications after surgery	Major complications	Patients with NSCLC and surgical resection
25	Outcome	Prolonged hospital stay after surgery	Stay in acute care hospital >14 days after surgery	Patients with NSCLC and surgical resection
26	Outcome	Re-admission rates after surgery	Readmission within 30 days of discharge	Patients with NSCLC and surgical resection
27	Outcome	1 year overall survival after surgery	Patients alive after 1 year	Patients with NSCLC and surgical resection
28	Outcome	2 year overall survival after surgery	Patients alive after 2 year	Patients with NSCLC and surgical resection
29	Outcome	5 year overall survival after surgery	Patients alive after 5 year	Patients with NSCLC and surgical resection
Systemic therapy				
30	Process	No adjuvant chemotherapy for stage IA NSCLC	No adjuvant chemotherapy within 90 days after surgery	Patients with resected stage IA NSCLC
31	Process	Adjuvant chemotherapy for resected stage II or III NSCLC	Adjuvant chemotherapy platinum based doublet received within 60 days after surgery	Patients with resected stage II or IIIA NSCLC
32	Process	Platinum-based chemotherapy for stage IV NSCLC	Received platinum-based chemotherapy	All stage IV NSCLC and IIIB
33	Process	Flowsheet for patients receiving chemotherapy	Flowsheet of chemotherapy and blood counts	For all NSCLC patients receiving chemotherapy
34	Process	Inoperable locally advanced NSCLC receiving chemotherapy	Receive concurrent or sequential chemotherapy	Stage IIIA NSCLC with PS 0-1, not undergoing surgery who receive radical radiotherapy >=54Gy
35	Process	Chemotherapy documented consent	Signed patient consent available	For all NSCLC patients receiving chemotherapy
36	Process	Chemotherapy consent	Prior to chemotherapy patient is informed about the risks and benefits of treatment, including likely symptoms and adverse effects, and whether treatment intent is curative or palliative	Patients with cancer receiving chemotherapy
37	Structure	Time to chemotherapy	Patients starting chemotherapy within 42 days of referral	All patients with lung cancer receiving chemotherapy
38	Process	Chemotherapy use in SCLC	Patients receiving chemotherapy	All patients with SCLC
39	Process	Palliative chemotherapy in SCLC	Patients receiving chemotherapy	Patients with SCLC not undergoing treatment with curative intent
40	Structure	Time to chemotherapy in SCLC	Patients receiving chemotherapy within 14 days of pathological diagnosis	All patients with SCLC
41	Process	Systemic anti-cancer treatment use in NSCLC	Patients receiving systemic anti-cancer treatment	All NSCLC not undergoing surgery
Radiotherapy				
42	Process	Radiation therapy for brain metastases	Whole-brain external beam radiation therapy or stereotactic radiosurgery	Patients with stage IV NSCLC with cranial metastasis
43	Process	No adjuvant radiotherapy for resected stage I, II NSCLC	No adjuvant radiotherapy	All early-stage (stage I or II) NSCLC patients with curative lung resection (and negative margins)
44	Process	Adjuvant radiotherapy for resected N2 NSCLC	Patients who received adjuvant radiotherapy	All resected NSCLC with N2 disease

45	Process	Single fraction for painful bone metastasis	Offered single fraction for painful bone metastasis	All patients receiving radiotherapy for painful bone metastasis
46	Process	Radiotherapy utilization	Lung cancer patients that received radiotherapy	All patients with lung cancer
47	Process	Radiotherapy for inoperable lung cancer	Number of patients with lung cancer not undergoing surgery who receive radical radiotherapy (≥ 54Gy) +/- chemotherapy, or SABR	All patients with lung cancer
			Combined therapy	
48	Process	Combined chemoradiotherapy for stage III NSCLC	Combined platinum-based doublet chemotherapy and radiation therapy	Patients with stage III NSCLC
49	Process	Chemotherapy or chemoradiotherapy for SCLC	Received chemotherapy or chemoradiotherapy	Patients with SCLC
50	Process	Chemoradiotherapy for limited stage SCLC	Receipt of cisplatin or carboplatin and etoposide with concurrent RT	Patients with limited stage SCLC
			Non-specific treatment	
51	Structure	Began therapy ≤ 35 days from time of first visit to specialist	Began therapy ≤ 35 days from time of first visit to specialist	Patients with NSCLC who began therapy
52	Process	Received anti-cancer treatment	Received anti-cancer treatment	All lung cancer patients
53	Process	Consideration for available clinical trials	Number of patients enrolled in a clinical trial	All lung cancer patients
			General Outcomes	
54	Outcome	1 year overall survival	Patients alive after 1 year	All patients with lung cancer
55	Outcome	2 year overall survival	Patients alive after 2 year	All patients with lung cancer
56	Outcome	5 year overall survival	Patients alive after 5 year	All patients with lung cancer
57	Outcome	Mortality rate	Number of deaths from lung cancer that occurred in a given time period	Per 100 000 people
58	Outcome	Incidence rate	Incidence of lung cancer that occurred in a given time period	Per 100 000 people
			Symptom Assessment	
59	Process	Screening for pain	Outpatient screening for presence or absence and intensity of pain using a quantitative scale	Patients with lung cancer
60	Process	Psychosocial stress factors and psychological symptoms screening	Asked about psychosocial stress factors and psychological symptoms	Patients with NSCLC
61	Process	Attention paid to physical symptoms: pain, suffocation, nausea, fatigue, weight loss, and insomnia	Patient reported that attention paid to physical symptoms: pain, suffocation, nausea, fatigue, weight loss, and insomnia	Patients with NSCLC
			Supportive care	
62	Process	Measure of supportive care needs	The supportive care needs survey short form 34	
63	Process	Psychosocial assessment	Reported being asked about psychosocial problems in family and problems related to living conditions	Patients with NSCLC
64	Process	Receipt of psychosocial care	Received psychosocial care from trained provider	Patients in need of psychosocial care
65	Process	Documented assessment of emotional well-being	Documented assessment of emotional well-being within 1 month of patients first visit	Patients being seen by medical oncologist
66	Process	Action taken to address emotional well-being	Documented action taken to address the problem	Patients that a problem with emotional well-being was identified

67	Process	Informed of oncology nurse specializing in lung cancer treatment	Informed of existence of oncology nurse specializing in lung cancer treatment	Patients with NSCLC
68	Process	Receipt of information	Informed adequately of 10 specified information aspects	Patients with NSCLC
69	Process	Patients reported they were consulted adequately	Patients reported they were consulted adequately	Patients with NSCLC
70	Process	Patient experience	The Ambulatory Oncology Patient Satisfaction Survey (AOPSS)	
71	Process	Lung Cancer Nurse Specialist review	Seen by Lung Cancer Nurse Specialist	All lung cancer patients
72	Process	Lung Cancer Nurse Specialist review at diagnosis	Seen by Lung Cancer Nurse Specialist present at diagnosis	All lung cancer patients
Palliative care				
73	Process	Palliative care referral in stage IV NSCLC	Referred for palliative care within 8 weeks of diagnosis	Patients with stage IV lung cancer