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Are working practices of lung cancer nurse specialists associated with variation in peoples' receipt of anticancer therapy?

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ABSTRACT

Objectives: Treatment choices for people with lung cancer may be influenced by contact and engagement with lung cancer nurse specialists (LCNSs). We investigated how service factors, LCNS workload, and LCNS working practices may influence the receipt of anticancer treatment.

Materials and methods: English National Lung Cancer Audit data and inpatient Hospital Episode Statistics for 109,079 people with lung cancer surviving 30 days from diagnosis were linked along with LCNS workforce census data and a bespoke nationwide LCNS survey. Multinomial logistic regression was used to determine adjusted relative risk ratios (RRRs) for receipt of anticancer therapies associated with LCNS assessment, LCNS workforce composition, caseload, LCNS reported working practices, treatment facilities at the patients' attending hospitals, and the size of the lung cancer service.

Results: Assessment by an LCNS was the strongest independent predictor for receipt of anticancer therapy, with early LCNS assessments being particularly associated with greater receipt of surgery (RRR 1.85, 95%CI 1.63–2.11). For people we considered clinically suitable for surgery, receipt was 55%. Large LCNS caseloads were associated with decreased receipt of surgery among suitable patients (RRR 0.71, 95%CI 0.51–0.97) for caseloads > 250 compared to ≤150. Reported LCNS working practices were associated with receipt of surgery, particularly provision of psychological support (RRR 1.60, 95%CI 1.02–2.51) and social support (RRR 1.56, 95%CI 1.07–2.28).

Conclusion: LCNS assessment, workload, and working practices are associated with the likelihood of patients receiving anticancer therapy. Enabling and supporting LCNSs to undertake key case management interventions offers an opportunity to improve treatment uptake and reduce the apparent gap in receipt of surgery for those suitable.

1. Introduction

A diagnosis of lung cancer is often associated with a poor prognosis because of its frequent identification at an advanced disease stage and the rapid decline in performance status; as such it has the highest mortality of all cancers [1,2]. Improvement in survival in the UK has been greater than in other high-income countries globally [3], although relative survival is reported to be lower than in other parts of Europe [4].

Increased uptake of treatment is crucial to drive improvements in lung cancer survival. The 2016 National Lung Cancer Audit (NLCA) reported improvements in the proportions of people with non-small-cell lung cancer (NSCLC) undergoing surgery and those with small-cell lung cancer (SCLC) receiving chemotherapy compared with those in previous years, but concluded that there was an unexplained variation in surgical resection rates; the majority of hospital providers did not meet a 60% target for the proportion of people receiving anticancer treatment (in the form of surgery, chemotherapy or radiotherapy) [5].

Previous studies have identified specific hospital-provider and patient factors associated with inequalities in access and uptake of lung cancer treatment across England [6–10], with similar characteristics shown to have an influence internationally [11]. We have previously

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shown that such factors are also associated with a patient's likelihood of assessment by a lung cancer nurse specialist (LCNS) [12]. Guidelines from the National Institute for Health and Care Excellence (NICE) recommend that patients have direct access to an LCNS for support throughout the cancer pathway [13]; NLCA annual reports show improvement over time in the proportion of patients seen by a nurse specialist, although recommended targets are not always met [14,15]. LCNSs have a crucial role in an individual's cancer journey as experienced professionals who case manage care, meet information needs, manage symptom control issues, support patients and families in decision-making and readiness for treatment, and advocate patient wishes within multidisciplinary settings [16,17]. However, whether these working practices are directly linked with treatment uptake has not been assessed.

To understand how contact with an LCNS may influence a person's decision for anticancer therapy, we assessed whether factors affecting LCNS workload are associated with receipt in an English lung cancer population and, in particular, those who could be expected to undergo surgical resection.

2. Materials and methods

NLCA data capturing cases of lung cancer diagnosed at hospital providers across the UK were linked with the 2011 National Cancer Action Team (NCAT) census of specialist cancer nurse workforces in England by hospital provider (National Health Service trust) code [18], and hospital episode statistics (HES) inpatient data according to NHS number provided the official record of admission episodes to NHS hospital trusts. We included NLCA patients from 146 English hospital providers who were first seen between January 2007 and December 2011 at a service with NCAT workforce data verified by regional cancer network (Appendix A). People diagnosed through death certificates only and those with mesothelioma or carcinoid were not included. We also excluded people who died within 30 days of their diagnosis as it is likely they were at a very advanced stage upon diagnosis and therefore did not have an opportunity to commence anticancer therapy or be assessed by an LCNS.

A combination of the NLCA and HES—where dates of surgery, chemotherapy and radiotherapy are recorded [19]—was used to assign people to one of four exclusive categories: surgery with or without chemotherapy or radiotherapy, chemotherapy with or without radiotherapy, radiotherapy alone, or no anticancer therapies. All chemotherapy and radiotherapy treatments were then combined for subgroup analysis. Whether radiotherapy was of curative or palliative intent was not distinguished because detail to definitively determine this was not available.

NLCA and HES data classified specialist anticancer treatment facilities available at each hospital provider: thoracic surgery facilities (surgical), chemotherapy available without surgery (chemotherapy), or neither treatment option onsite (no specialty). A hospital provider with a specialty in chemotherapy was defined by at least 75% of patients receiving an anticancer drug at a service where they were also first seen, as previously described by Powell et al. [8]. NLCA data were used to determine the annual number of new lung cancer patients seen by a service in each year of the study, with an average providing a measure of service size.

Using NCAT national census information on salary bands, we categorized the composition of LCNS workforces as Band 7 only, Bands 6–7 or Band 8 included. Each hospital provider's LCNS caseload was calculated as the total number of patients first seen there divided between the LCNS whole-time equivalent (WTE) workforce, assuming people followed the lung cancer pathway at that same site [12]. Evidence about whether the patient was assessed by an LCNS was obtained from NLCA data, as was the timing of assessment relative to diagnosis. Where no information was entered, patients were separately categorized as missing and were included in the analyses.

3. Statistical analysis

There were three or more possibilities for the receipt of treatment. We performed multinomial logistic regression using Stata (SE15) to calculate the relative risk ratio (RRR) of receipt of specified therapies relative to a base group of no anticancer therapy. The RRR is sometimes interpreted as a conditional odds ratio or called a multinomial odds ratio. Cluster robust standard errors were derived to calculate confidence intervals for RRRs using regional cancer networks to account for hierarchical groupings of observations. Exposure variables were individual patient-recorded LCNS assessment and its timing, salary band composition of the LCNS workforce, the average LCNS caseload at the service, treatment facilities available, and the annual service size. Univariate analyses were performed, and models were mutually adjusted for exposures as well as patient co-morbidity defined using HES IP ICD-10 codes [20], age at diagnosis, sex, socioeconomic quintile (based on income deprivation domain for the national population), performance status, and cancer stage as recorded in the NLCA.

As receipt of treatment is influenced by a number of factors that we were unable to control for, we conducted a subgroup analysis restricted to people who we deemed were suitable for surgery based on clinical guidelines and author expertise (RBH, PB) and the clinical data available to us. Suitability for surgery was defined as a recorded performance status of 0–1 (World Health Organization, WHO) and NSCLC stages I, II, IIIA (Union for International Cancer Control versions 6 and 7) [20].

For people who were suitable for surgery, receipt of therapy was also assessed according to LCNS-reported experiences of working practice by using responses from a bespoke e-survey disseminated to all LCNSs in the UK's National Lung Cancer Forum for Nurses (NLCFN) (Appendix B). A total of 230 survey responses from 105 hospital providers were collected; the response rate was estimated to be 76% of WTE LCNS positions in England [21], with a completion rate for questions presented here ranging from 83% to 100%. Responses were linked to the combined dataset based on the NHS trust code where the LCNS worked. Routine provision of key LCNS interventions was defined as offered to more than 70% of patients along the clinical pathway from pre-diagnosis up to and including the point of treatment. As the role of the LCNS can vary widely, affirmative responses were aggregated according to hospital provider to present the perspective of at least one LCNS and an indication of key interventions available to the patient population served.

4. Results

A total of 109,079 patients in our study population were diagnosed with lung cancer between 2007 and 2011 and survived 30 days; of these, 31.8% did not receive anticancer therapy, 33.9% received chemotherapy, 18.3% received radiotherapy, and 16.1% received surgery (Table 1).

4.1. LCNS workforce factors

Assessment by an LCNS was associated with increased RRR in receipt of each therapy group compared to not being assessed (surgery RRR 1.98, chemotherapy RRR 2.18, radiotherapy RRR 1.84 after adjustments). LCNS assessment before/at diagnosis also resulted in an increased RRR in each therapy group compared to assessment after diagnosis, particularly for surgery (RRR 1.85 95%CI 1.63–2.11). Where workforces included a Band-8 LCNS, there was an associated 27% reduction in RRR for receipt of chemotherapy (RRR 0.73, 95%CI 0.54–0.97), whilst average caseloads of > 250 patients per LCNS were associated with a 26% increase in the RRR for receipt of radiotherapy (RRR 1.26, 95%CI 1.00–1.59).

Table 1
Lung cancer nurse specialist (LCNS) workload factors and their associations with receipt of anticancer therapy.

	Total		No therapy	Receipt of surgery			Receipt of chemotherapy			Receipt of radiotherapy		
	n = 109,079		n = 34,729	n = 17,459			n = 36,951			n = 19,940		
	Freq	%	%	%	RRR[a]	(95% CI)	%	RRR[a]	(95% CI)	%	RRR[a]	(95% CI)
Assessed by LCNS												
No	4,730	*4.3*	*8.0*	*3.3*	1		*2.0*	1		*3.3*	1	
Yes	70,904	*65.0*	*57.3*	*65.4*	1.98	(1.11–3.53)	*70.7*	2.18	(1.24–3.82)	*68.9*	1.84	(1.17–2.87)
Missing	33,445	*30.7*	*36.0*	*31.3*	1.73	(1.32–2.26)	*27.3*	2.14	(1.67–2.75)	*27.8*	1.72	(1.41–2.10)
First LCNS assessment												
After diagnosis	30,578	*28.0*	*28.4*	*20.2*	1		*30.1*	1		*31.1*	1	
Before/at diagnosis	36,995	*33.9*	*25.7*	*41.5*	1.85	(1.63–2.11)	*37.8*	1.27	(1.14–1.42)	*34.9*	1.16	(1.05–1.28)
Missing	41,506	*38.1*	*47.2*	*38.3*	1.41	(0.93–2.14)	*32.1*	0.74	(0.52–1.07)	*34.0*	0.81	(0.56–1.18)
LCNS workforce												
Band 7 only	47,244	*43.3*	*43.7*	*44.0*	1		*44.4*	1		*40.9*	1	
Bands 6–7	46,677	*42.8*	*42.7*	*41.6*	0.94	(0.76–1.16)	*42.5*	0.97	(0.78–1.20)	*45.5*	1.15	(0.97–1.35)
Band 8 included	15,158	*13.9*	*14.9*	*14.4*	0.81	(0.57–1.14)	*13.0*	0.73	(0.54–0.97)	*13.7*	0.96	(0.73–1.25)
Total LCNS caseload												
≤150 patients	22,673	*20.8*	*21.7*	*21.1*	1		*20.9*	1		*37.3*	1	
151–250	61,218	*56.1*	*56.4*	*56.3*	0.97	(0.82–1.14)	*56.8*	1.08	(0.87–1.33)	*96.9*	1.09	(0.91–1.30)
> 250	25,188	*23.1*	*23.2*	*22.5*	0.96	(0.73–1.25)	*22.2*	1.00	(0.78–1.28)	*40.0*	1.26	(1.00–1.59)
Treatment facilities												
No specialty	27,499	*25.2*	*29.4*	*23.7*	1		*22.8*	1		*24.3*	1	
Surgical	29,646	*27.2*	*24.0*	*31.9*	1.80	(1.42–2.28)	*28.4*	1.81	(1.45–2.26)	*26.8*	1.47	(1.20–1.80)
Chemotherapy	51,934	*47.6*	*47.8*	*44.4*	1.22	(0.95–1.56)	*48.8*	1.39	(1.10–1.75)	*48.9*	1.27	(1.05–1.53)
Annual service size												
< 175 new LC patients	39,797	*36.5*	*37.5*	*37.6*	1		*36.7*	1		*34.1*	1	
175–264	32,959	*30.2*	*30.5*	*28.4*	0.83	(0.63–1.09)	*29.8*	0.87	(0.67–1.15)	*32.8*	1.05	(0.89–1.24)
≥265	36,323	*33.3*	*33.3*	*34.0*	0.89	(0.73–1.08)	*33.5*	0.95	(0.79–1.15)	*33.1*	1.03	(0.86–1.23)

LC, lung cancer.
[a] Relative risk ratio adjusted for LCNS assessment and timing, workforce banding, average caseload size per LCNS, therapy availability and service size, as well as patient's age, sex, performance status, stage, comorbidity, and socioeconomic deprivation. Clustered by English Regional Cancer Network.

4.2. Hospital-provider factors

Specialist anticancer treatment facilities were associated with greater RRRs for receipt of each therapy group compared to services with no specialty, availability of surgical facilities resulting in the greatest associations (surgery RRR 1.80; chemotherapy RRR 1.81; radiotherapy RRR 1.47 after adjustments). Availability of specialist chemotherapy facilities was associated with a greater RRR for receipt of chemotherapy (RRR 1.39, 95%CI 1.10–1.75) and radiotherapy (RRR 1.27, 95%CI 1.05–1.53), but no association was observed for receipt of surgery. The annual service size was not associated with receipt.

4.3. Clinical suitability for surgical resection

Our subgroup criteria identified 17,213 patients (15.8% of all patients) suitable for surgery based on cancer stage and performance status; 54.7% of people within this subgroup received surgery and 11.1% received no anticancer therapy (Table 2). For those suitable for surgery, timing of LCNS assessment before/at diagnosis was strongly associated with its receipt (RRR 1.68, 95%CI 1.36–2.07). Large LCNS caseloads of > 250 new and surviving patients were associated with lower RRR for receipt of surgery (RRR 0.71, 95%CI 0.51–0.97). Surgical facilities were associated with a 60% increase in RRR compared to no specialty (RRR 1.60, 95%CI 1.22–2.08), whilst services which saw 265 new patients per year were associated with receipt of the alternative therapy option of chemotherapy or radiotherapy (RRR 1.32, 95%CI 1.01–1.71).

The association between LCNS-reported working practices and receipt of treatment was analyzed in 13,588 people who were suitable for surgery, survived 30 days, and were represented by a response to a national LCNS survey (Table 3). Availability of administrative support was not associated with receipt of surgery, nor were provision of proactive management, holistic needs assessment or investigation management. Provision of health promotion was associated with a 29% increase in RRR for surgery (RRR 1.29, 95%CI 1.01–1.65), whilst routine provision of social support was associated with a 56% increase in receipt of surgery (RRR 1.56, 95%CI 1.07–2.28). Where psychological support was routinely offered, there was an associated increase in RRR of receiving surgery (RRR 1.60, 95%CI 1.02–2.51) and the alternative therapy options (RRR 1.44, 95%CI 1.15–1.81). Where LCNS teams reported readiness to challenge any member within the multidisciplinary team, there was an associated increase in the RRR for receipt of the alternative therapy options (RRR 1.44, 95%CI 1.07–1.93), although receipt of surgery did not reach significance (RRR 1.49, 95%CI 0.93–2.39).

5. Discussion

Advanced nursing practice in cancer care offers tremendous advantages through provision of cancer-specific expertise, leadership and continuity across the whole care pathway. Despite their complex skillsets, few data exist to quantify the impact of LCNSs on clinical outcomes, and methods to do so require cautious interpretation. Utilizing a large dataset representative of people with newly diagnosed lung cancer [22], linked to hospital records and survey data, we observed that assessment by an LCNS, assessment before/at diagnosis, and the availability of specialist surgical facilities at a hospital provider were the strongest independent predictors from resource-specific factors for the receipt of anticancer therapy. This observation was particularly true for receipt of surgery. Where the individual may be considered suitable for surgery, caseloads > 250 new and surviving patients per LCNS were associated with reduced likelihood of surgery, whilst provision of key interventions were associated with greater receipt.

Table 2
Lung cancer nurse specialist (LCNS) workload factors and their associations with receipt of anticancer therapy among patients considered suitable for surgery.

	Total		No therapy	Receipt of surgery			Chemotherapy/radiotherapy		
	n = 17,213		n = 1,910	n = 9,417			n = 5,886		
	Freq	%	%	%	RRR[a]	(95% CI)	%	RRR[a]	(95% CI)
Assessed by LCNS									
No	549	*3.2*	*5.5*	*3.4*	1		*2.1*	1	
Yes	13,040	*75.8*	*67.9*	*74.6*	1.74	(0.93–3.26)	*80.1*	1.68	(0.93–3.01)
Missing	3,624	*21.1*	*26.6*	*22.0*	1.20	(0.85–1.96)	*17.8*	1.43	(0.99–2.06)
First LCNS assessment									
After diagnosis	4,500	*26.1*	*27.7*	*22.2*	1		*32.0*	1	
Before/at diagnosis	8,039	*46.7*	*37.2*	*49.3*	1.68	(1.36–2.07)	*45.7*	1.08	(0.91–1.29)
Missing	4,674	*27.2*	*35.0*	*28.6*	1.27	(0.82–1.96)	*22.3*	0.64	(0.41–1.01)
LCNS workforce									
Band 7 only	7,049	*41.0*	*43.9*	*43.6*	1		*41.9*	1	
Bands 6–7	7,377	*42.9*	*40.6*	*42.7*	1.00	(0.82–1.23)	*43.8*	1.12	(0.94–1.34)
Band 8 included	2,427	*14.1*	*15.5*	*13.7*	0.79	(0.54–1.15)	*14.3*	0.93	(0.59–1.48)
Total LCNS caseload									
≤150 patients	3,583	*20.8*	*18.3*	*21.7*	1		*20.2*	1	
151–250	9,747	*56.6*	*57.3*	*56.5*	0.83	(0.66–1.04)	*56.7*	0.92	(0.76–1.10)
> 250	3,883	*22.6*	*24.5*	*21.8*	0.71	(0.51–0.97)	*23.1*	0.86	(0.65–1.16)
Treatment facilities									
No specialty	4,016	*23.3*	*26.8*	*21.9*	1		*24.5*	1	
Surgical	5,241	*30.4*	*24.8*	*32.9*	1.60	(1.22–2.08)	*28.3*	1.27	(0.96–1.68)
Chemotherapy	7,956	*46.2*	*48.4*	*45.2*	1.15	(0.86–1.55)	*47.2*	1.04	(0.84–1.28)
Annual service size									
< 175 new LC patients	5,923	*34.4*	*36.3*	*35.1*	1		*32.8*	1	
175–264	5,202	*30.2*	*32.8*	*28.8*	0.88	(0.71–1.10)	*31.6*	1.00	(0.80–1.27)
≥265	6,088	*35.4*	*30.9*	*36.1*	1.12	(0.90–1.40)	*35.7*	1.32	(1.01–1.71)

LC, lung cancer.
[a] Relative risk ratio adjusted for LCNS assessment and timing, workforce banding, average caseload size per LCNS, therapy availability and service size, as well as patient's age, sex, performance status, stage, comorbidity, and socioeconomic deprivation. Clustered by English Regional Cancer Network.

5.1. Strengths and limitations

Our robust multinomial models are adjusted for patient socio-demographic and disease factors that may be important confounders, as well as organizational factors such as caseload and service specialty. To address immortal time bias, the analysis was restricted to patients surviving 30 days post-diagnosis. To address differences in therapy suitability within a heterogeneous lung cancer population, subgroup criteria were selected according to clinical suitability for surgery.

Linkage to a nationwide LCNS survey adds further insight into LCNS working practices at the level of hospital provider; however, aggregation of responses may not represent the experiences of all LCNSs or their caseloads. Those who did not respond to the survey may suffer greater time pressures.

Table 3
Lung cancer nurse specialist (LCNS) reported working practices and their associations with receipt of anticancer therapy among patients considered suitable for surgery.

	Total		No therapy	Receipt of surgery			Chemotherapy/radiotherapy		
	Freq	%	%	%	RRR[a]	(95%CI)	%	RRR[a]	(95%CI)
Suitable for surgery (n)	17,213		1,910	9,417			5,886		
Patients represented by survey response (n)	13,588		1,393	7,466			4,729		
Administrative support available	6,792	*50.0*	*48.2*	*50.6*	1.10	(0.86–1.39)	*49.5*	1.01	(0.83–1.22)
Patients represented by survey response (n)	13,041		1,337	7,137			4,567		
Proactive management routinely provided	11,059	*84.8*	*83.4*	*84.0*	1.06	(0.79–1.43)	*86.4*	1.21	(0.85–1.72)
Holistic needs assessment routinely provided	11,901	*91.3*	*89.1*	*91.7*	1.27	(0.83–1.95)	*91.3*	1.28	(0.73–2.23)
Health promotion routinely provided	11,733	*90.0*	*87.2*	*90.7*	1.29	(1.01–1.65)	*89.7*	1.23	(0.90–1.67)
Investigation management routinely provided	12,392	*95.0*	*94.2*	*94.7*	1.22	(0.85–1.73)	*95.7*	1.19	(0.85–1.64)
Psychological support routinely provided	12,225	*93.7*	*90.9*	*93.9*	1.60	(1.02–2.51)	*94.3*	1.44	(1.15–1.81)
Social support routinely provided	12,834	*98.4*	*98.1*	*98.4*	1.56	(1.07–2.28)	*98.5*	1.31	(0.91–1.88)
Patients represented by survey response (n)	7,782		826	4,225			2,731		
LCNS confident challenging all MDT members	6,366	*81.8*	*76.0*	*82.4*	1.49	(0.93–2.39)	*82.6*	1.44	(1.07–1.93)

MDT, multidisciplinary team. Routine provision of intervention defined as offered by at least one LCNS at service to more than 70% of their caseload from pre-diagnosis to treatment. Negative response RRR = 1; affirmative responses presented.
[a] Relative risk ratio adjusted for LCNS assessment and timing, workforce banding, average caseload size per LCNS, therapy availability and service size, as well as patient's age, sex, performance status, stage, comorbidity, and socioeconomic deprivation. Clustered by English Regional Cancer Network.

Our analyses support LCNS assessments as an important aspect in improving the receipt of treatment, although we could not distinguish in our data whether contact with an LCNS was a consequence of a decision to start treatment, even when the LCNS assessment preceded treatment. Other resource-related factors were assessed to further elucidate the impact of the LCNS workforce on receipt of treatment.

We found missing data on LCNS assessment for 31% of all patients. It has previously been shown that the percentage of missing data reduced during the study period from 32% in 2007 to 10% in 2011 [12], which may introduce bias through differences in working practices over time. The number of people without an initial LCNS assessment is reassuringly low relative to those assessed or those missing data; however, this discrepancy may overestimate the impact of the initial LCNS assessment, and we considered further measures of LCNS involvement and working practice on receipt of treatment.

The linked dataset of people surviving 30 days included a total of 17,549 people who received surgery, of whom 21.5% did not have a recorded performance status and 17.9% were missing a complete cancer stage entry. People suitable for surgery without a recorded performance status or cancer stage were not included in the restricted analysis, although our inclusion criteria provided the highest proportion of recipients compared to more liberal definitions.

5.2. Hospital provider context and receipt of anticancer therapy

People were more likely to be in receipt of therapy if first seen in a service with specialist anticancer treatment facilities. This was similarly true when the people considered were restricted to those suitable for surgery, with the specific finding that specialist surgical facilities were associated with greater receipt of surgery. A potential explanation is that resources at such services may focus on patients who have the potential to benefit most from therapy, yet this raises questions of inequality and adds to studies that identify discrepancies in patient resection rates according to the proximity of surgical facilities [6,9].

5.3. LCNS assessment and receipt of anticancer therapy

We have previously shown that receipt of treatment is associated with LCNS assessment and early timing of assessment [12]. Here, we determined the impact of service factors and LCNS working practices on treatment receipt, and we restricted analyses to those who should be considered suitable for surgery. The observation that resection was more likely if assessed by an LCNS before/at diagnosis may reflect a discrepancy in patient confidence and knowledge around surgical options when LCNS assessment and opportunity for intervention precedes diagnosis [20,23]. LCNSs have excellent understanding of patient context and requirements to improve eligibility for therapies, and they act as a constant supportive presence [16]; this is particularly important when there may be anxiety regarding treatment risks [23]. This analysis provides evidence that timely LCNS assessment before/at diagnosis offers the best chance for everyone with a lung cancer diagnosis to receive the most appropriate therapy.

5.4. LCNS working practices and receipt of anticancer therapy

Inclusion of Band-8 LCNSs reduced the chances of receipt of chemotherapy in the overall population, whilst the proportion of people who did not receive therapy was also relatively large. It is possible that nurses may be more receptive to an individual's preference for no therapy, supporting their decision and advocating it within multidisciplinary settings [16]. The confidence required to support alternative decisions is likely an attribute of highly qualified and experienced LCNSs [24].

In the subgroup analysis, associations were found with the key LCNS roles of health promotion, psychological support and social support (e.g. signposting financial advice), providing evidence that the ability to support patients and direct them to further sources of assistance can increase the likelihood of surgical resection. LCNS confidence within the multidisciplinary team was associated with increased patient receipt of other therapies in the suitability subgroup, suggesting that LCNS confidence and multidisciplinary team inclusivity are important in encouraging patients' receipt of treatment, although its influence on receipt of surgery in those with underlying suitability did not reach confidence levels.

Administrative support was not associated with differences in receipt of surgery for those suitable, where provision may be expected to be associated with increased receipt, particularly as the pressure of large caseloads are associated with reduced receipt. However, nurses frequently go beyond their contractual hours to avoid pressures that could affect patient outcomes. Such dedication may obscure the true impact of administrative support on patients' receipt of treatment.

5.5. Improving treatment uptake

The 2016 NLCA report notes improvement in recent years in the number of surgical operations in people with NSCLC, but notes substantial variation across hospital providers [5]. Though clinical detail was limited, we identified people who were broadly suitable for surgery (16% of our cohort), yet only 55% received it. Improving uptake in suitable patients alone presents an opportunity to improve upon treatment rates and highlights the gap between suitability and patient preference.

Where surgery was a suitable option, likelihood of receipt was almost 30% lower at services with LCNS caseloads > 250 compared to those where caseloads were ≤150 people. These data indicate that the largest caseloads impede decisions for surgery and may not offer sufficient time to appease concerns regarding treatment risks [23], regardless of suitability.

In 2014, The LCNS workforce was estimated at 263 WTE positions in England [21], equating to caseloads of 117 new patients, with 47 more having survived the preceding year at a 1-year survival rate of 38% [5], totalling 164 patients on each LCNS caseload if shared equally between all WTE positions. This figure is likely to vary drastically between providers and regions; indeed 23% of our English cross-section were seen where caseloads were > 250 people. We recommend ensuring that WTE positions represent 1% of the expected new lung cancer incidence, enabling caseloads of ≤150 managed patients (new and surviving), closely aligned to NLCFN guidance (new only) [25].

Caseload pressure may also be reduced by assistance from clinical support workers and through LCNS delegation of routine clerical tasks to care coordinators [26]. Reducing caseload pressures could offer sufficient time for well-informed individual treatment decisions and assure access to psychological and social support, and could allow further LCNS focus on symptom and pathway management to facilitate optimal treatment. The relationship between specialist nurse staffing levels and optimal caseload is a challenge to simulate in a complex patient group; our findings can contribute to current and future models [27,28].

6. Conclusion

Championing the LCNS role is an appropriate strategy to improve treatment rates, as contact and working practices are associated with receipt of treatment, potentially via improved patient comprehension of the disease and engagement with options. We propose that enabling and supporting LCNSs to undertake key case-management duties, whilst monitoring WTE working hours relative to manageable caseload sizes, could reduce workload pressures sufficiently to improve treatment uptake in all lung cancer diagnoses, highlighted in those who are clinically suitable. Future studies should further elucidate patient reasons for refusal of optimal treatment strategies.

Contributors

The conception of the study was done by LJT and RBH. The LCNS survey was designed by LJT and AL. AK acquired and managed the data from the HSCIC, all analysis was performed by IS. IS, LJT, AK, PB and RBH were involved in the data interpretation. AL, AT and DB provided LCNS expertise. The paper (including the initial draft) was written by IS. All authors critically reviewed the manuscript and approved it prior to submission.

Ethical considerations

The data were obtained from the Healthcare Quality Improvement Partnership. Ethical approval from the University of Nottingham medical school research ethnics committee was obtained by the researchers to work on a linked Hospital Episode Statistics and National Lung Cancer Audit dataset (RU943 177570-MV6J3). The National Lung Cancer Audit has Ethics and Confidentiality Committee (ECC) approval to use patient information from the National Health Service (NHS). Finally for this specific set of work, we also obtained approval from HQIP who commission the audit, and HSCIC Caldicott guardian signed off the data-sharing agreement (IG Reference: IC381DS). The data were anonymized in the linked dataset by the HSCIC personnel prior to being given to the researchers.

Competing interests

IS, AT, AL and DB have no conflicts of interest. PB is funded by the Healthcare Quality Improvement Partnership (HQIP) to act as a clinical lead for the National Lung Cancer Audit. LT has conducted the statistical analyses for the National Lung Cancer Audit annual reports from 2009 to 2013, funded by the NHS Information Centre. AK has conducted the analysis for National Lung Cancer Audit annual reports 2014 to current, including the pleural mesothelioma reports and Lung Cancer Clinical Outcomes Publications, funded by the Royal College of Physicians. LT and AK have not received any personal earnings from the NHS HSCIC for this work. RH has a grant provided by the British Lung Foundation chair of respiratory epidemiology.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.lungcan.2018.07.022.

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