Royal College of Physicians

Society for Cardiothoracic Surgery in Great Britain and Ireland

National Lung Cancer Audit

Lung cancer clinical outcomes publication

(for the 2017 audit period)

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In association with:

British Thoracic Oncology Group

National Lung Cancer Forum for Nurses NLCFN

Roy Castle Lung Cancer Foundation

Public Health England

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

HQIP
Healthcare Quality Improvement Partnership

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National Lung Cancer Audit

The National Lung Cancer Audit (NLCA) is commissioned by HQIP. The NLCA is a programme of work that aims to improve the quality of care, services and clinical outcomes for patients with lung cancer in England, Scotland and Wales. To find out more about the NLCA visit www.rcplondon.ac.uk/projects/national-lung-cancer-audit.

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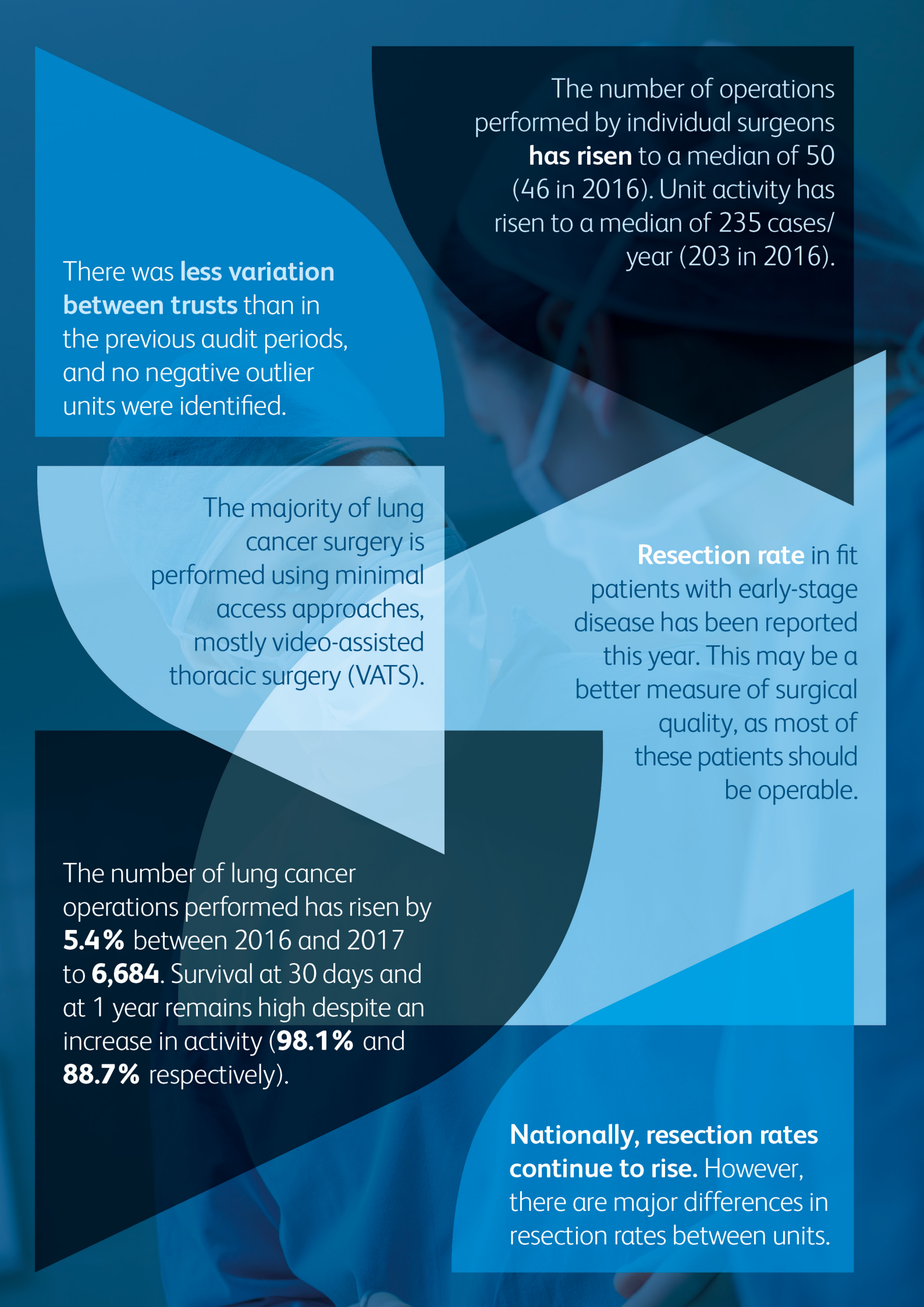


The number of operations performed by individual surgeons **has risen** to a median of 50 (46 in 2016). Unit activity has risen to a median of 235 cases/ year (203 in 2016).

There was **less variation between trusts** than in the previous audit periods, and no negative outlier units were identified.

The majority of lung cancer surgery is performed using minimal access approaches, mostly video-assisted thoracic surgery (VATS).

Resection rate in fit patients with early-stage disease has been reported this year. This may be a better measure of surgical quality, as most of these patients should be operable.

The number of lung cancer operations performed has risen by **5.4%** between 2016 and 2017 to **6,684**. Survival at 30 days and at 1 year remains high despite an increase in activity (**98.1%** and **88.7%** respectively).

Nationally, resection rates continue to rise. However, there are major differences in resection rates between units.

Contents

1. Executive summary

This audit report forms the sixth lung cancer clinical outcomes publication (LCCOP). Data from 27 surgical units in England, performing thoracic surgery between 1 January and 31 December 2017, were analysed, following a 6-week period of data validation by surgical units. Key findings include:

- Overall, 129 surgeons performed lung cancer surgery during the audit period.
- The number of lung cancer operations performed has risen by 5.4% between 2016 and 2017 to 6,684.
- Survival at 30 days and at 1 year is high at 98.1% and 88.7% respectively. This was maintained despite the increase in activity this year.
- There was less variation between trusts than in the previous audit periods, and no negative outlier units were identified.
- As in previous years we have reported the overall surgical resection rate by trust, but in addition this year we have reported the resection rate in fit patients with early-stage disease. This new measure may be a better measure of surgical quality, as most of these patients should be operable.
- National resection rates continue to rise, however, there are major differences in unit resection rates, with some units more than twice as likely to operate on cancer patients than others. Addressing this variation could increase the number of patients offered surgery by over 1,000 patients every year.
- Individual clinician and trust expertise is increasing. The number of operations performed by individual surgeons has risen to a median of 50. Unit activity has risen to a median of 235 cases/year. This compares with 46 cases per surgeon and 203 cases per unit in 2016.
- Median length of stay following surgery was 6 days. Shorter lengths of stay do not seem to be associated with higher readmission rates.
- The majority of lung cancer surgery is performed using minimal access approaches, mostly video-assisted thoracic surgery (VATS) (55% compared with 53.4% in 2016).
- Only 3.5% of resections require pneumonectomy (removal of a whole lung), a historically low level.

2. Recommendations

Recommendation		Result (page in the report)	Standard	Key audience
1	Surgical units with resection rates in stage I/II, PS 0–1 patients below 55% should review their processes for surgical selection and data collection to identify whether more fit, early-stage lung cancer patients could be offered surgery.*	Stage I–II, PS 0–2 rates (omitting tertiary trusts) range from 50.5% to 92.7% (page 18).	Target standard proposed by the NLCA/SCTS (2019).	Surgical lead for lung cancer, MDTs, cancer managers and commissioners of lung cancer surgery.
2	Surgical units with pneumonectomy rates above 5% should carry out a review of these cases to determine if alternative surgical approaches could be considered.	3.5% of all resections are pneumonectomy operations (page 12).	Target standard proposed by the NLCA/SCTS (2019).	Surgical lead for lung cancer and commissioners of lung cancer surgery.
3	All surgical units should carry out a review into rates of and reasons for readmission to hospital after surgery on a subset of their patients, to determine whether processes need to be modified to reduce these.	41% of patients were readmitted within 90 days of surgery (page 21).	n/a.	Surgical lead for lung cancer, MDTs, cancer managers and commissioners of lung cancer surgery.
4	All surgical units should share good practice points though the SCTS network.	n/a.	n/a.	Surgical lead for lung cancer and commissioners of lung cancer surgery.

* A 55% threshold for the resection rate in stage I–II PS 0–2 patients was chosen as a threshold as it approximates the 4th quartile of unit results. There are other non-surgical radical treatment options for early-stage disease, and some patients opt for no treatment.

MDTs = multidisciplinary teams; NLCA = National Lung Cancer Audit; PS = performance status; SCTS = Society for Cardiothoracic Surgery

3. Introduction

The lung cancer clinical outcomes publication (LCCOP) is an NHS England initiative, commissioned by the Healthcare Quality Improvement Partnership (HQIP), to publish quality measures for lung cancer surgery using national clinical audit and administrative data. The aims of publishing these results are to:

- reassure patients that the quality of clinical care is high
- assist patients in having informed conversations with their healthcare team about treatment options, including surgery
- provide information to individuals, teams and organisations to allow them to monitor and improve the quality of the clinical care that they provide
- inform the commissioning of NHS lung cancer services.

This is the sixth report on the activity of surgical teams and their contribution to lung cancer care. The data relate to patients diagnosed with lung cancer (excluding small-cell lung cancer (SCLC)) who underwent surgery between 1 January and 31 December 2017.

Data for this report is based on patient-level information collected by the NHS, as part of the care and support of cancer patients. The data is collated, maintained and quality assured by the National Cancer Registration and Analysis Service (NCRAS), which is part of Public Health England (PHE). Validation of local data, and collection of data on surgical approach, has been performed in collaboration with the Society for Cardiothoracic Surgery (SCTS) and their network of local audit leads in every NHS unit.

4. Methods

Patients undergoing lung resection for primary lung cancer within the English NHS are included. Operations for SCLC are not included. Diagnostic or staging operations, and resections for metastatic disease, are also excluded.

Lung cancer operations are extracted from the NCRAS data and sent to local SCTS audit leads within each surgical unit for local validation. The records are cross-referenced to Hospital Episode Statistics (HES) data to obtain comorbidity and other data. Named consultants are cross-referenced against the General Medical Council (GMC) Specialist Register.

Casemix adjustment and outlier notification

Survival outcomes are adjusted using comorbidity and demographic data from HES and NCRAS, and presented as odds ratios relative to pooled national data. Units with odds ratios for survival beyond 95% confidence intervals (CI) (alert) level are notified directly. Units beyond the 99.8% (alarm) level (both negative and positive (good practice)) are both notified and identified in the LCCOP report.

HQIP's *Clinical Outcomes Publications: Technical Manual* was used to guide the development of LCCOP. The full methodology report can be accessed at www.hqip.org.uk/resource/clinical-

outcomes-publication-technical-manual/. Negative outlier units are required to complete and submit a response and action plan.

5. Results

Local validation

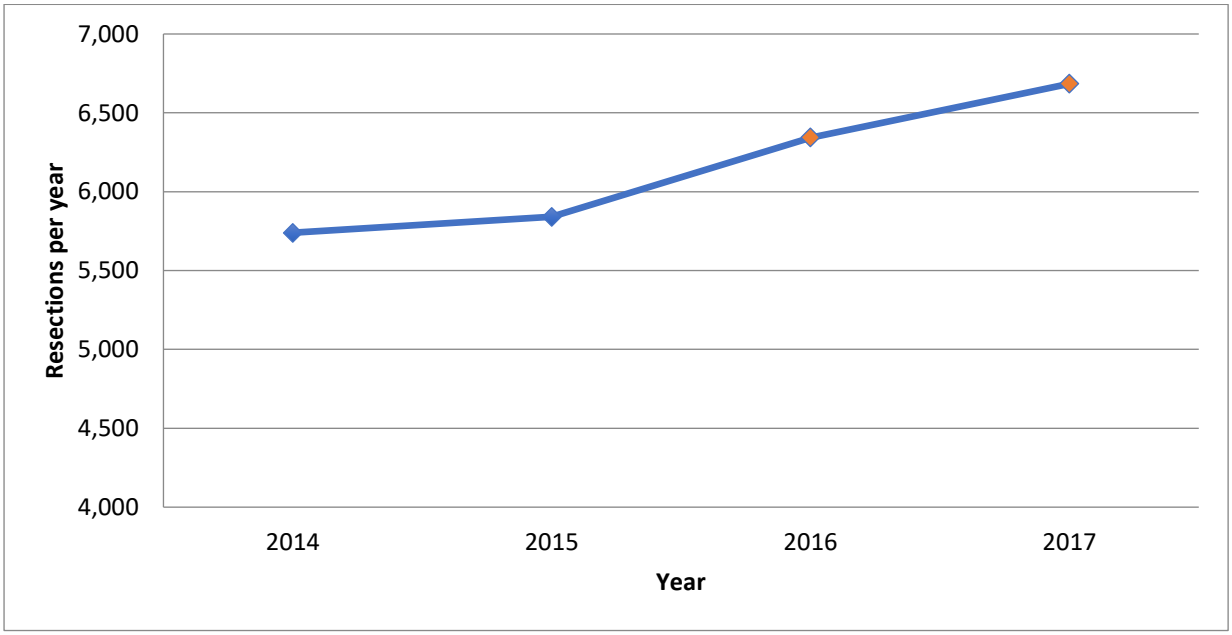
Of the 27 NHS England units, 25 performed local clinician validation of their data. University Hospitals Coventry & Warwickshire NHS Trust and Newcastle Upon Tyne Hospitals NHS Foundation Trust did not validate, and their HES and NCRAS data is therefore presented without validation.

National activity and trends

In 2017, 6,641 patients underwent 6,684 lung cancer resections, an increase of 5.4% on the 6,343 resections performed in 2016. This is in line with the trend of increasing activity seen in LCCOP since its inception. Activity has increased by nearly 1,000 resections per year over the last 3 years (Fig 1).

After the closure of the thoracic surgery unit at the Royal Devon and Exeter Hospital in 2016, 27 NHS trusts in England performed lung cancer surgery in 2017.

Fig 1 Total lung cancer resections 2014–2017



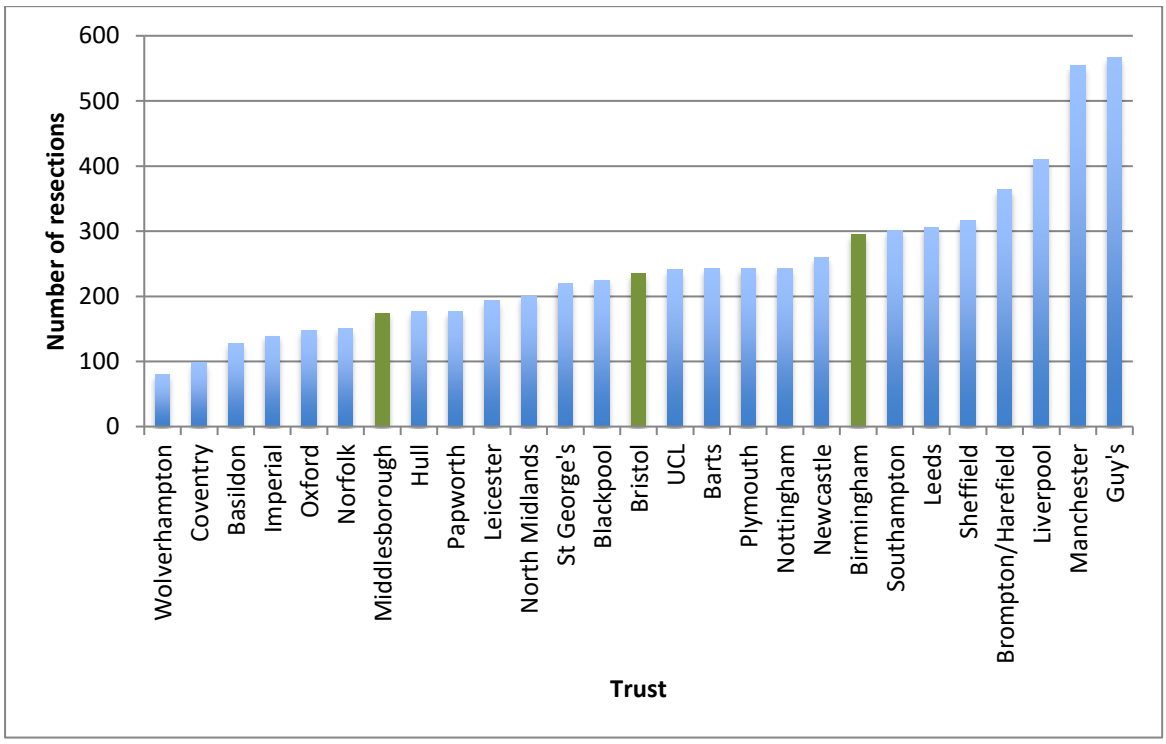
Resections for SCLC have been excluded since 2016.

Unit level activity

Surgery is provided in quite different circumstances across the country, from relatively small units in local acute hospitals, to large units in specialty-specific hospitals. There is a wide range of unit sizes, performing between 80 to 566 lung surgeries/year (Fig 2). The median number of surgeries performed in a unit has increased by 16% to 235 per year, in comparison with 203 in

2016 (IQR 175–278 as compared to 166–278 in 2016). Six units, nearly the entire lowest quartile, performed fewer than the 150 cases/year recommended in the NHS England commissioning guidance for thoracic surgery.*

Fig 2 Number of resections performed in 2017 by trust



Trusts closest to the 1st, 2nd and 3rd quartiles are marked in green.

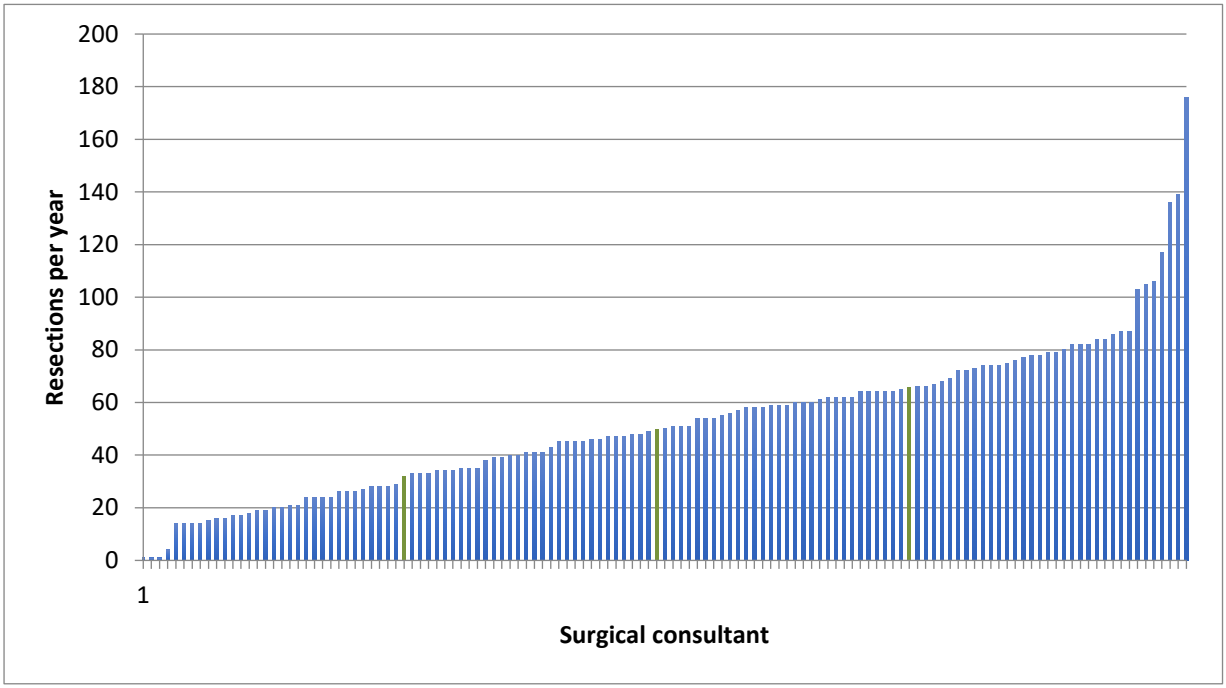
Surgeon level activity

A total of 129 surgeons performed lung cancer resections in 2017. The median number of cases operated on by individual surgeons was 50 (IQR 32–66). This compares to the median of 46 (IQR 31–70) cases reported by 125 surgeons in 2016, an 8.7% year-on-year increase (Fig 3).

The increase in surgical activity has therefore been due both to slight increases in the number of operating consultants and in the number of resections performed per surgeon. At the same time, one unit closed in 2016 while the others have grown in size. No new units have opened. The net effect is for surgery to be performed by more experienced surgeons in slightly larger surgical units than previously.

* www.england.nhs.uk/publication/thoracic-surgery-adults/

Fig 3 Lung cancer resections in 2017 by individual clinician



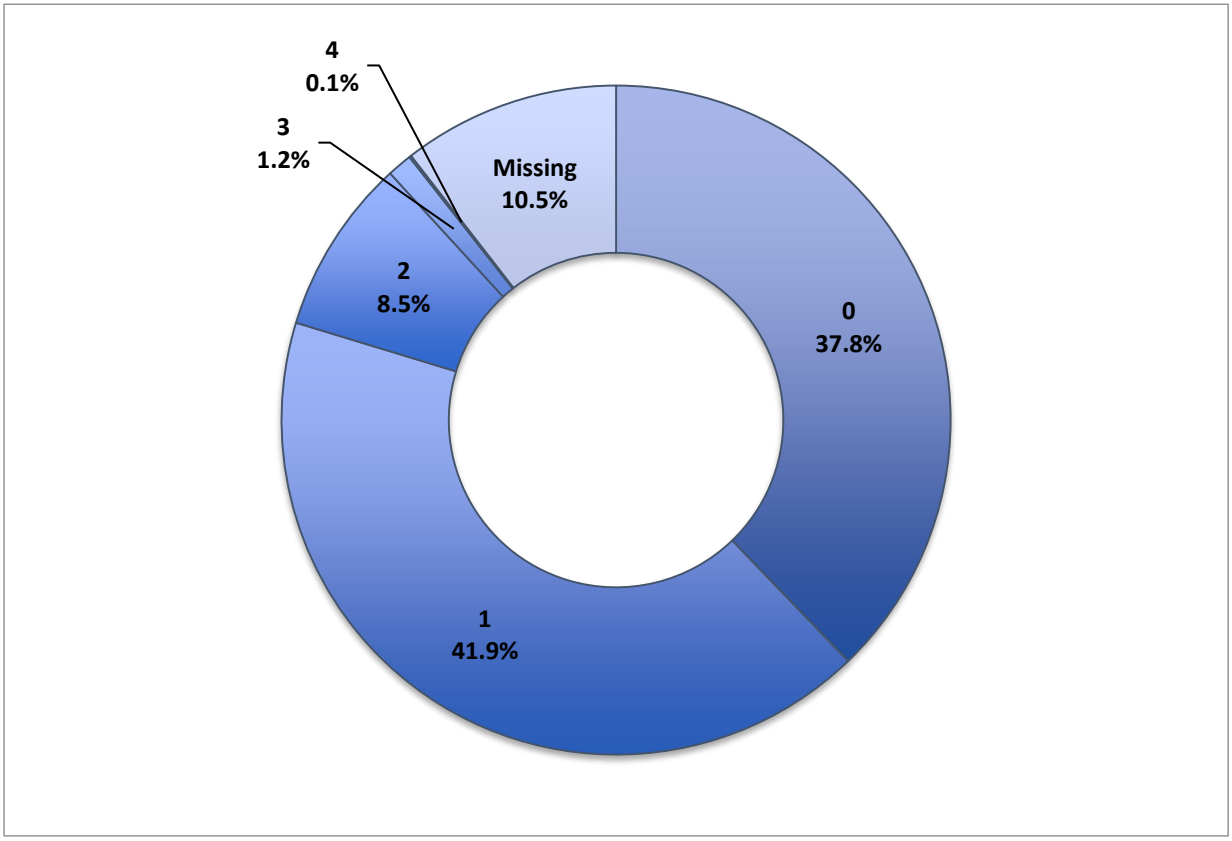
The data points closest to the 1st, 2nd and 3rd quartiles are marked in green.
Note that consultants with very small numbers of resections may only have been in post for part of the year in question.

Key data

Women comprised 52.8% of all patients undergoing lung cancer resection. This female predominance contrasts with the male predominance (52% in 2017) seen in total lung cancer diagnoses, meaning that women are more likely to undergo surgery as part of their treatment. Differences in stage at presentation, fitness or other factors may be responsible.

The predominance of good performance status patients is expected, since unfit patients are unlikely to be considered for what is usually major surgery (Fig 4). Of patients with a recorded performance status (PS), 89% are PS 0 or 1.

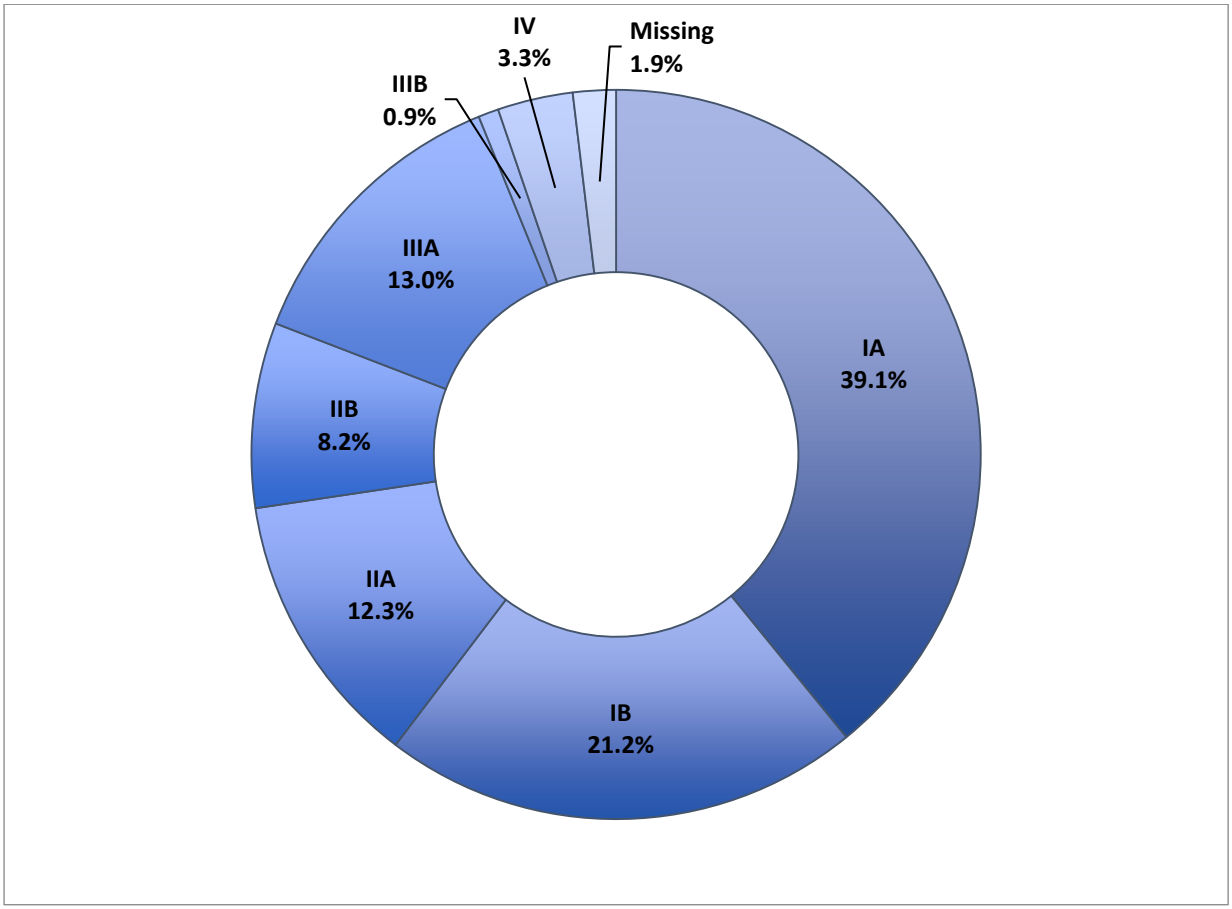
Fig 4 Resections in 2017 by WHO performance status



WHO = World Health Organization

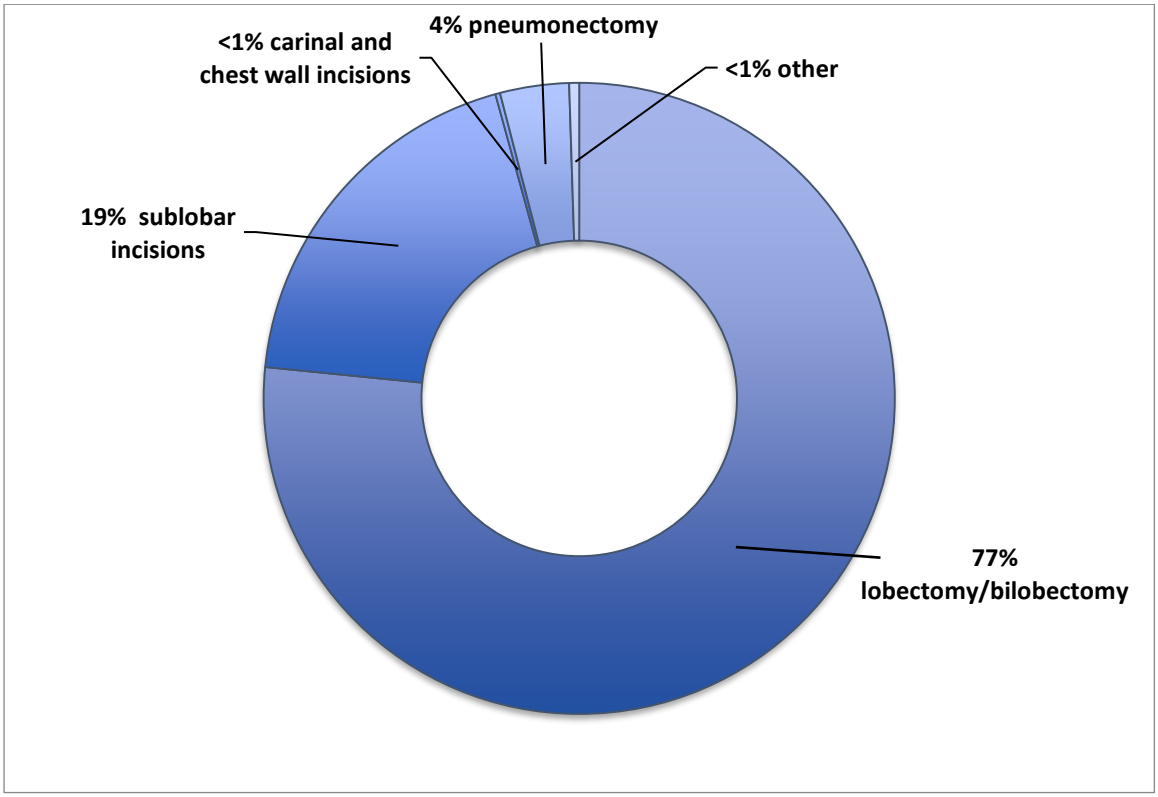
Current National Institute for Health and Care Excellence (NICE) guidance suggests surgery in fit patients with early-stage disease, and in some more advanced-stage patients as part of multimodality therapy. 80.8% of resections were performed for patients with stage I or II disease (Fig 5).

Fig 5 Resections in 2017 by cancer stage



Lobectomy is the operation recommended by NICE in patients who are fit for surgery and who do not require a larger resection to achieve clear resection margins. It is encouraging that 77% of all lung resections are lobectomy or bilobectomy operations (Fig 6). Pneumonectomy operations, which involve removal of the whole lung and are associated with poorer survival, comprised only 3.5% of all resections. In 2013 this figure was 5.8%, and historically it was far higher. However, the proportion of patients undergoing pneumonectomy varies considerably across the surgical units (0.7–13.8%).

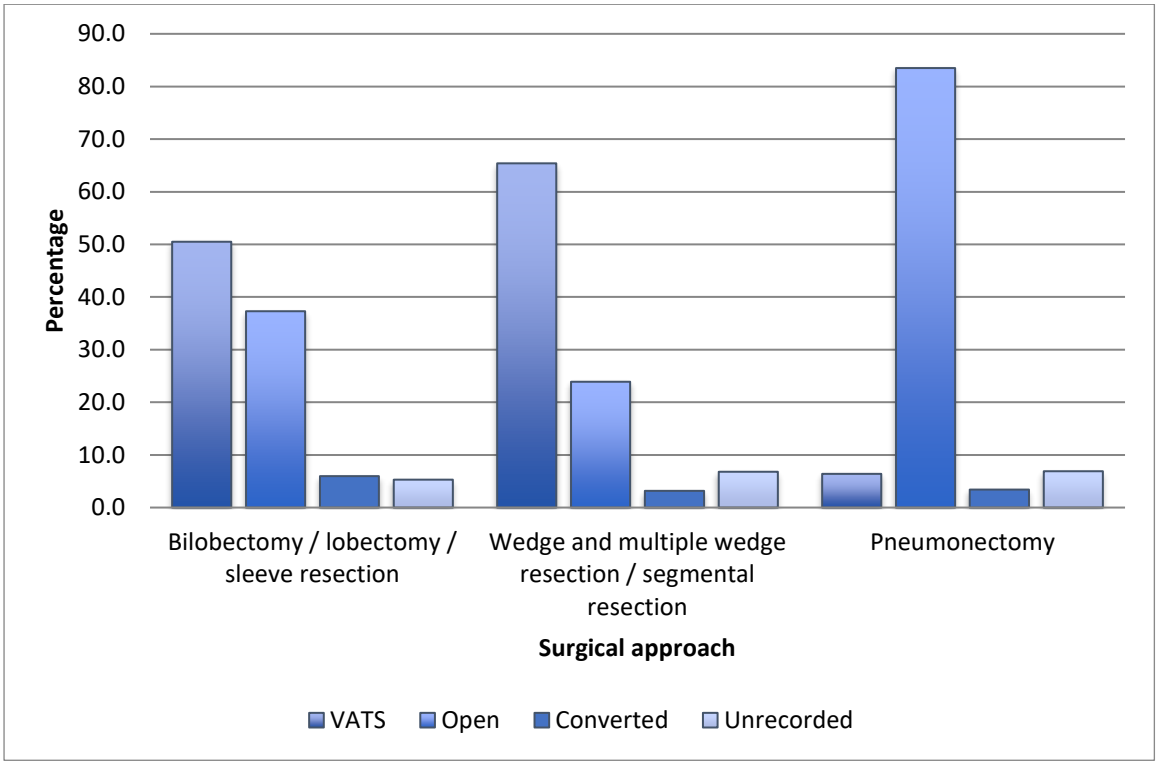
Fig 6 Resections in 2017 by operation performed



Minimal access approaches, particularly video-assisted thoracic surgery (known as VATS or thoracocopic surgery) now predominate for lung cancer surgery. Of the 6,303 operations with an approach recorded, 55.8% (3,515) were completed via VATS or a robotic approach, a slight increase from 53.4% in the preceding year. Minimal access surgery is most commonly performed for sublobar resections (segments and wedges) and least commonly for pneumonectomy, where 83.5% were planned and completed as open operations. In patients with an approach recorded, conversion from VATS to open surgery occurred in 10.6% of all lobectomies and bilobectomies started by VATS, and 4.7% of sublobar resections started by VATS. VATS pneumonectomy remains uncommon, perhaps because many surgeons prefer to maximise the chances of avoiding a pneumonectomy and its attendant risks by dissecting central tumours directly.

Robotic approaches remain uncommon but have increased slightly. In 2017, 57 cases were reported; 49 of these were lobectomy or bilobectomy operations. They represented 1% of all lobectomy and bilobectomy operations where an approach was documented. Data completeness for surgical approach has improved, with only 5.7% unrecorded compared with 14.6% in our last report.

Fig 7 Surgical approach used by resection performed in 2017

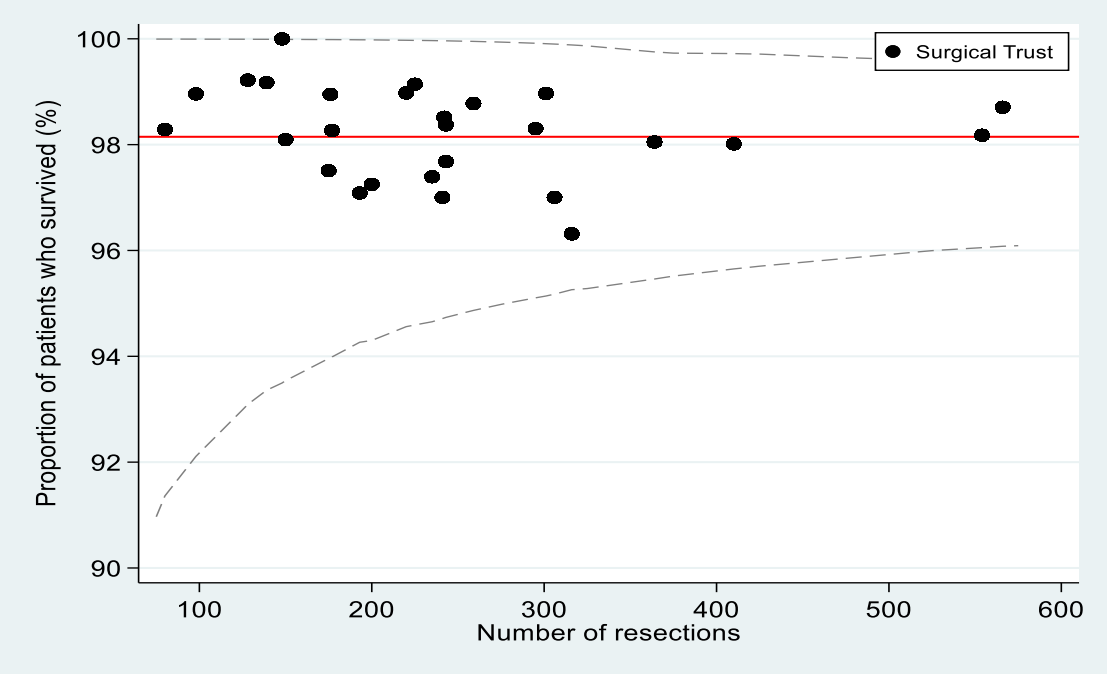


VATS = video-assisted thoracic surgery

Survival proportions: 30 days and 1 year after surgery

Of 6,684 patients undergoing a lung resection, 6,560 were alive at 30 days; a survival proportion of 98.1% (Fig 8). This is within 0.1% of the proportions reported in our two most recent reports. It is encouraging that survival rates have remained unchanged while overall activity and resection rates continue to rise.

Fig 8 Adjusted 30-day survival by trust

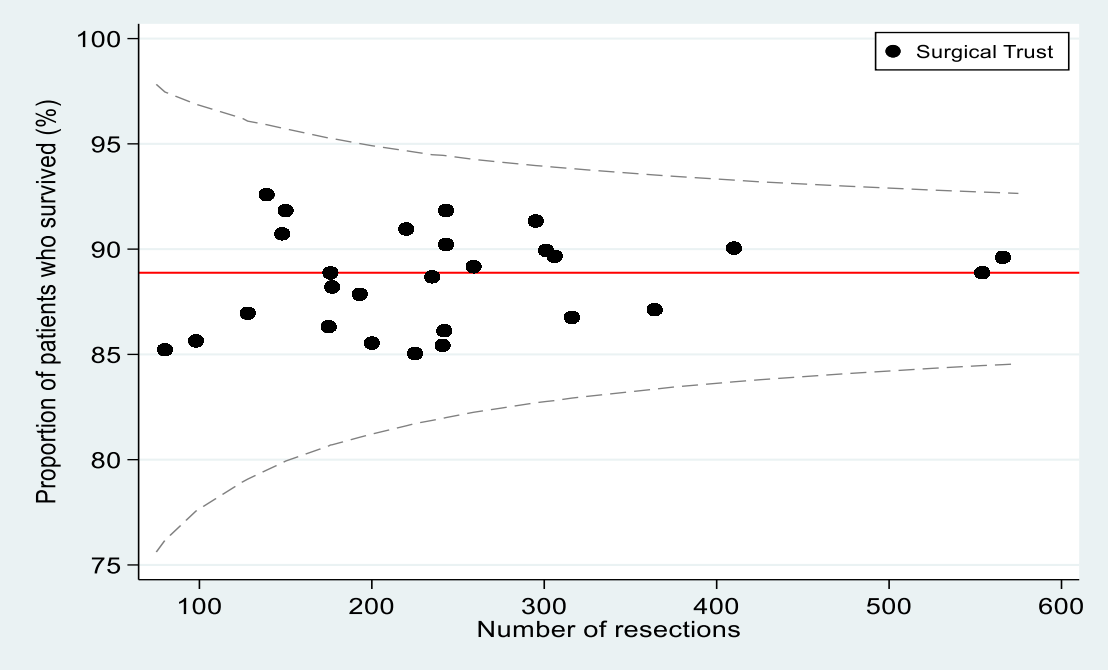


All trusts this year achieved 30-day survival proportions within the expected range, defined as an adjusted odds ratio within 99.8% confidence intervals of the national figure. There were no negative outliers. Oxford University Hospitals was a positive outlier on 30-day mortality, performing 148 lung resections who all survived for at least 30 days. Although the total number of operations performed in this unit was relatively low, we note that this hospital achieved an identical 100% survival proportion at 30 days in the last LCCOP report.

To compare results from individual trusts as fairly as possible, results are adjusted for age, sex, PS, stage, laterality, percentage FEV1,[†] comorbidity scores, socioeconomic status and pneumonectomy. This is the first time that pneumonectomy has been included in the risk adjustment. The survival after pneumonectomy is lower than for other resections, reflecting patients with larger or more central tumours which can only be cured with these major operations. The effect of this change is for risk-adjusted survival to appear slightly more favourable in trusts with a higher than average number of pneumonectomies. By 1 year after surgery, 5,927 patients – 88.7% of all patients undergoing resection – were still alive (Fig 9). All units were within the expected range, and no units were identified as either positive (good practice) or negative outliers.

[†] Forced expiratory volume in 1 second

Fig 9 Adjusted 1-year survival by trust

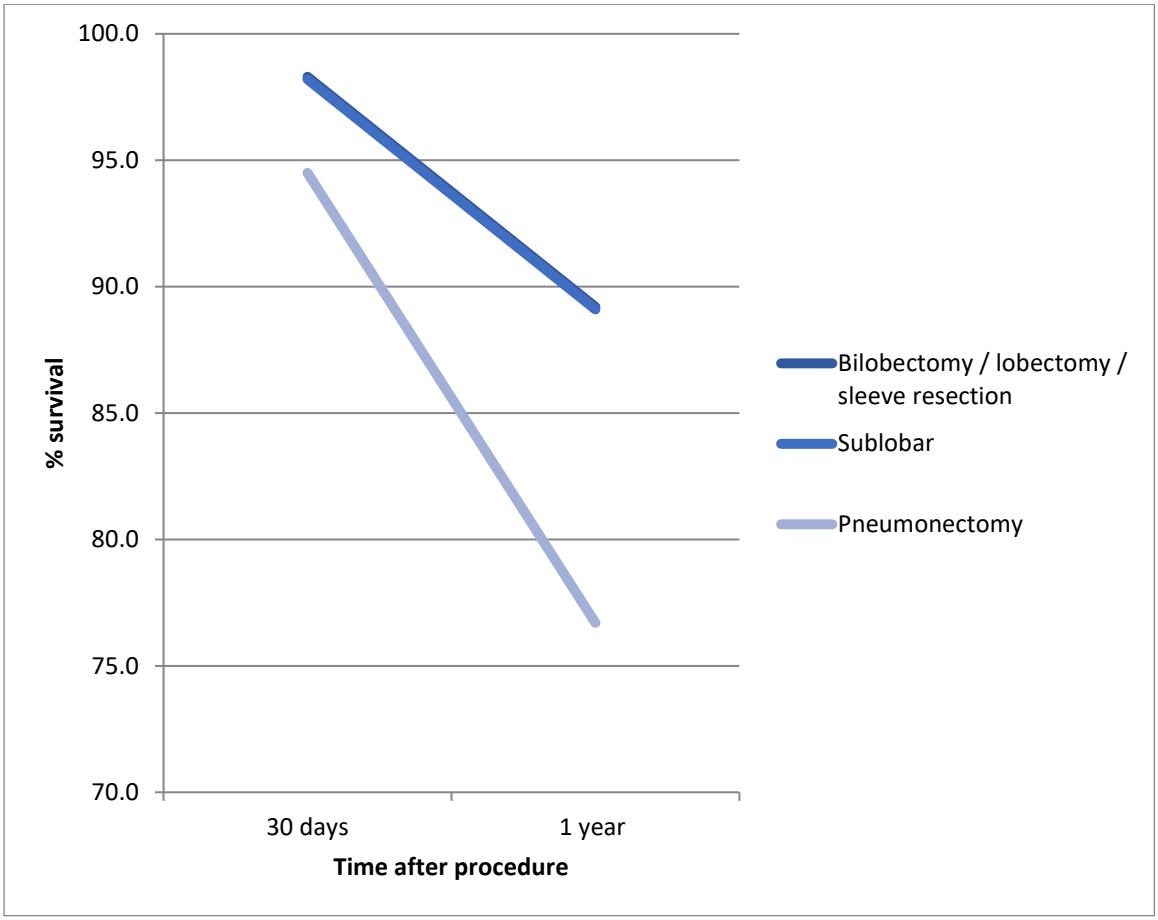


Survival after specific surgical procedures

The procedure performed has an impact on survival, with lower survival seen after pneumonectomy compared with lobectomy or bilobectomy operations at 30 days (95.5% vs 98.3%) and 1 year (76.7% vs 89.2%). Although unadjusted for other factors such as tumour stage, these data seem to support current NICE guidance that pneumonectomy should be reserved for cases where a lobectomy is not possible.[‡] Pneumonectomy in modern practice is an uncommon operation, making up only 3.5% of all operations in 2017.

[‡] www.nice.org.uk/guidance/ng122

Fig 10 Survival at 30 days and 1 year by procedure performed



Note: the survival for bilbectomy / lobectomy / sleeve resection (30 days, 98.3%; 1 year, 89.2%) and sublobar (30 days, 98.2%; 1 year, 89.1%) resections are similar and the lines overlap on the above graph.

This year, 90-day survival has not been reported. It was originally included in LCCOP as a longer-term outcome, but was superceded by the addition of 1-year results in the 2017 report. Odds ratios for 30- and 90-day survival were highly correlated (Pearson correlation coefficient 0.65 in LCCOP 2018), and being an outlier in one but not the other was uncommon. It was felt to add little additional information to the 30 day metric, and it has therefore been decided to remove the 90 day metric this year.

Resection rates

Resection rates are calculated for surgical trusts by dividing the number of patients undergoing resection by the total number of patients diagnosed in all the MDTs served by that surgical unit. A small number of MDTs are served by two surgical trusts. Since the number of cases operated for these MDTs in their two surgical providers is known, their activity is divided between the two surgical trusts in the same proportion as the resected patients.

The overall resection rate is influenced by factors, including the stage distribution of disease referred to a unit, which are not related to the quality of the surgical care provided. We have therefore added a new metric this year; the resection rate in early-stage patients (I or II) of good PS (defined as World Health Organization (WHO) 0–2). Although there is an accepted role for surgery outside this grouping (for example in multimodality treatment of stage IIIA disease),

NICE guidance recommends surgery as first-line treatment in fit patients with early-stage disease. These more specific resection rates may better represent the quality of surgical care than the overall rate. The results are shown below in Figs 11–13.

Stereotactic radiotherapy (SABR) is an alternative form of radical treatment for patients who are unfit for lobectomy. NICE recommends consideration of both sublobar lung resection and SABR in these patients. Combined radical treatment rates, including both surgical and radiotherapy treatments, are published by trust first seen in the information sheet for the NLCA 2018 annual report.

It is important to note that three surgical units (shown in yellow in Figs 11–13) serve what the NLCA define as 'tertiary' MDTs.[§] These are lung cancer teams that have unusual, non-geographical referral patterns. The resection rates calculated for these units are not robust and should not be directly compared with others. The stage I/II, PS 0–2 resection rate for one of these units, the Royal Papworth, is greater than 100%, which illustrates this problem. In part, this inaccuracy is due to coding of operations by the date they were performed, while the total number of cancers diagnosed are reported by the date of diagnosis, creating slight inaccuracies. Nevertheless, we feel that resection rate data is important and useful in understanding the service provided by surgical trusts.

Overall resection rates range from 13.0–30.4% between surgical trusts, a two-fold difference. Stage I–II, PS 0–2 rates (omitting tertiary trusts) range from 50.5–92.7%. This large variation is unexplained and should prompt individual units to look carefully at their process of selection for surgery. The quality of local preoperative assessment, access to surgery and adherence to recognised best practices may be responsible for this variation.

Increasing the resection rate in fit, early-stage lung cancer patients should be a priority for quality improvement in lung cancer surgery. Early-stage patients who undergo surgery enjoy better outcomes than those who do not,[**] and mortality after surgery is low. If the stage I/II PS 0–2 resection rates achieved in the top 25% of surgical trusts were delivered to all patients, an additional 1,036 patients would have surgery every year.[††] Section 6 'Highlighting best practice' includes a case study from Oxford University Hospitals NHS Foundation Trust, which has achieved consistently high resection rates during the period that LCCOP have been reporting them (as well as high survival).

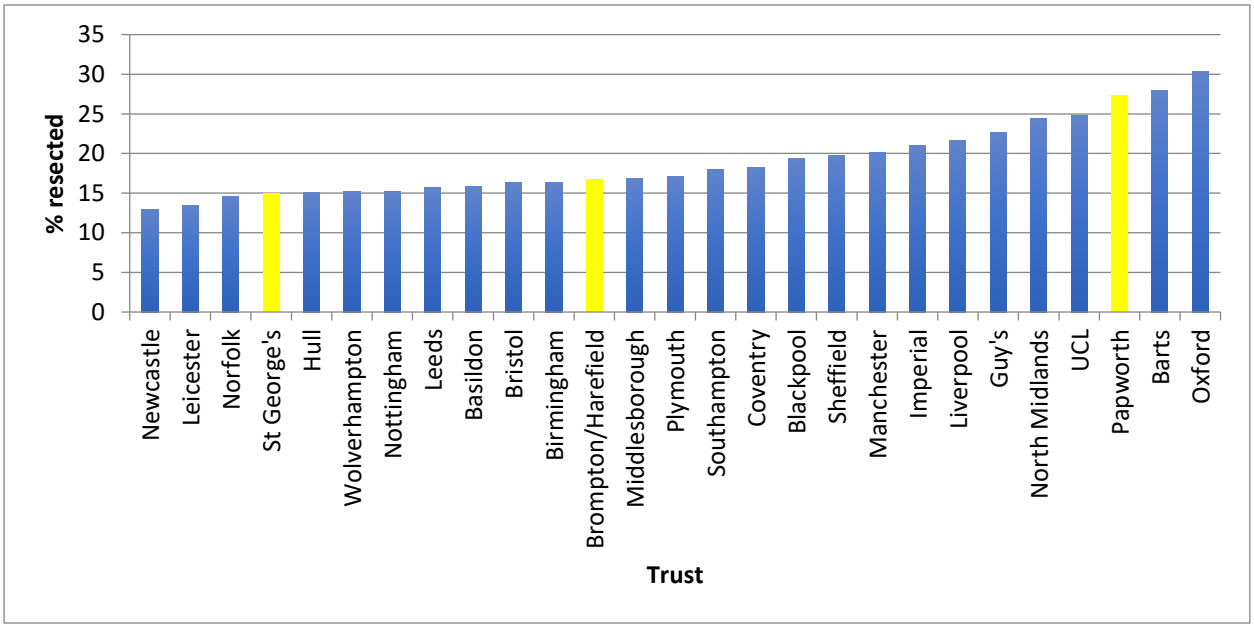
[§] In all resection rate charts, the surgical trusts serving 'tertiary' MDTs, whose resection rates are hard to calculate reliably, are shown in yellow.

[**] Riaz SP, Luchtenborg M, Jack RH. Population-based study in England 2004–2006. *Eur J Cancer* 2012;48(1):54–60.

[††] Based on a resection rate in the six highest resecting units of 78.4%. Excluding surgical trusts serving 'tertiary' MDTs.

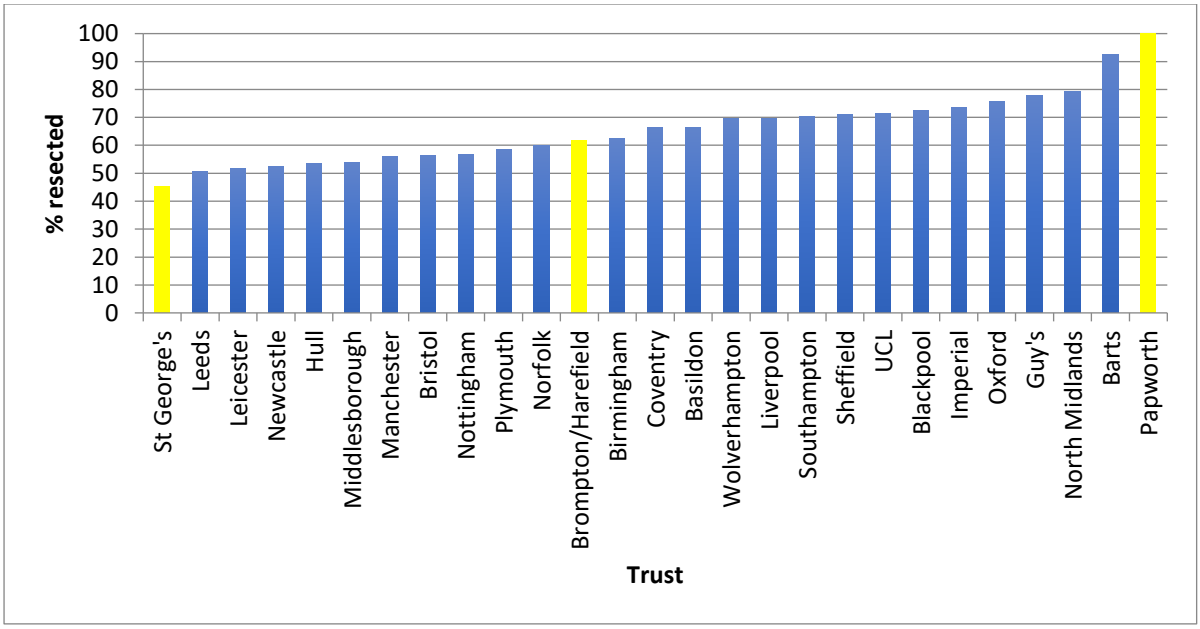
The overall and the stage I/II PS 0–2 specific resection rates are highly correlated (correlation coefficient 0.81) in this year's data.

Fig 11 Overall resection rate in 2017 by surgical trust



Note: Trusts shown in yellow serve tertiary MDTs where resection rates are difficult to calculate. Results should not be directly compared with others.

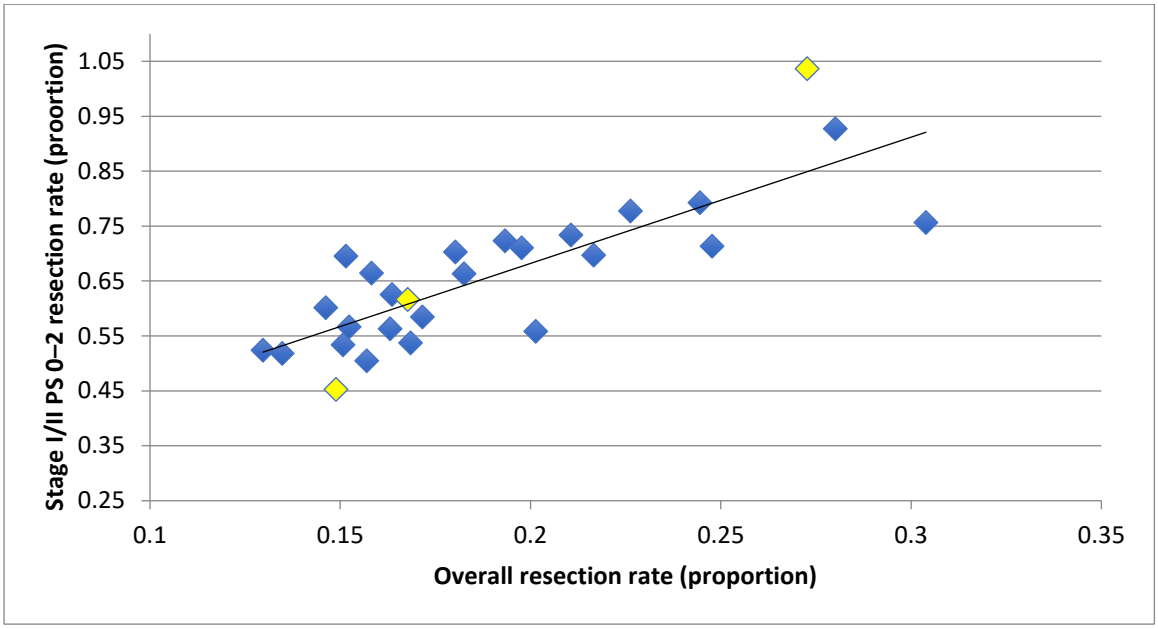
Fig 12 Stage I/II, WHO PS 0–2 specific resection rate by surgical trust



Note: Trusts shown in yellow serve tertiary MDTs where resection rates are difficult to calculate. Results should not be directly compared with others.

PS = performance status; WHO = World Health Organization

Fig 13 Overall vs PS 0–2 stage 1–2 specific trust resection rates

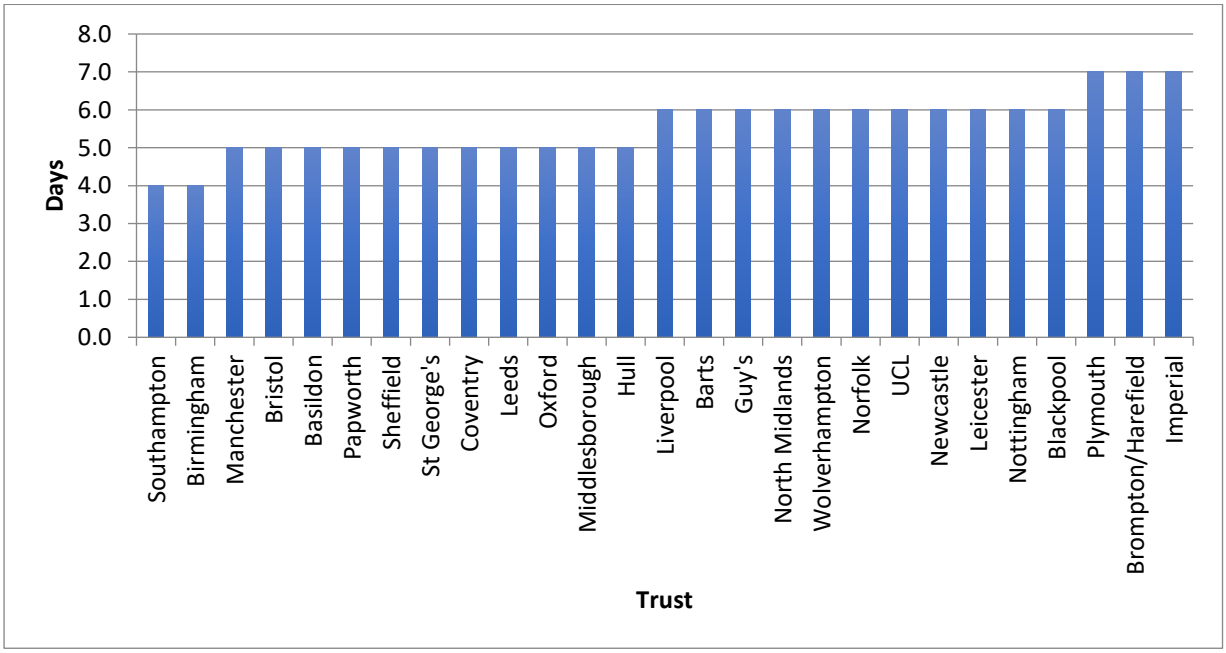


Note: Trusts shown in yellow serve tertiary MDTs where resection rates are difficult to calculate. Results should not be directly compared with others.
PS = performance status

Length of stay

The median length of stay after lung cancer resection was 6 days (IQR 4–8). Length of stay has remained static, but the variation between trusts has reduced slightly, with the highest quartile falling from 9 to 8 days since 2015.

Fig 14 Median length of stay in 2017 by trust



Readmission rates

Last year we reported readmission rates after surgery, and showed that 42% of patients were readmitted within 90 days. This year, a similar 41% were readmitted within 90 days of surgery. These admissions include elective or acute admission to any NHS England hospital for any cause.

The majority of these readmissions both nationally and by trust are short. Although trust mean lengths of stay after readmission range from 2.7 to 7.4 days, the data is widely spread (standard deviations 2.7–18 days), short readmissions predominate. Median lengths of stay for trusts vary from just 0 to 1 days.

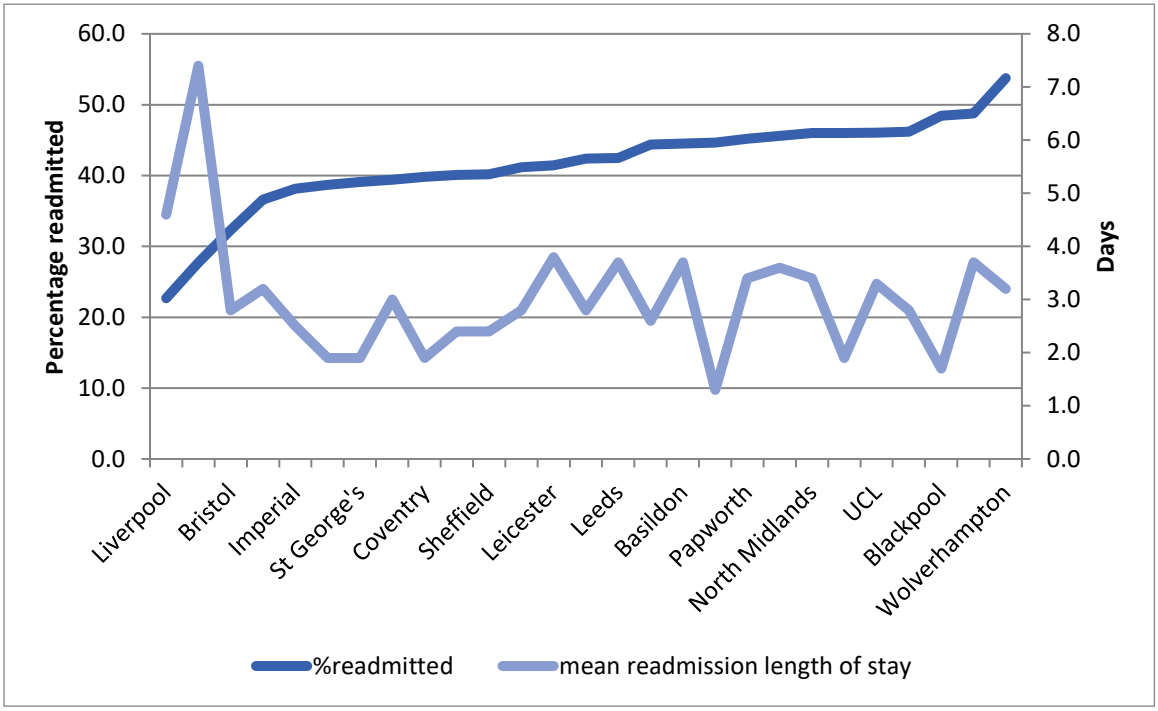
These admissions will include not only management of complications but also further planned cancer care – for example chemotherapy appointments – and emergency and elective management of comorbidities.

There is variation between trusts, with 90-day readmission rates ranging from 22.7–53.8% (Fig 15).

We have seen no evidence that trusts with short lengths of stay suffer higher readmission rates. There is no significant correlation between trust median length of stay and their rate of readmission at 90 days (correlation coefficient 0.07).

In summary, although we have seen high readmission rates after lung cancer surgery, the causes for these readmissions are not yet fully understood. The chance of readmission is probably of interest to patients and stakeholders and so we have reported it, but we are not confident that it can be used to assess the quality of surgery. Other factors may be more important. Some units have been auditing readmissions locally to understand this better.

Fig 15 90-day readmission after lung cancer resection for all causes in 2017, by trust



'Readmission length of stay' means the number of days spent in hospital following first readmission within 90 days from the date of lung resection.

6. Highlighting best practice

The thoracic team at Oxford University Hospitals NHS Foundation Trust have achieved high resection and survival rates. Consultant thoracic surgeon Elizabeth Belcher reflects on how they have achieved this.

Oxford has a consistently high resection rate year on year. By offering a greater proportion of lung cancer patients the option of surgical treatment, long-term survival rates can be improved. The Oxford Surgical Pathway aims to support early-stage lung cancer patients to maximise their chances of receiving operative treatment. Each part of the pathway is subject to a multidisciplinary approach where team members focus on surgery as the optimal radical treatment of choice.

Oxford offers the complete range of radical treatments for early-stage lung cancer; however, there is a presumption of surgery for all early-stage patients. Two thoracic surgeons attend our MDT in person, providing an internal second surgical opinion. This approach maximises surgical opportunities for borderline operable patients. We invite all potentially operable patients to attend a surgical clinic, so that they can be informed first-hand of the potential benefits of surgery in relation to other radical treatments.

Undergoing thoracic surgery for cancer can be a daunting and emotional time for patients and their families. Consequently, patients may avoid activities that can trigger breathlessness which can lead to deconditioning and a greater risk of developing postoperative complications. Oxford's MacMillan-funded 'Survivorship in Early Lung Cancer' programme or 'SOLACE' aims to provide assistance with the physical, psychological and social aspects of surviving cancer. It offers pre-habilitation to maximise the proportion of patients who are considered fit for surgery, despite their comorbid conditions, and to enhance functional capacity prior to operation. Twice weekly 'Therapy Gym' classes last for 60 minutes. The postoperative component of the programme also aims to assist long-term recovery and survival. MacMillan intervention levels are used to quantify the level of involvement chosen by patients.

The course includes:

- an individual assessment before the course and an individualised training programme
- advice on thoracic surgery and recovery for cancer
- signposting to other services
- a chance to meet others who have been through or are going through a similar pathway
- an individual assessment after the course to evaluate change in physical status and quality of life.

The majority of patients undergoing resection of early-stage lung cancer will be cured; however, a significant minority will develop recurrence or new primary lung tumour. Oxford has delivered a 'Virtual computed tomography (CT) lung cancer follow-up' programme for patients following lung cancer resection. Patients have a single point of contact for 5 years, via our advanced nurse specialist, and are able to receive results through our virtual clinic, avoiding unnecessary and costly trips to the hospital. Oxford's CT follow-up programme patients, who do develop recurrence or new lung cancer, are radically treatable in the majority of cases.

7. Document purpose

Document purpose	To disseminate results on the outcomes of lung cancer surgery for patients who had operations between 1 January and 31 December 2017.
Title	Lung cancer clinical outcomes publication 2019 (for the 2017 audit period).
Author	Royal College of Physicians, Care Quality Improvement Department.
Publication date	January 2020.
Target audience	NHS staff in lung cancer multidisciplinary teams; hospital managers and chief executives; commissioners; lung cancer researchers; lung cancer patients, their families and their carers.
Description	This is the sixth lung cancer clinical outcomes publication on individual activity of surgeons or their specific contribution to lung care. The data relate to patients diagnosed with lung cancer (excluding small-cell cancers) who underwent surgery during the period between 1 January and 31 December 2017.
Related publications	National Lung Cancer Audit annual reports: www.rcplondon.ac.uk/NLCA
Contact	nlca@rcplondon.ac.uk

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