

## AUDIT UPDATE

## Population-based trends in use of surgery for non-small cell lung cancer in a UK region, 1995–2006

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**ABSTRACT**

**Objective** To assess time trends in use of surgery in patients with non-small cell lung cancer (NSCLC) in a UK region.

**Methods** Cancer registration data for patients diagnosed with NSCLC between 1995 and 2006 in the East of England were analysed. Rates of surgery use for different age, gender, diagnosis period, tumour subtype and deprivation quintile groups were examined.

**Results** The analysis included 18 767 patients with NSCLC. During the study period, 13% of patients were treated by surgery. Use of surgery decreased over time from 15% in 1995–1997 to 11% in 2004–2006 ( $p=0.022$ ). Initial socioeconomic differences in surgery use narrowed significantly over time ( $p=0.028$ ) and became non-apparent at the end of the study period.

**Conclusions** Use of surgery in patients with NSCLC decreased during the study period, possibly reflecting increasing quality of preoperative staging processes. Initial socioeconomic inequalities in surgery use became undetectable at the end of the study period. The findings provide baseline information to support comparisons with patterns of clinical management in more recent years.

**INTRODUCTION**

Variation in use of surgery for patients with non-small cell lung cancer (NSCLC) is of particular interest because, among suitable patients, surgery remains the only treatment modality that could result in cure. The proportion of patients with NSCLC who are treated by surgery is lower in the UK compared with other countries (online supplement 1), possibly because of relatively more advanced stage at diagnosis.<sup>1</sup>

Cancer services in the UK have since the late 1990s benefited from substantial investment and national quality improvement policy initiatives, such as the National Health Service (NHS) Cancer Plan (2000) and the establishment of multidisciplinary team working. A national lung cancer clinical audit initiative (LUCADA) was established to support reliable data collection and quality improvement in 2005, but there is limited evidence about population-based trends in surgical management in earlier periods.

**METHODS****Data**

We examined surgery use in East of England patients diagnosed with NSCLC during 1995–2006. Anonymous data were obtained from the Eastern

Cancer Registration and Information Centre (ECRIC), a population-based cancer registry covering a general population of ~5.6 million, for patients registered with ICD-10 (International Classification of Diseases-10th Revision) code C34. We restricted analysis to patients with NSCLC tumours defined using relevant ICD-oncology codes (online supplement 2-a). Patient socioeconomic status was assigned using the Index of Multiple Deprivation 2004 deprivation score of Lower Super Output Area of residence to define quintile groups (1, most affluent; 5, most deprived). Treatment information was abstracted from clinical records by trained registry staff. Lung cancer surgery was defined as surgery aimed at removing malignant lung tumours, excluding diagnostic procedures or other organ surgery, using suitable Office for Population and Censuses and Surveys, 4th Revision (OPCS-4) classification codes (online supplement 2-b).

**Analysis**

Using univariable and multivariable logistic regression, associations were examined between surgery use and gender, age group (<60, 60–69, 70–79 and ≥80); 3-year diagnosis period (1995–1997, 1998–2000, 2001–2003 and 2004–2006); NSCLC subtype; and deprivation quintile group. Reported  $p$  values relate to multivariable analysis, unless otherwise stated.

**RESULTS**

There were 18 813 patients with NSCLC, representing 51% of all (36 742) patients with lung cancer of any tumour type during the 12-year study period; 12% of all lung cancer patients had small cell carcinoma, 36% had unspecified lung cancer and 1% had other lung cancer types (online supplement 2-a). The characteristics of patients with NSCLC are presented in table 1. The mean age of NSCLC patients increased slightly from 69.1 in 1995–1997 to 69.9 in 2004–2006. Surgery was used for 13% of all NSCLC patients, with the mean age of patients treated by surgery increasing from 65.7 in 1995–1997 to 66.7 in 2004–2006.

Surgery use decreased notably during the study, from 15% in 1995–1997 to 11% in 2004–2006,  $p=0.022$  (table 1). Use of surgery was significantly less frequent among older patients (17, 17, 12 and 3% for patients aged <60, 60–69, 70–79 and ≥80, respectively) and in patients with unspecified NSCLC type (ie, 7%, compared with 13% for squamous cell and 16% for adenocarcinoma patients).

**Table 1** Patient characteristics and associations between patient and tumour characteristics and surgery use in patients with non-small cell lung cancer, 1995–2006

	All patients	Patients treated by surgery	% treated with surgery	Unadjusted OR	Lower 95% CI	Upper 95% CI	p Value	Adjusted OR	Lower 95% CI	Upper 95% CI	p Value
All patients	18 813	2374	12.6%	—	—	—	—	—	—	—	—
Men	12 308	1567	12.7%	—	—	—	—	—	—	—	—
Women	6505	807	12.4%	0.97	0.89	1.06	0.522	0.95	0.86	1.04	0.249
Age group linear trend*	—	—	—	<i>0.66</i>	<i>0.63</i>	<i>0.69</i>	<0.001	<i>0.66</i>	<i>0.63</i>	<i>0.69</i>	<0.001
<60	3165	530	16.8%	—	—	—	—	—	—	—	—
60–69	5215	875	16.8%	1.00	0.89	1.13	—	1.00	0.89	1.13	—
70–79	7486	882	11.8%	0.66	0.59	0.75	—	0.66	0.59	0.75	—
≥80	2947	87	3.0%	0.15	0.12	0.19	—	0.15	0.12	0.19	—
Diagnosis period linear trend*	—	—	—	<i>0.91</i>	<i>0.88</i>	<i>0.95</i>	<0.001	<i>0.95</i>	<i>0.92</i>	<i>0.99</i>	0.022
1995–1997	4461	647	14.5%	—	—	—	—	—	—	—	—
1998–2000	4629	574	12.4%	0.83	0.74	0.94	—	0.87	0.77	0.98	—
2001–2003	4847	617	12.7%	0.86	0.76	0.97	—	0.95	0.85	1.08	—
2004–2006	4876	536	11.0%	0.73	0.64	0.82	—	0.85	0.75	0.97	—
Other non-small cell	3698	252	6.8%	—	—	—	—	—	—	—	—
Adenocarcinoma	5490	896	16.3%	2.67	2.30	3.09	<0.001	2.58	2.23	3.00	<0.001
Squamous cell	9625	1226	12.7%	2.00	1.73	2.30	<0.001	2.08	1.80	2.41	<0.001
Deprivation linear trend*	—	—	—	<i>0.95</i>	<i>0.92</i>	<i>0.99</i>	0.009	<i>0.96</i>	<i>0.93</i>	<i>0.99</i>	0.018
Most affluent	3531	480	13.6%	—	—	—	—	—	—	—	—
2	4256	540	12.7%	0.92	0.81	1.05	—	0.95	0.83	1.09	—
3	4829	619	12.8%	0.93	0.82	1.06	—	0.95	0.83	1.08	—
4	4384	537	12.3%	0.89	0.78	1.01	—	0.90	0.79	1.03	—
Most deprived	1813	198	10.9%	0.78	0.65	0.93	—	0.78	0.65	0.94	—

\*Entered as a continuous variable.

OR: Odds Ratio CI: Confidence Interval

Italics denote such 'test for linear trend' variables.

Higher deprivation was associated with lower probability of surgery use (OR=0.96 when moving from one deprivation group to the one immediately more deprived,  $p=0.018$ ). This inequality, however, mainly related to earlier study years, and narrowed over time, reflecting decreasing surgery use among more affluent patients in particular (online supplement 3-a). Further, there was a significant interaction between deprivation group and diagnosis period (OR=1.04,  $p=0.028$ ), indicating significant narrowing in inequality over time.

### Sensitivity analysis

We examined the proportion of lung surgery performed for other lung cancer types (online supplement 3-b) particularly for the substantial proportion of patients with 'unspecified' lung cancer. Only 66 of 13 161 patients (0.5%) with 'unspecified' lung cancer were treated by surgery. This means that even if all patients in the 'unspecified' lung cancer group did have NSCLC tumours, the observed decreasing time trends in use of surgery would not have been altered substantially.

### DISCUSSION

The cardinal and perhaps surprising finding is that use of surgery decreased notably during the study. These findings agree with evidence from the USA and Ireland.<sup>2–3</sup> A substantial decrease in surgery use between 1992 and 2002 among NSCLC Medicare patients has been reported previously,<sup>2</sup> potentially reflecting either an increasing proportion of NSCLC patients with severe obstructive lung disease or increasing difficulties in accessing specialist care.<sup>2</sup> In the context of our study, both of these hypotheses are unlikely explanations for the observed temporal trends in surgery use. First, if co-morbidity was increasing over time this could have been expected to affect more deprived patients predominantly. Instead, we observed a decrease over time in the use of surgery in

the more affluent groups. Secondly, access to specialist management has increased during the study because of national policy initiatives. We therefore believe that the observed reduction in surgery use most probably reflects improved patient selection because of better staging, by endoscopic ultrasound, and/or CT and functional imaging (PET) scanning.<sup>4</sup> Similar decreasing trends in surgery use have been reported for upper gastrointestinal cancers.<sup>5</sup> The proportion of patients with 'unspecified' lung cancer who were treated by surgery was very small and could not explain the observed decrease in use of surgery.

Initial socioeconomic inequalities in surgery use became non-apparent later on in the study. Use of surgery decreased with increasing age. This possibly reflects increasing levels of co-morbidity among older age patients although age per se is poorly associated with co-morbidity or performance status (online supplement 4, <sup>1 2</sup>). Surgery can improve survival in older patients with NSCLC (online supplement 4, <sup>3</sup>). Interpretation of the appropriateness of resection rates in the elderly is difficult, but the findings could inform further monitoring and substantiate comparisons about the use of surgery in elderly patients with NSCLC in other populations.

In conclusion, during 1995–2006, there was decreasing use of surgery in patients with NSCLC in an English region. The reason for this decrease cannot be stated with certainty but may reflect the wider availability of better quality preoperative staging information. Further and ongoing surveillance of trends in surgical management of patients with NSCLC in the UK is required.

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