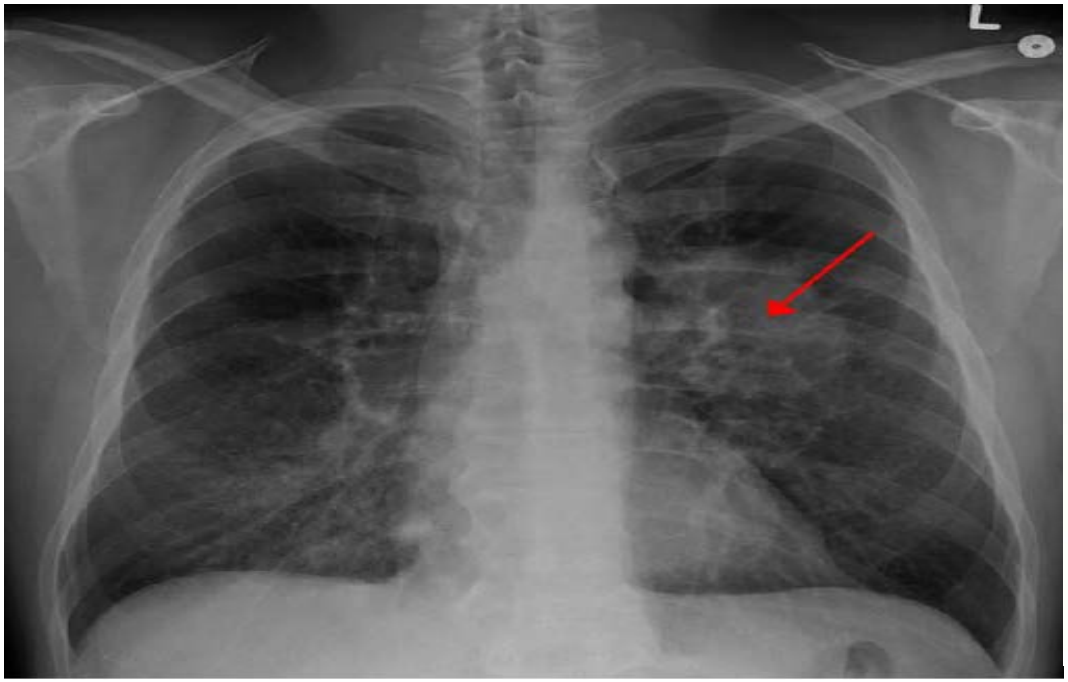
KCE REPORT 266Cs

Federaal Kenniscentrum voor de Gezondheidszorg
Centre Fédéral d'Expertise des Soins de Santé
Belgian Health Care Knowledge Centre

SYNTHESIS

QUALITY INDICATORS FOR THE MANAGEMENT OF LUNG CANCER



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HEALTH SERVICES RESEARCH

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FOREWORD

We hear more and more often say that cancer is becoming a chronic disease. The reason is that our therapeutic arsenal has continued to improve over the last decades. A progress that does not seem to stop. But, for some tumours, the prognosis remains invariably dark. Lung cancer is certainly part of those: it is even the cancer entailing the highest mortality in men. More than half of these patients die within the year following diagnosis, and less than a quarter are still alive three years later.

This is not a reason to give up. Playing on the quality of care, we can certainly gain ground. Experience shows that improving the prognosis of cancer often proceeds in small steps, with concurrent progress being made on multiple fronts. That is why it is essential that a set of quality indicators spans the whole range of the diagnostic and therapeutic management of these patients.

Thanks to the valuable contributions of clinical experts, and with the invaluable help of the Belgian Cancer Registry, we can now present such a set of indicators. The variability of the results observed for a number of them gives us hope that progress is still actually possible. We should now take action on the basis of these figures and take the steps that are logically necessary.

Because for the patient, the only thing that matters is the result.

Christian LÉONARD
Deputy general director

Raf MERTENS
General director

KEY MESSAGES

- A set of 23 quality indicators for lung cancer covering the diagnostic and therapeutic pathway has been defined. These indicators were measured using data of the Belgian Cancer Registry of the incidence years 2010-2011, coupled to the health insurance billing data (2009-2012) and the Crossroads Bank for Social Security, without the need for extensive investments in additional data collection. Results can be used for quality improvement processes.
- In Belgium, good results are achieved in terms of short-term mortality and long-term survival. International comparison based on 2007 data showed that 5-year relative survival is similar to those in neighbouring countries, and favourable compared to the European mean. Postoperative mortality is below the 5% target and also compares favourably to that of other countries.
- Excellent results are achieved for the following process indicators: histopathological confirmation of the diagnosis, the use of PET-CT before treatment with curative intent and appropriate use of adjuvant chemotherapy.
- Some indicators deserve attention and corrective actions can immediately be implemented:
    - Reporting of essential data to the Belgian Cancer Registry such as clinical and pathological TNM-stage and WHO performance status is definitely insufficient (e.g. 25% missing data for clinical stage).
    - In 20% of clinical stage III patients who are eligible for treatment with curative intent, no brain imaging is performed
    - Time from pathological diagnosis to first active treatment shows a large variability between centres. In one third of the patients, this time interval exceeded one month.
- Results for other indicators are do not directly reflect the quality of care delivered, but can inform initiatives to change future clinical practice. This is the case for indicators regarding invasive mediastinal staging, EGFR mutation analysis, guideline-concordant treatment and systemic therapy near the end of life.
- Three important comorbidities can be reliably identified based on drug reimbursement data: respiratory diseases (COPD, asthma), cardiovascular diseases (including hypertension) and diabetes. It was not possible to identify patients having renal insufficiency. Identifying comorbid conditions through pharmaceutical data has several shortcomings however: there is no information on the specific diagnosis, nor on the severity of the disease.
- Lung cancer surgery is very dispersed in Belgium. Half of the Belgian centres (44/89) perform less than 10 interventions per year and only 9 centres perform at least 40 interventions yearly. Analysis of Belgian data reveals that a very low yearly volume is associated with a higher postoperative mortality. In addition, a positive volume-outcome relationship is observed for one-year survival. Results at 3 years are less pronounced.

- Some essential outcome indicators such as quality of life or patient satisfaction could not be evaluated by means of the administrative data. Moreover, billing codes are often not specific (e.g. general codes for all surgical interventions whatever their extent), billing rules are not always respected (e.g. start date of radiotherapy not registered) and the results of diagnostic tests or imaging are not recorded in the administrative databases. These limits hamper a more in-depth evaluation of clinical practice.
- The Belgian Cancer Registry will provide individual feedback to the centres, based on the figures from this report, to support local quality improvement initiative

SYNTHESIS

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LIST OF ABBREVIATIONS

ABBREVIATION	DEFINITION
ATC	Anatomical Therapeutic Chemical
BCR	Belgian Cancer Registry
COPD	Chronic Obstructive Pulmonary Disease
CT	Computer tomography
DDD	Defined Daily Dose
DICA	Dutch Institute for Clinical Audit
DLCO	Diffusing capacity of the lung for carbon monoxide
EBUS	Endobronchial ultrasound
EGFR	Epidermal growth factor receptor
FEV1	Forced expiratory volume in 1 second
HR	Hazard Ratio
IMA - AIM	Intermutualistic Agency
INSZ - NISS	Unique national security number
KSZ - BCSS	Crossroad Bank for Social Security
MDT	Multidisciplinary team
MRI	Magnetic resonance imaging
NSCLC	Non-small cell lung cancer
OR	Odds Ratio
QI	Quality indicator
RCT	Randomized Controlled Trial
SLCL	Small cell lung cancer
WHO	World health Organisation

1. BACKGROUND AND OBJECTIVES

Since several years, Belgium is engaged in quality improvement initiatives for cancer patients. One of them is the creation of an integrative quality system,[1] consisting of guideline development, quality indicators definition and feedback to hospitals (see Box 1). This approach has already been successfully implemented for five types of cancers: **rectum** (in collaboration with PROCARE), **breast**, **testis**, **oesophagus** and **stomach**.[2-5] Building on previous experience, this report presents the development of a set of quality indicators (QIs) for the management of **lung cancer**.

1.1. Lung cancer, a frequent and lethal disease

Lung cancer is a frequent and lethal disease. Every year, more than 8000 patients are diagnosed with lung cancer in Belgium, predominantly males (70%) with a long history of smoking. Lung cancer is the leading cause of cancer death in males and the second in females. Because it presents most often in advanced stage (i.e. metastasised), more than half of the patients die within the first year after diagnosis. Age-standardised 5-year survival is low, within the range of 10-20% in most countries.[6, 7]

There are two main types of lung cancer, based on the cancer cell type. Small cell lung cancer (SCLC) accounts for approximately 15% of all lung cancers. About three quarters are non-small cell lung cancers (NSCLC), with adenocarcinoma being the most common subtype of NSCLC. Further subtypes of NSCLC can be identified using molecular markers, enabling the use of a rapidly increasing number of targeted treatments.[8]

An evidence-based Belgian guideline for the diagnosis and treatment of SCLC and NSCLC were published in 2013.[8] Key elements for the treatment of early and locally-advanced stage disease are surgery or (chemo)radiation. Staging before the start of treatment, including mediastinal staging, is important to offer optimal treatment to each patient. For advanced disease that is not amenable to therapy with curative intent, chemotherapy or new targeted therapies can be considered.[8]

Box 1 – A Belgian integrative quality improvement system in oncology

An integrative quality system in oncology has been developed by the KCE, the College of Oncology and the Belgian Cancer Registry (BCR).[1] A first step is the development and dissemination of a clinical practice guideline for a certain type of cancer, followed by the development of a set of indicators to evaluate and measure the quality of care for this specific cancer. Individual feedback is then provided to all Belgian hospitals. This feedback subsequently can lead to corrective actions taken by the hospitals, to improve the quality of care. After a couple of years, this cyclic process should start again with the adaptation of the guideline to the latest scientific evidence.[1]

1.2. Improve quality of care through feedback

1.2.1. Three objectives

The **first objective** of this report is to develop a set of quality indicators for the diagnosis and treatment of lung cancer, and to provide insight in patterns and outcomes of care for lung cancer patients in Belgium. Auditing practice can reveal to what degree evidence-based recommendations are implemented, which outcomes are achieved in the Belgian population, which practices are associated with better outcomes and, most importantly, what can be done to optimize lung cancer care in the future.

At the time of publication of this report, each hospital will receive an individual feedback reporting its own results, benchmarked to results obtained by other hospitals, which are kept blinded.

Remark: following the scheme proposed in Box 1, the evaluation of the quality of care based on a set of quality indicators would ideally start after the implementation of the clinical recommendations proposed by the guideline, after 2014. In this report, we will only give a baseline figure for each of the indicators, since processes of care and their outcomes will be evaluated for patients who were diagnosed in the period 2010-2011. The results presented here can serve as a starting point to follow up the quality of care in the future.

A **second objective** of the report is to assess whether patients' main comorbidities can be identified based on pharmaceutical billing data and whether they can be used in a model to better account for the case-mix of patients. If successful, this could have the advantage of an improved adjustment for case-mix when comparing outcomes between centres without requiring any supplementary data collection or data linkage (because pharmaceutical billing data are readily available in health insurance databases).

A **third objective** of the report is to assess the volume-outcome relationship: do patients treated in high-volume hospitals have better outcomes than patients treated in low-volume hospitals? This has been mostly studied for surgical procedures,[9] but less frequently for radiotherapy.[10]

1.2.2. Target audience: clinicians specialized in lung cancer and multidisciplinary teams

The primary audience of this report are clinicians that provide care for lung cancer patients (pulmonologists, surgeons, radiation oncologists, medical oncologists, pathologists, etc...). They may be interested to read about the quality of care in general, but will probably be even more interested to receive their individual (hospital) feedback, and to discuss it at a multidisciplinary team (MDT) meeting.

The set of indicators developed in this project can obviously be used by others. For instance, in the past, some oncological centres have decided to measure themselves the set of quality indicators for testicular cancer on a regular basis, in order to monitor directly the quality of their care.[11] Also, the set of indicators on breast cancer has been chosen by the Flemish indicator project, "VIP^2" to provide regular feedback to hospitals in Flanders.[12]

How to read this synthesis?

This synthesis contains a summary of the methodology, the main findings, discussion of results, strengths and weaknesses, the conclusions and recommendations.

For each section, more details can be found in the following two documents:

-The scientific report: contains a detailed description of the aim and general methodology of the report, the methods used for case-mix adjustment, the pilot study, the descriptive statistics of the included population and the methodology and results of the volume-outcome analyses.

-A supplementary document: contains a technical fiche for each quality indicator, with all results, discussion and conclusion. Billing codes that were used to calculate the indicators are listed at the end of this document.

2. DATA AND METHODS

For the development of the set of quality indicators for lung cancer patients, we followed the standardized KCE methodology to identify, select, test and measure the indicators (see Box 2).[1] Because patients may be in contact with different hospitals (for instance, be diagnosed in one hospital but receive treatment – surgery or radiotherapy – in another), we developed a specific algorithm to attribute each patient to the centre where he/she was diagnosed or received treatment (surgical centre or centre of radiotherapy) (see section 2.3). The method to test the feasibility of identifying comorbidities of patients based on their pharmaceutical billing data during the year before the cancer diagnosis, is described in section 2.4.

2.1. The data: a linkage between the Belgian Cancer Registry data and administrative databases

The primary **data source** in this project is the **Belgian Cancer Registry** database. It is linked on the one hand with **health insurance data** obtained via the Intermutualistic Agency (IMA – AIM), to provide details on all cancer-related diagnostic and therapeutic procedures and pharmaceuticals which are reimbursed by sickness funds, and on the other hand with **vital status** data obtained via the Crossroads Bank for Social Security (KSZ - BCSS) (Kruispuntbank van de Sociale Zekerheid – Banque Carrefour de la Sécurité Sociale). The linkage was based on the patients' unique social security number (INSZ – NISS), and has been approved by the Sector Committee of Social Security and of Health (Health Section) of the Belgian Privacy Commission (Sectoriaal comité van de Sociale Zekerheid en van de Gezondheid, afdeling gezondheid/Comité sectoriel de la Sécurité Sociale et de la Santé, section santé).[13]

2.2. The patients: diagnosed in 2010-2011 with exclusion of patients with other invasive tumours

All patients diagnosed with invasive lung cancer in **2010** or **2011** were selected from the BCR database. This corresponds to a cohort of 15 746 patients. IMA – AIM data covering **2009-2012** were available for the vast majority of those patients (>99.5%). The vital status was followed up until December 31st **2014,** allowing a follow-up of at least three years for all patients.

Patients with another tumour registered in the BCR database, i.e.± 17% of the patients, were excluded to maximally ensure that reimbursed oncological treatments were prescribed to treat lung cancer and not another (recurrent) tumour.

Box 2 – Standardized methodology in four steps to develop a set of quality indicators in oncology

Step 1: Creation of a list of potentially interesting QIs

Medline and quality reports published by other agencies were searched to identify existing QIs for lung cancer. This list was complemented by QIs derived from the recommendations of the KCE lung cancer guideline.[8] A total of **120 QIs** were selected in this first step.

Step 2: Selection of relevant and measurable QIs

An expert panel (25 clinicians, see colophon) scored each QI on its relevance on a 1-5 scale. All indicators were then scored for their measurability with available data, and only measurable indicators were retained. The final decision on inclusion or exclusion of indicators was taken during two consensus meetings with the clinical expert panel, KCE and BCR. The criterion for initial selection was that more than 50% of the experts scored the QI as being relevant, but the group had the possibility to overrule the common score (in case of overlapping indicators, or in case quality of care was thought to be generally good in Belgium for a given indicator). At the end of this step **23 indicators** were retained.

Step 3: Pilot study: validation of the indicator results in 6 hospitals

A validation phase allowed to verify the technical definition of each quality indicator and the reliability of indicator results. This phase was run in collaboration with six hospitals (called pilot centres, see colophon) that were selected based on optimal representativeness of all Belgian hospitals.

Each participating hospital received the list of assigned patients and its indicators results, and was invited to compare these data with the information contained in their own medical files. The validation results allowed the refinement of the algorithm which attributed patients to a centre (see section 2.3) and of the calculation of some indicators.

Step 4: Measure QIs in a national database, and assess hospital variability

All indicators were measured at national level, and per hospital (if appropriate). Simple descriptive statistics were used to report results at national level. Funnel plots were used to show graphically the variability between centres (see Box 3). The results and conclusions were discussed during a last expert meeting.

2.3. Assigning each patient to a single centre? Not straightforward…

The diagnosis and staging process includes in the majority of patients at least one (and in many cases all) of the following tests or procedures: a bronchoscopy (or EBUS - endobronchial ultrasound if no bronchoscopy was performed), a punction biopsy, lung function tests and a CT scan of the chest. In addition, patients are often discussed at a MDT meeting to finalize the diagnosis and to plan the treatment. **In 96.9% of the patients, the diagnostic centre was identified based on the centre where most of the diagnosis and staging work-up took place**.

For the remaining 3.1% of the patients an algorithm was created to assign patients to one diagnostic centre with priority for the centre of MDT, prior to the centre where bronchoscopy (or EBUS) was performed, prior to the centre of punction biopsy, prior to the centre of lung function tests, prior to the centre of CT scan.

This algorithm has been tested and validated during the pilot study, and eventually allowed the assignment of 99.1% of the cohort to a single diagnostic centre. The remaining 0.9% was not taken into account in the analysis of the variability between centres.

For the indicators which were specific to a certain treatment (surgery or radiotherapy) the patient was assigned to the centre where that treatment was performed.

Definitions

Centre/Hospital = hospitals working under **the same agreement number in 2011**. One hospital can be composed of several sites or campuses.

Diagnostic Centre: centre where most of the diagnosis and staging process took place.

Surgery/Radiotherapy Centre: centre where the treatment was performed (patient treated in satellite centres are counted in the main centre where the satellite centre is affiliated with).

2.4. How to identify comorbidity based on data of pharmaceutical billing data?

The presence of one or several comorbidities at the time of cancer diagnosis may have an impact on therapeutic decisions and on outcomes, so every effort should be made to include this information in statistical models (see section 2.5) when centres are compared on patterns and outcomes of care. However, this information is neither readily available in BCR data, nor in IMA – AIM billing data. A proxy may be created based on reimbursed pharmaceutical delivery before diagnosis (for instance, from a regular delivery of insulin to a patient we can deduce that the latter is diabetic).

A literature review identified the following major comorbidities for patients diagnosed with lung cancer: **respiratory disease**, **cardiovascular disease**, **renal disease and diabetes.** A fifth factor, **previous history of cancer**, was not retained in our study because patients with multiple tumours were excluded.

Methods to measure these four comorbidities based on pharmaceutical billing data via the Anatomical Therapeutic Chemical (ATC) classification were based on previously published studies.[14, 15]

A validation phase was performed in collaboration with the six hospitals included in the pilot study. The comorbidities identified **via pharmaceutical data** were **compared** with the reporting of these comorbidities in the **patients' hospital medical files** (which was considered as the gold standard in this study). A specific electronic questionnaire was developed to extract patient comorbidities from medical files (available on request).

This validation phase not only allowed to evaluate the reliability of the case definition rules but also to define the cut-off in terms of Defined Daily Dose

(DDDs), i.e. what is the yearly minimum number of doses that a patient should take to be identified as having the comorbidity, in order to maximize the agreement between the medical file and the pharmaceutical data. A series of statistics that assess the agreement between the two methods were calculated.

2.5. The association between volume and outcomes

The **annual surgical volume** of each hospital was based on all lung cancer patients operated in 2010-2011, 2011 and within 9 months after their diagnosis of lung cancer, including patients with multiple tumours. Centres were then categorised as follows: very low-volume (<10 patients/year), low-volume (10-19), medium-volume (20-39) and high-volume (≥ 40). Of note, the definition of these categories is based on the Belgian data and differs from definitions used in other countries. For example, in a UK study, low-volume hospitals performed less than 70 interventions per year.[16] For the outcome analysis, only NSCLC patients with unique tumours who underwent thoracic surgery were included in the analysis.

Case-mix adjustment:

Multivariate models (logistic regression and Cox proportional hazards regression) were used to assess the relation between hospital volume and outcomes, adjusted for potential confounders identified beforehand: sex, age, histological subtype, sub-localisation, combined stage, number of days of hospitalisation during the year prior to lung cancer diagnosis, WHO performance status and comorbidities (chronic respiratory disease, cardiovascular disease and diabetes mellitus) as identified based on pharmaceutical billing data (see section 2.4).

Similar models were used to assess the impact of **radiotherapy volume** on outcome. Radiotherapy volume was divided in the categories < 50, 50 – 99 and ≥ 100 patients treated per year. Stage IV patients were excluded because it is likely that most of them received palliative treatment.

To analyse **the impact of the diagnostic volume,** the centres were divided in 4 categories, based on the number of all lung cancer patients diagnosed during the study period (≤50, 50-99, 100-149 and ≥ 150 patients diagnosed per year). Patients referred for treatment were counted in the centre of diagnosis.

Further details on the statistical modelling and sensitivity analyses can be found in the scientific report.

3. WHAT DO THE INDICATORS TELL ABOUT THE QUALITY OF CARE?

3.1. A study including almost 13 000 patients

Almost 13 000 patients were included in this analysis (76% NSLCL, 16% SCLC, 8% other histology). Their main characteristics (age, sex, stage) are described in Table 1.

Table 1 – Summary of the characteristics of the included population

	All patients[$] (N = 12 839)		NSCLC (N = 9817)		SCLC (N = 2004)	
	n	%	n	%	n	%
Sex						
Male	9 053	70.5	6 904	70.3	1413	70.5
Female	3 786	29.5	2 913	29.7	591	29.5
Age						
Mean (±SD) (years)	67.7y (±11.1y)		67.0 (±10.9)		67.0(±10.3)	
Combined Stage[*,£]						
Stage known						
I	1 721	16.3	1 415	17.0	50	3.4
II	955	9.0	826	10.0	69	4.7
III	2 639	24.9	2 073	25.0	394	27.0
IV	5 275	49.8	3 987	48.0	947	64.9
Stage missing (X)[*]	2 249	17.5	1 516	15.4	544	27.1

[$]including NSCLC, SCLC and 1018 patients with other histology.
[£] Combined stage combines information from the clinical and pathological stage. The pathological stage prevails over the clinical stage except when the clinical stage is stage IV.
[*] X (missing) category includes 28 tumours with staging not applicable (NA). The % for stages I, II, III and IV are computed excluding the X category.

3.2. Twenty-three quality indicators measured: from diagnosis to end-of-life care

Here we summarize the main results of the analysis of the quality indicators. An overview can be found in Table 2.

For each QI, we provide results at national level and benchmark these results against a target (if possible) or results from international studies. In addition, we provide an indication of the degree of variability across centres (large, moderate, limited, very limited) based on visual inspection of the funnel plots, which are available in the scientific report.

Targets

If applicable, a minimum or maximum target was proposed in advance for the indicators. Even for processes that are strongly recommended, the target is seldom 100% as patients may refuse or may have contra-indications.
To define a target, we first searched the international literature. If no target was proposed by other authors, we defined a target by expert consensus.

QIs have been classified into four main categories:

1. survival,
2. quality of data reporting to BCR,
3. quality of diagnosis and staging,
4. quality of treatment provided:
    a. for NSCLC
    b. for SCLC,
    c. safety of care: short-term mortality after treatment,
    d. quality of care near the end of life

More info in the technical fiches in the supplement of the report:

All technical fiches are presented in the supplement of the scientific report. They contain definition, rationale, technical implementation, all analyses, including subgroup and sensitivity analyses, and a discussion of the results.

Table 2 – Results for quality indicators for the diagnosis and treatment of lung cancer patients (patients diagnosed in 2010-2011)

ID	Quality Indicator	Result	Target	Variability*
1 year survival				
S-1	Observed survival 1 year after diagnosis	43.9%	--	Moderate, with some low and some high outliers
	All NSCLC patients	46.4%		
	Stage I	88.4%		
	Stage II	73.8%		
	Stage III	53.2%		
	Stage IV	28.2%		
	All SCLC patients	33.7%		
S-2	Relative survival 1 year after diagnosis of lung cancer	45.3%	--	Not assessed
Quality of data reporting to Belgian Cancer Registry				
DR-1	(A) % patients with clinical TNM stage recorded at BCR	76.8%	100%	Large, with many low outliers
	(B) % patients with surgery, with pathological TNM stage recorded at BCR	80.1%	100%	Large, with many low outliers
Diagnosis and Staging: Pathology, imaging and mediastinal staging				
DS-1	Median time from incidence date to first active treatment (days)	20 d.	--	Very large
DS-2	(A) % patients with histopathologically confirmed diagnosis	92.7%	--	Moderate, with some low outliers
	(B) % patients with histopathologically confirmed diagnosis for whom the tumour type is identified	99.5%	--	Very limited, uniformly high
	(C) % NSCLC patients for whom the subtype has been identified	94.1%	--	Moderate, some low outliers
DS-3	% cI-III NSCLC patients who had a PET-CT prior to treatment with curative intent	94.4%	--	Limited
DS-4	% cIII patients who had brain imaging (CT or MRI) before treatment with curative intent	78.7%	--	Moderate, some low outliers
DS-5	(A) % cII-III patients who had minimally invasive mediastinal staging (EBUS or EUS or mediastinoscopy) before treatment with curative intent	49.2%	--	Moderate, with some low outliers
	(B) % cII-III patients who had mediastinoscopy before treatment with curative intent, for whom mediastinoscopy was preceded by EBUS or EUS	30.1%	--	Not assessed

ID	Quality Indicator	Result	Target	Variability*
DS-6	% of NSCLC patients who had FEV1 and DLCO performed before surgery	88.9%	95%	Limited, with some low and high outliers
DS-7	% NSCLC patients who had a bone scintigraphy performed after a PET-CT	5.2%	0 %	Moderate, with some high outliers
DS-8	% NSCLC patients whose WHO performance status was assessed at diagnosis	80.0%	--	Large, with many low outliers
Diagnosis and Staging: EGFR testing (only in patients diagnosed in 2011)				
DS-9	% combined stage IV non squamous NSCLC patients for whom EGFR mutation analysis was performed	52.7%	95%	Moderate, with some low outliers
DS-10	% patients tested for EGFR mutation before receiving anti EGFR treatment	58.1%	95%	Not assessed
Diagnosis and Staging: Multidisciplinary team meetings (MOC-COM)				
DS-11	% patients discussed in MDT within 6 weeks after incidence date	72.8%	95%	Large, with many low outliers
DS-12	% cIII NSCLC patients with surgery discussed in MDT before start of treatment	66.3%	95%	Could not be assessed due to small sample size
Treatment of Non-Small Cell Lung Cancer				
TRT-1	% NSCLC patients who received guideline-concordant care[a]	58.3%		Moderate, with symmetrical high and low outliers
	% cI-II NSCLC patients who had surgery	59.9%		Moderate, with symmetrical outliers
	% cIII NSCLC patients who received primary chemoradiation	33.8%		Moderate, with symmetrical outliers
	% cIV NSCLC patients who received chemotherapy or targeted therapy	70.2%		Moderate, with symmetrical outliers
TRT-2	% cIII NSCLC patients treated with radiotherapy receiving concurrent or sequential chemotherapy	81.0%		Very limited, with few high and low outliers
TRT-3	% pT1-T3 pN1-2 M0 NSCLC patients who received adjuvant chemotherapy after resection	65.8%	70%	Could not be assessed due to small sample size
TRT-4	% pIA NSCLC patients who received adjuvant chemotherapy	1.2%	< 1%	Could not be assessed due to small sample size

ID	Quality Indicator	Result	Target	Variability*
Treatment of Small Cell Lung Cancer				
TRT-5	% SCLC patients who received guideline-concordant treatment[b]	70.2%	--	Limited, with few low and high outliers
	% cI-III SCLC patients who received chemoradiation (concurrent or sequential)	50.7%	--	Could not be assessed due to small sample size
	% cIV SCLC patients who received platinum-etoposide combination first-line chemotherapy	80.7%	--	Could not be assessed due to small sample size
Safety of care (60-day mortality after treatment)				
SAF-1	% patients who died within 60 days after primary surgery for NSCLC	3.9%	--	Limited, with a few high outliers
SAF-2	% stage I-II-III patients who died within 60 days after end of primary (chemo)radiotherapy with curative intent	9.3%	--	Very limited, with no outliers
Aggressiveness of care at the end-of-life				
EOL-1	% patients who received chemotherapy or targeted therapy within 2 weeks of death	12.9%		Could not be assessed because centre not known for all patients

** variability across centres beyond random error*
[a] Guideline-concordant care is defined as surgical resection for stage cI-II, chemoradiation for stage cIII and chemotherapy or targeted therapy for stage cIV;
[b] Guideline-concordant treatment is defined as chemoradiation (concurrent or sequential) for cI-III patients or first-line chemotherapy with platinum-etoposide combination for cIV patients

3.2.1. Survival one year after diagnosis

Overall the 1-year observed survival was 43.9% (indicator S-1 in Table 2), while the 1-year relative survival was 45.3% (indicator S-2). At 3 years, observed survival decreased to 20.2%, relative survival to 21.6%. The small difference between observed and relative survival indicates that the mortality is almost entirely attributable to the lung cancer, and not to the underlying natural mortality rate of the population. Patients with NSCLC diagnosed at stage I or II attained higher observed and relative survival rates (respectively 88.4% and 73.8%).

Median survival time was 9.5 months. Factors associated with higher survival at 1 year were: lower stage at diagnosis, NSCLC histology, female sex, younger age at diagnosis, better performance status at diagnosis, not being diabetic, and not having been hospitalized more than 2 weeks in the year before diagnosis (as a proxy of the patient's general condition).

In surgical patients (n=2084), 1-year survival was 88.3%, but this rate dropped to 77.5% at 2 years and 68.9% at 3 years. These results are slightly higher than those reported earlier in Belgium: 85.5% at 1 year and 73.5% at 2 years (patients diagnosed in 2004).[17]

In the EUROCARE-5 study (patients diagnosed in 2000-2007), Belgian results for 5-year relative survival (15.4%) scored favourably compared to the European mean from the 28 countries included. As the majority of lung cancer patients is diagnosed with metastatic disease, 5-year survival may reflect the quality of care in a limited manner. For diseases with a poor prognosis, measuring results of delivered care in terms of quality of life, patient centeredness and survival is more relevant in a shorter term, e.g. after one year. In the EUROCARE-5 study, Belgian results were good in terms of 1-year relative survival: 44.8% compared to a mean for Central Europe of 42.3% (Austria, Belgium, France, Germany, Netherlands, Switzerland).[18]

3.2.2. Quality of data reporting to Belgian Cancer Registry (BCR)

Precise determination of clinical and pathological stage is important to offer the best possible treatment tailored to each patient's situation. Furthermore, (clinical and pathological) TNM stage is a crucial parameter in the evaluation of quality as it is used in the technical definition of many indicators and in case-mix adjustment for outcomes. Underreporting may bias the results, as patients with unknown TNM stage cannot be included in the calculation of many indicators. Centres that are poor reporters may also perform poorly on other aspects, and their patients are more likely not to be included when measuring the indicator, giving biased results.

Clearly, for both clinical (76.8%, DR-1A) and pathological (80.1%, DR-1B) TNM stage reporting, there is ample room for improvement (Table 2, DR-1). In some centres the reporting rate is terribly low (around 30-40%, Figure 1A). These low reporting rates may be explained by a lack of correct, complete staging in the medical files or by flawed reporting processes.

3.2.3. Diagnosis and staging

Pathology, imaging and mediastinal staging

Correct and timely diagnosis and assessment of tumour characteristics and the health condition of the patient are of utmost importance to inform treatment decisions. An overview of the results for the eight selected indicators can be found in Table 2.

The median number of days from incidence date (date diagnosis was confirmed, by pathology for the majority of patients) to first treatment (including the time for transferring the patient, if applicable) was 20 days (DS-1). In 32.7% of the patients this period was longer than one month. There was also a large variability between centres (Figure 1B), denoting room for improvement in this area, although the Belgian situation compares favourably to what is reported in the international literature.

The three indicators related to histopathological diagnosis show excellent results (above 90%, see Table 2). Regarding preoperative evaluation of the lung function, results are acceptable (88.9%) but still stay short of the target of 95% (DS-6).

The indicators on the use of medical imaging during the staging process indicate that, while PET-CT is almost always performed before treatment with curative intent (DS-3, 94.4%), this is not yet the case for brain imaging

for cIII patients (DS-4, 78.7%, with moderate variability between centres, see Figure 1C). Brain imaging is thus also an area for improvement.

Forty-nine percent of the cII-III patients who had a treatment with curative intent underwent mediastinal staging (Table 2). The need for this procedure depends on the result of the PET-CT, which is not available in our database. Therefore, it is not possible to define a patient group that should have had invasive mediastinal staging, and we cannot define a clear target for this indicator, but variability between centres can be informative, especially for centres that perform invasive mediastinal staging less frequently. Moreover, recommendations have changed since 2010-2011, hence higher results are expected in the future.

Finally, completeness of performance status reporting to BCR (80%, DS-8) could also be improved.

EGFR mutation analysis

Ideally, stage IV non-squamous NSCLC patients should have their tumour tested for the presence of EGFR-activating mutations to guide treatment decisions. Anti-EGFR treatment should only be started if an activating mutation is present, although reimbursement criteria for second-line treatment also allow prescription based on immunohistochemistry (IHC) testing. For the studied period (data available for 2011 only), the number of mutation analyses performed is considered low (52.7%, DS-9, 58.1%, DS-10). This can be explained by the fact that, in 2011, the national guideline recommending EGFR-mutation analysis was not yet available.

Therefore, the data for 2011 cannot yet be considered as an indicator of quality of care, but should be considered as a benchmark for improvement in the future. A major limitation to assess the appropriate use of anti-EGFR therapy is the unavailability of test results in the administrative databases.

Multidisciplinary team (MDT) meetings

Multidisciplinary team (MDT) consultation is important to assure optimal clinical decision making and quality of care for all patients, whatever their stage or condition (see indicator DS-11).[19] MDT consultation is especially important when careful patient selection is critical and complex, e.g. the selection of clinical stage III patients who may be eligible for surgery (see indicator DS-12).

On a national level, the percentage of patients who were discussed in a multidisciplinary team meeting before initiating the treatment is lower than aimed for (95%), i.e. respectively 72.8% (DS-11) for all patients and 66.3% (DS-12) for cIII patients having had surgery, with a large variability between centres (funnel plot in Supplement).

Available data might somewhat underestimate the real frequency, a known issue with these data.[19]

3.2.4. Treatment

Patterns of care for NSCLC and SCLC

Guideline-concordant treatment should be applied as much as possible, taking into account patients' condition and preferences.

Non-Small Cell Lung Cancer (NSCLC)

The proportion of NSCLC patients receiving guideline-concordant care[a] (58.3%, TRT-1) is similar to or even higher than observed in three other countries (UK, The Netherlands, US), with moderate variability between centres in clinical stage I-II and clinical stage III patients.

Small Cell Lung Cancer (SCLC)

The proportion of SCLC patients receiving guideline-concordant care was 70.2%[b] (TRT-5), with limited variability between centres. While it is difficult to put forward an exact target for this indicator (because patient, tumour and centre-related factors play a role in treatment decisions), results in other countries show similar results.

The results described above should not be interpreted as a large proportion of patients not receiving appropriate care, as the general condition of a patient and his/her preferences determine to a large extent the choice of treatment. Explaining why patients did or did not receive guideline-

[a] Guideline-concordant care is defined as surgical resection for stage cI-II, chemoradiation for stage cIII and chemotherapy or targeted therapy for stage cIV

[b] Guideline concordant treatment is defined as chemoradiation (concurrent or sequential) for cI-III patients or first-line chemotherapy with platinum-etoposide combination for cIV patients

concordant care requires a more in-depth investigation. It is therefore not possible to put forward an exact target for this indicator. However, comparing individual results with other centres and with the national average can be informative to identify possible areas to change practice or to identify groups of patients that may benefit from referral for second opinion.

Adjuvant chemotherapy

The use of adjuvant chemotherapy appears to be appropriate in Belgium. Adjuvant chemotherapy in pT1-T3 pN1-2 M0 NSCLC patients may be slightly underused (65.8%, TRT-3), while adjuvant chemotherapy overuse in pathological stage IA NSCLC patients is almost absent (1.2%, TRT-4).

Safety of care: short-term mortality after treatment

Two indicators measure the safety of care: 60-day mortality after surgery (SAF-1) and after the end of primary (chemo)radiotherapy with curative intent (SAF-2).

The proportion of patients who died within 30, 60 and 90 days after surgery was 2.0%, 3.9% and 4.8% respectively, all below the set target of 5% (SAF-1). Results for 30-day mortality are similar to results reported in four other countries (Italy, USA, Spain, Denmark).

Mortality within 60 days after the end of primary (chemo)radiotherapy (in SCLC and NSCLC patients) was 9.3% (SAF-2). No results for short-term mortality after (chemo)radiation with curative intent for lung cancer were found in the literature, but survival curves from other population-based studies indirectly suggest similarly high mortality shortly after radiotherapy. The results may be an indication of the poor prognosis and frail general health of many cIII NSCLC patients.

End-of- life care

The quality of care at the end of life encompasses several aspects, with focus on symptom control, quality of life and special attention to the patient's wishes and preferences. For most of these aspects, quality measurements would require a prospective survey among patients or their families, but some indicators can also be measured using billing data. One indicator proposed in the international literature measures the intensity of treatment near the end of life.[20]

In Belgium, 13% of patients received chemotherapy or targeted therapy within two weeks of death (EOL-1). This is similar to what is observed in lung cancer patients in other countries, but higher compared to some other types of cancer (for instance 5.2% for stomach cancer, 4.3% for pleura cancer).[21]

Death within two weeks after the last administration of systemic treatment may be due to fatal toxicity, disease progression or causes not related to lung cancer and its treatment.

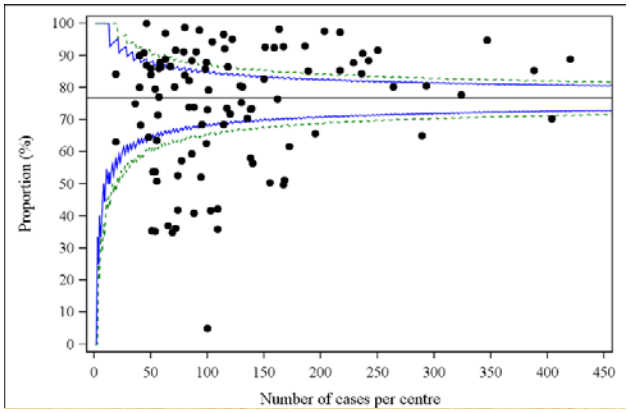
Box 3 – Funnel plot, a useful tool to assess variability and outliers

If applicable, the variability between centres was graphically represented using funnel plots. These plot each hospital's result against a measure of its precision (usually the hospital volume, but not always), with control limits of 95% and 99.8% around the overall result at national level. In these plots, hospitals within the control limits are assumed to be subject to 'common-cause' variability, whereas those that are 'out-of-control' will exhibit 'special cause' variability and **may deserve further scrutiny**.[22]

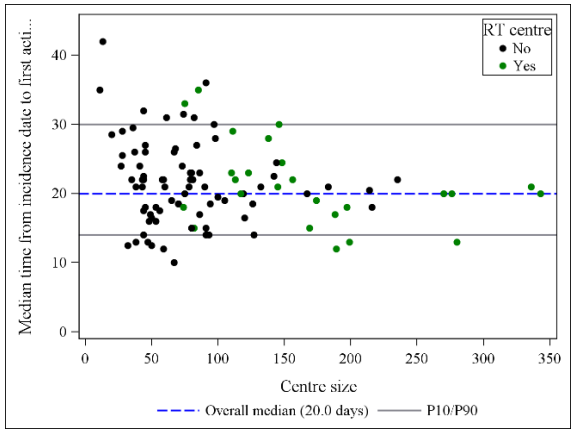
Funnel plots are used in quality assessments as this presentation avoids spurious ranking of hospitals.[23] Hospitals with too few eligible patients were excluded.

Figure 1 – Examples of indicators showing moderate to large variability

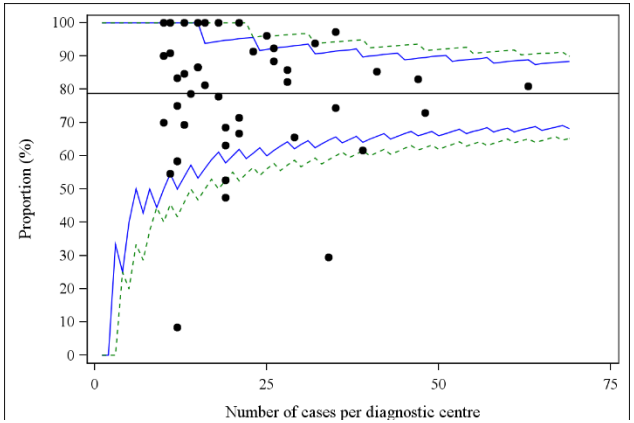
DR-1 (A) % cTNM stage reported to the BCR



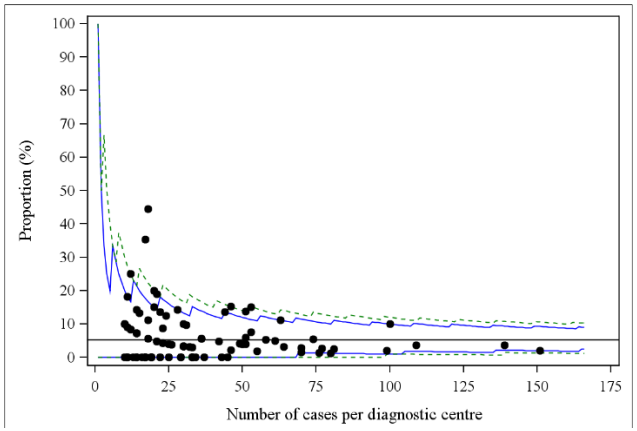
DS-1 Time from incidence date to first active treatment



DS-3 (A) cIII patients who had brain imaging (CT or MRI) before first treatment

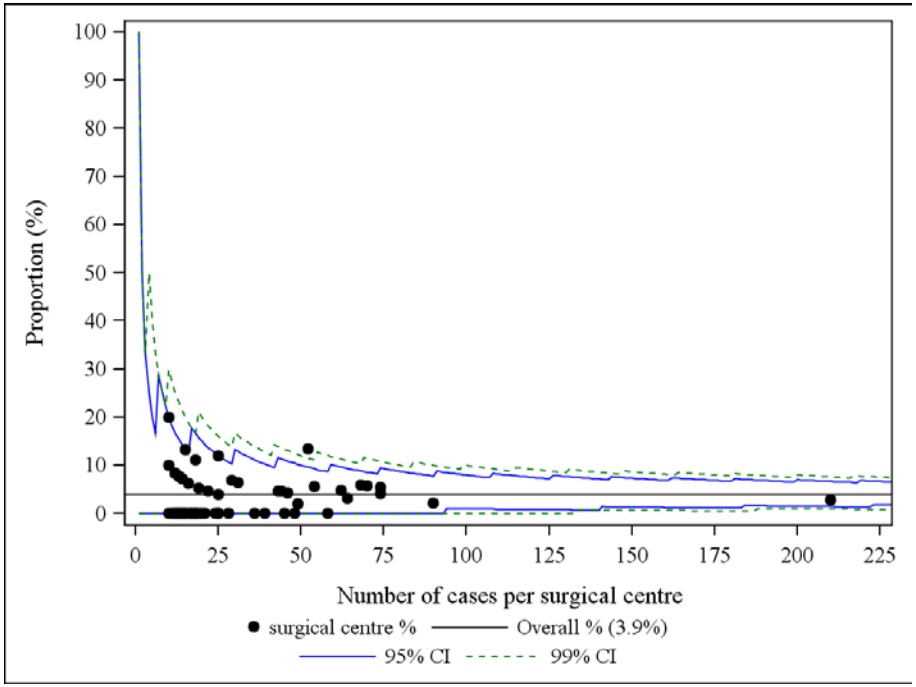


DS–5 Bone scintigraphy after a PET-CT



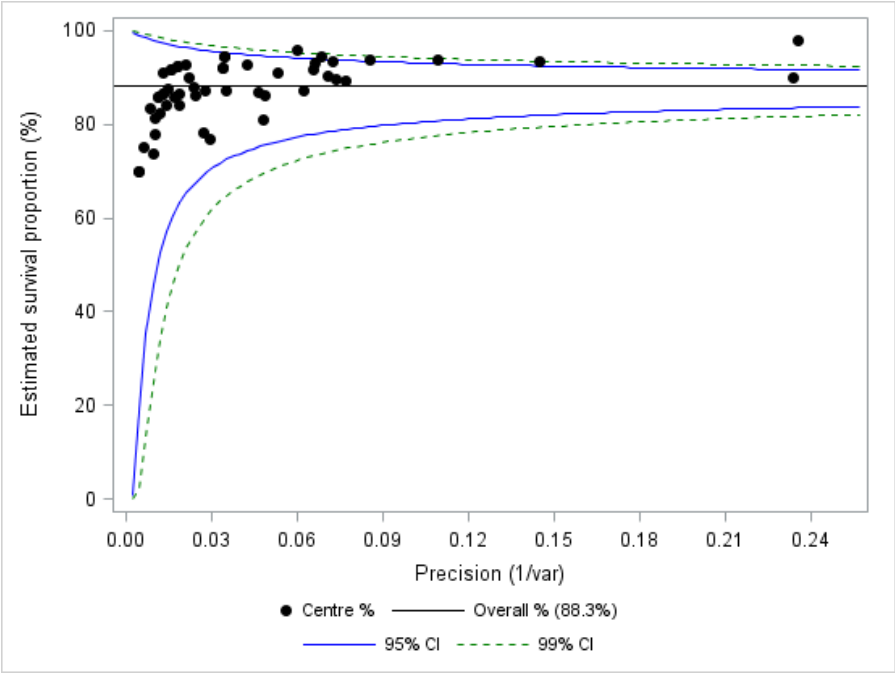
● Centre % ——— Overall % ——— 95% CI - - - - - 99% CI

Figure 2 – Funnel plot: 60-day mortality after surgery (NSCLC patients, 2010-2011)



Note 2: 31 centres were not shown in the figure because denominator was smaller than 10.

Figure 3 – Funnel plot: 1-year survival after surgery (NSCLC patients, 2010-2011)



Note: 6 centres with less than 20 patients at risk and a survival of 100% were not represented in this analysis.

Warning: On this graph, the X-axis is NOT the surgical volume of the centre, but the precision of the estimate (which depends partly on the volume of the centre), as in this way the funnel limits have the correct asymptotic coverage of 95%.

3.3. Three comorbidities identified using patient pharmaceutical billing data

An objective of this study was to assess whether patients' main comorbidities can be identified based on pharmaceutical billing data and to be used as a case-mix correction factor. The pilot phase demonstrated that pharmaceutical billing data provided a **valid** approach to measure **three major comorbidities** in lung cancer patients (cardiovascular diseases, respiratory diseases and diabetes mellitus), and **failed** to do so for the fourth one (renal insufficiency). More details are presented in chapter 8 of the report.

The main limitation of this approach, as already described in the literature,[15] is that some diseases cannot be differentiated because the same drugs are used for different diseases. For example, it appeared very difficult to distinguish asthma from COPD, or hypertension from other, more severe cardiovascular diseases. Using pharmaceutical data to identify a specific disease implies that those drugs are used exclusively for the treatment of that disease. Furthermore, the drugs identified must be used at any stage of the disease in order to be able to identify the disease whatever its stage. For example, moderate renal insufficiency is not medically treated and cannot be identified in pharmaceutical databases. Therefore, the influence of renal insufficiency on the management of lung cancer patients could not be used for case-mix adjustment in the present study.

In conclusion, this study showed that pharmaceutical data may be a valuable source for identifying and measuring three main comorbidities for lung cancer, when these data are not otherwise available at a population level. These comorbid conditions can contribute to risk adjustment modelling of quality indicators.

3.4. What's the impact of hospital volume on the outcome?

Three hypotheses have been tested:

1. Do patients operated in hospitals which perform more often lung cancer surgery (high-volume centres, or specialized centres) have better outcomes?
2. Do lung cancer patients treated with radiotherapy in high-volume radiotherapy centres have better outcomes?
3. Are there differences in treatments given between low- and high-volume centres?

In this section we present a summary of the main findings, all methods and results are detailed in chapter 11 of the report.

3.4.1. Surgical volume

Referral patterns for surgery

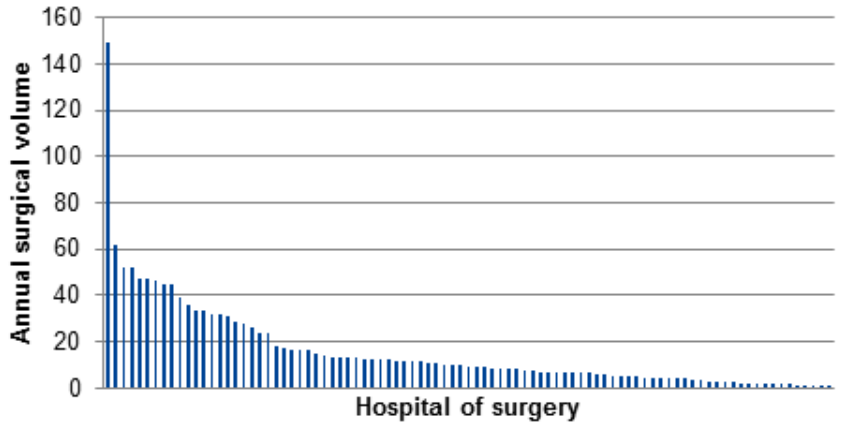
A detailed analysis of the different referral patterns between hospitals showed that 17.5% (380/2172) of the operated patients were referred, i.e. the centre that performed the main diagnostic and staging procedures was different from the centre that performed the surgery. The data do not allow to differentiate patient- from physician-initiated referral.

Surgical Volume

During the period 2010-2011, 89 hospitals performed surgery for lung cancer. The annual surgical volume per centre is illustrated in Figure 4. As was observed for other cancer surgeries,[3, 17] the majority of hospitals are low-volume centres, with half of the centres being very low-volume centres (< 10 operations per year) and only 9 centres being high-volume (i.e. ≥40 operations per year).

Case-mix differs between hospital volume categories: high-volume centres operate relatively more stage II-III patients compared to (very) low-volume centres. In general, statistical models confirmed the presence of a *negative confounding factor:* taking into account the case-mix, the differences observed in outcomes between very low and higher-volume centres increased after adjustment.

Figure 4 – Annual surgical volume for lung cancer patients* (2010-2011)



** All lung cancer patients (including patients with multiple tumours) with surgery in 2010-2011*

Surgical volume and outcomes

The impact of surgical volume was analysed at three time points: 60-day mortality, 1-year survival and 3-year survival (Table 3).

For short-term mortality (60-day mortality), the adjusted mortality rate was higher in very low-volume centres (6.4%), as compared to 3-4% in the other volume categories. This finding underlines the necessity of a minimum surgical volume of at least 10 interventions per year to minimize short term mortality. We found no or limited evidence of volume-outcome relationship beyond this cut-off.

For 1- and 3-year survival, the adjusted survival rates were the lowest in very low-volume centres (< 10/year) and the highest in high-volume centres (≥ 40/year), with intermediate survival in intermediate-volume centres, which is concordant with the volume-outcome assumption. The absolute difference in adjusted survival between very low and high-volume centres was around 5-6%, which is rather modest, especially in the light of the many uncertainties related to biases that may not be accounted for by the statistical adjustments (extent of surgery unknown, socioeconomic status) Sensitivity analyses confirmed statistically significant effects of volume on 1-year survival and smaller relative effects at 3 years.

Conclusion: 1-year and 3-year survival rates are higher in high-volume centres, but the results at three years are less pronounced. The effect of surgical volume on post-operative mortality is not demonstrated, except for very low-volume centres (<10/year) which consistently display worse results than other centres.

The three main limitations of these analyses are:

- Case-mix was not fully taken into account: potentially important confounders such as socioeconomic status or respiratory function were lacking. Some major comorbidities having an impact on treatment strategy (e.g. renal insufficiency) could not be captured. Missing data on stage are more frequent in low-volume centres.
- Some “high-volume” hospitals are in reality a cluster of (very) low-volume sites, each performing a small number of operations yearly, which may have attenuated the differences between low and high-volume hospitals.
- Administrative data hamper to differentiate the types of surgery, lobectomy from pneumonectomy (the latter having higher mortality rates, and probably performed more often in high-volume centres).

A correction of these shortcomings would most likely further accentuate the observed volume-outcome relationship.

Table 3 – NSCLC patients with surgery: outcome by hospital volume

	Annual surgical volume			
	<10	**10-19**	**20-39**	**≥40**
Hospitals (N = 89)	44	24	12	9
Patients (N=2084)	306	474	534	770
60-day mortality				
% observed	6.2	3.0	3.7	3.6
% adjusted	*6.4*	*3.1*	*4.0*	*3.3*
Adjusted OR	**Ref.**	**0.45 (0.22-0.94)**	**0.60 (0.3-1.2)**	**0.49 (0.26-0.91)**
1-year survival				
% observed	85.3	87.9	89.1	89.2
% adjusted	*84.2*	*86.9*	*89.0*	*89.9*
Adjusted HR (on mortality rate)	**Ref.**	**0.71 (0.47-1.05)**	**0.66 (0.44-0.98)**	**0.56 (0.38-0.81)**
3-year survival				
% observed	67.3	68.5	70.4	68.9
% adjusted	*64.5*	*68.2*	*69.4*	*70.4*
Adjusted HR (on mortality rate)	**Ref.**	**0.87 (0.66-1.12)**	**0.82 (0.64-1.06)**	**0.79 (0.62-1.00)**

Factors included in the model are: sex, age, stage, histological subtype, WHO performance status, 3 comorbidities (chronic respiratory disease, cardiovascular disease and diabetes) and hospitalisation days one year before lung cancer diagnosis.
OR Odds Ratio, HR Hazard Ratio

Our findings are similar to what is reported in the international literature. A systematic review published in 2012 identified 19 studies on the effect of procedural volume or surgeon specialty on outcomes in lung cancer surgery.[9] For hospital volume there was a variation across studies in cut-off values of the highest hospital volume strata (between 20 and 129.4 procedures annually) and the lowest volume strata (between 3.6 and 60 procedures annually). The authors concluded that postoperative mortality is lower in high-volume hospitals (OR=0.7; 95% CI: 0.62-0.81), but they could not demonstrate a statistically significant effect on survival (OR=0.93; 95% CI: 0.84-1.03).[9]

3.4.2. Radiotherapy volume

The analyses revealed no effect of radiotherapy volume on 60-day mortality and 1- and 3-year survival.

To our best knowledge no information exists on the volume-outcome relationship for (chemo)radiotherapy with curative intent in lung cancer patients. There are some data for other cancers, e.g. nasopharyngeal cancer,[24] but at this stage, it seems not possible to make out, based on our data, whether there is a volume-outcome effect or not.

3.4.3. Diagnostic volume

For cI-II NSCLC patients, there is a trend towards a higher use of surgery in centres with a higher diagnostic volume: 53.5% of the cI-II patients were operated in low-volume centres (<50 patients diagnosed per year) versus 67.0% in high-volume centres (>150 patients diagnosed per year), but the relationship was not statistically significant. For cIII NSCLC patients, the diagnostic volume was not associated with the use of chemoradiotherapy.

These two results are congruent with the results from a Dutch study.[25]

For stage cIV patients the relationship was reversed: lower use of chemotherapy in centres with a higher diagnostic volume (statistically significant). Reasons for this finding are unclear, but two hypotheses were raised in the expert group. Larger centres may discuss more with the patient whether treatment is wanted and therefore more patients decide not to undergo chemotherapy. Moreover, there is usually a higher enrolment of patients in clinical trials in larger centres, and because these systemic treatments do not appear in health insurance billing data (because drugs tested in clinical trials are paid by the sponsor), the use of chemotherapy

may be under-estimated somewhat. These two hypotheses cannot be verified based on our data.

For both cI-III and cIV SCLC patients, there is a trend towards a higher use of guideline-concordant treatment in centres with larger diagnostic volume: 65.1% of all patients received guideline concordant treatment in small-volume centres versus 77.8% in large-volume centres, but again this relationship is statistically not significant.

4. STRENGTHS AND LIMITATIONS

This study is built on an exhaustive national database

The main strength of our study is the ability to assess the quality of care for almost all lung cancer patients diagnosed in Belgium during 2010-2011. This corresponds to a cohort of more than 12 000 patients. The main data source is the Belgian Cancer Registry, which has a coverage of more than 98% of all cancer cases in Belgium. These data were linked with data from the Intermutualistic Agency (IMA – AIM) and the Crossroads Bank for Social Security (Kruispuntbank van de Sociale Zekerheid – Banque Carrefour de la Sécurité Sociale). Survival data were available until 31 December 2014, resulting in a follow-up of at least 3 years after diagnosis for all patients. No specific data registration efforts were thus necessary to perform this study, and all Belgian centres were de facto included.

Results have been validated in six pilot centres

Another strength of this report was the validation of results by six Belgian hospitals, selected to be as representative as possible of all Belgian hospitals. Academic and non-academic, large and medium-volume centres, French-speaking and Dutch-speaking hospitals were included. The validation study showed that 98% of the patients could be reliably attributed to a hospital, and that indicator results showed face validity.

There are still some crucial data missing in the Registry

A limitation that can and should improve in the future, is the incomplete data reporting of (amongst others) TNM stage and performance status to the Belgian Cancer Registry. These data are really vital for complete patient inclusion and correct case-mix correction.

Administrative data lack clinically important variables

This way of data collection has unfortunately also important limitations. INAMI – RIZIV billing codes in the IMA – AMI data are often not specific and do not allow precise and refined analyses (e.g. only limited information on indication for and dose schedules of radiotherapy, or on the type of surgery (pneumonectomy versus lobectomy) that was actually performed). Moreover, these data do not include the results of the tests or imaging performed, further limiting detailed analysis. The lack of clinical variables often resulted in the most pertinent quality indicators not being measurable. Consequently, we sometimes had to rely on proxy indicators instead

(indicators that are less accurate but measurable). Finally, drugs tested in clinical trials do not appear in health insurance billing data because they are paid by the trial sponsor.

And the patient's point of view is also lacking

As these quality measurements were performed retrospectively based on data collected for other purposes (billing data), patient-reported outcome data that are important to evaluate the results of the care delivered were not available. Prospective data collection on quality of life, functional recovery and patient experiences would certainly be an asset for future quality assessments.

The interpretation of some process indicators is not always straightforward

The indicators included in this study are mainly process indicators that measure whether an intervention has been performed or not, without consideration of how well it was performed. Indirectly, it is assumed that, if recommendations from evidence-based guidelines are followed, the best possible outcomes are achieved. However, interpretation of process indicators is more complex. For example, RCTs may show that concurrent chemoradiation is associated with better survival than sequential chemoradiation or radiotherapy alone in fit patients, whereas patients in daily practice may have important comorbidity and achieve better results with monotherapy. Furthermore, patient values and preferences may differ from what is proposed by general recommendations. Certainly in the lung cancer population, comorbidity and patient preferences are important factors to guide treatment decisions.

The data are outdated but can serve as a baseline measure

This study is based on the latest available data at the time the study was started, i.e. based on patients diagnosed in 2011. The feedback that will be sent to centres, early 2016, will thus be based on data from five years ago. Since then, recommendations (e.g. mutation analyses) and technologies (e.g. stereotactic radiotherapy) have evolved, and clinical teams may have changed. Hence, centres may prefer to review their more recent data before taking corrective actions. However, along with the national results, individual feedback data can serve as a baseline for follow-up, provided quality will continue to be monitored regularly in the future.

5. CONCLUSIONS AND FUTURE PROSPECTS

Towards a real integrative quality system, which includes patient-reported outcomes

First, the results of this project make clear that we need more complete and accurate reporting of data to the Belgian Cancer Registry to allow more precise and correct evaluation of the quality of care for lung cancer patients in Belgium. Quick and fluent data collection would make it possible to provide comprehensive feedback to care providers on a regular and timely basis. To make that happen, however, investments in data registration and analysis will be necessary.

As prognosis for locally-advanced and metastatic disease is poor, overall survival may not be the only outcome of importance for lung cancer patients. Overall benefit-risk balance and quality of life should also play an important role when deciding for or against (further) treatment. To have a better overall assessment of the results of lung cancer care, patient-reported outcomes such as quality of life should prospectively be collected. The BCR has recently started initiatives for more prospective collection of patient-reported data for patients with colorectal cancer.

Ideally, this type of feedback should be sent on a regular basis, based on the most recently available data. In the Netherlands for example, the Dutch Institute for Clinical Audit (DICA, https://www.clinicalaudit.nl/) has set up such a system with yearly feedbacks.

There is a need to centralise surgery for lung cancer

This report supports the previous plea for centralisation of lung cancer surgery which was done on the basis of a literature review.[8] There are now Belgian data to confirm this.

At present, patients diagnosed with cancer (whatever its rarity or complexity) are treated in the vast majority of Belgian hospitals. Minimum caseloads for hospitals or medical specialists are not required to maintain a surgical activity in a hospital. Several previous KCE reports illustrated the dispersion of care in Belgium, both for common and for rare cancers (colon cancer, lung cancer, pancreatic cancer, testis cancer, breast cancer, oesophageal cancer, and gastric cancer).[2, 3, 17, 26] The need for centralisation of care and

suggestions for operationalisation have been elaborated extensively in a previous KCE report on that subject.[26]

Time for quality improvement initiatives, with or without public reporting of results

When benchmarking results between hospitals, cautious interpretation is warranted. The use of funnel plots avoids spurious ranking of hospitals and outlier dots can reliably designate either good or bad performers. Statistical modelling can often only partially account for differences in case-mix and other biases.[22, 27] Judging quality of care delivered by a hospital is further hindered by the often small number of patients treated per hospital in Belgium. Hence, from a sheer statistical point of view, small volumes of activity make it impossible to offer an acceptable level of assurance about the quality delivered to the patient.

In that sense, 'statistical proof' of poor quality cannot be a requirement for quality improvement initiatives. Individual hospital feedback allows hospitals to investigate further the reasons for results, compare with best practices and initiate change projects adapted to their local situation.

In this report, following KCE and BCR rules of non-disclosure of data, all hospital results are kept anonymous. Avoiding a name-and-blame culture may encourage all caregivers involved to accept joint accountability and work together towards improvement of outcomes. Regional initiatives on quality improvement, such as the "Vlaams Indicatorenproject voor Patiënten en Professionnals"[12] (VIP^2 project), may go a step beyond and encourage hospitals to make the results of their feedback publicly available on their website. This is a voluntary choice of each hospital collaborating to the VIP^2 project, and has eventually led to the creation of a common web platform where quality of care results from Flemish hospitals are available.[28] This is the result of years of political commitment to public disclosure of quality data.

RECOMMENDATIONS

To the Federal Minister of Health and the Ministers of the federated entities:

- **Further follow-up of the quality of lung cancer care based on the developed set of quality indicators with the possibility of public reporting is indicated. This requires a system that can provide regular and timely feedback to Belgian oncological centres.**
- **Centralization of lung cancer surgery as part of the reform of the healthcare landscape, in a limited number of centers with sufficient activity that meet a minimum of quality standards, functioning within networks with the ability to refer patients. As a first step, hospitals that perform less than 10 interventions per year (half of the Belgian hospitals) should refer their patients (who might be eligible for surgery) to hospitals with a higher volume of lung cancer surgery.**

To the scientific societies of surgeons, radiation oncologists, medical oncologists, chest physicians and all healthcare providers involved in care for lung cancer patients:

- **Multidisciplinary teams are encouraged to evaluate their individual results on the quality indicators as transmitted by the Belgian Cancer Registry, to benchmark their results and to engage into the quality improvement process.**
- **Oncological centres should improve reporting of all required data to the Belgian Cancer Registry.**

To the Belgian Cancer Registry

- **Further development of case-mix adjustment methods, with linkage of RHM – MZG and BCR database and further validation of the pharmaco-algorithm to define comorbidity should be undertaken.**
- **Prospective collection of patient-reported outcomes and data for other relevant but not-measurable indicators, e.g. surgical resection margins, recurrence, etc, should be facilitated.**

To the pathological laboratories

- **To provide pathological reports in synoptic and standardised format. This can facilitate collection of comprehensive data (e.g. results of mutation analysis) and the integration of this information in the Belgian Cancer Registry database.**

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COLOPHON

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