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The Victorian Comprehensive Cancer Centre lung cancer clinical audit: collecting the UK National Lung Cancer Audit data from hospitals in Australia

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Abstract

Background: Clinical audit may improve practice in cancer service provision. The UK National Lung Cancer Audit (NLCA) collects data for all new cases of thoracic cancers.
Aim: To collect similar data for our Victorian patients from six hospitals within the Victorian Comprehensive Cancer Centre and associated Western and Central Melbourne Integrated Cancer Service.
Methods: We conducted a retrospective audit of all newly diagnosed patients with lung cancer and mesothelioma in 2013 across the six Victorian Comprehensive Cancer Centre/Western and Central Melbourne Integrated Cancer Service hospitals. The objectives were to adapt the NLCA data set for use in the Australian context, to analyse the findings using descriptive statistics and to determine feasibility of implementing a routine, ongoing audit similar to that in the UK. Individual data items were adapted from the NLCA by an expert steering committee. Data were collated from the Victorian Cancer Registry, Victorian Admitted Episodes Dataset and individual hospital databases. Individual medical records were audited for missing data.
Results: Eight hundred and forty-five patients were diagnosed across the sites in 2013. Most were aged 65–80 (55%) and were male (62%). Most had non-small-cell lung cancer (81%) with 9% diagnosed with small cell lung cancer and 2% with mesothelioma. Data completeness varied significantly between fields. For those with higher levels of completeness, headline indicators of clinical care were comparable with NLCA data. The Victorian population seem to lack access to specialist lung cancer nurse services.
Conclusion: Lung cancer care at participating hospitals appeared to be comparable with the UK in 2013. In future, prospective data collection should be harmonised across sites and correlated with survival outcomes. One area of concern was a lack of documented access to specialist nursing services.

Introduction

Lung cancer is the leading cause of cancer-related morbidity and mortality among Australians.[1] Published data suggest that there is geographical variation in the delivery of cancer care across Victoria, with suboptimal compliance to best clinical practice.[2] Those living significant distances from specialist lung cancer services are less likely to have pathological diagnosis, be discussed at a multidisciplinary meeting, consult with a lung cancer specialist in radiation or medical oncology or be considered for curative surgery.[3,4] Available published data also suggest underutilisation of radiotherapy and chemotherapy, both in the radical and palliative context.[2,5]

Since its inception in 2004, the National Lung Cancer Audit in the UK has collected, examined and published comprehensive patient-centred data on lung cancer patients in England, Wales and Scotland. It is hailed as

Abbreviations: LCA, National Lung Cancer Audit; VAED, Victorian Admitted Episodes Dataset; VCCC, Victorian Comprehensive Cancer Centre; VCR, Victorian Cancer Registry; WCMICS, Western and Central Melbourne Integrated Cancer Service

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an exemplar of a national cancer audit, capturing prospective data for all lung cancer cases from all National Health Service trusts with a view to identify gaps in service provision and drive improvement in both local and national service delivery. A multidisciplinary group of lung cancer experts define a set of clinical indicators for each audit, aligned with the National Institute for Health and Care Excellence lung cancer guidelines and set targets for each indicator annually. The data are collected using software to allow hospitals directly to enter data or upload it from their local system, after which data are cleansed, linked and risk adjusted. The audit coverage approaches approximately 98% of cases each year. With demonstrable increases in surgical resection rates, active treatment rates and access to lung cancer nurse specialists, as well as modest improvements in overall survival,[6] the audit provides valuable information to benchmark ongoing quality improvement at a local National Health Service trust level and against international comparators.

The Victorian Comprehensive Cancer Centre (VCCC) and Western and Central Melbourne Integrated Cancer Service (WCMICS) are an alliance of 10 clinical and research organisations based in metropolitan Melbourne who are committed to cancer control in Victoria. These entities provide a comprehensive range of cancer services covering the full continuum of patient care to nearly a fifth of Victoria's population and is characterised by its ageing population structure, multicultural diversity and relatively high levels of socioeconomic disadvantage. The VCCC and WCMICS aimed to adapt the UK NLCA model to an Australian context, enabling participating health services to address areas of variation from best practice and to foster a culture of quality improvement.

Several of the individual health services participating in our audit have in-house lung cancer databases that have been developed independently of each other. As a result, these are not harmonised or collect the same information. Hence we aimed to perform an initial retrospective audit using the NLCA data set in order to inform the development of a subsequent unified prospective audit process across our sites.

Methods

Development of the audit

We audited all patients with a new diagnosis of lung cancer or mesothelioma across the six Victorian hospitals that are members of the VCCC. The six hospitals included in the audit were Austin Health, Melbourne Health, Peter MacCallum Cancer Centre, St Vincent's Hospital Melbourne, Western Health and Werribee Mercy. The scope of the audit was adapted from the NLCA to include data on patient demographics, diagnostic investigations, multidisciplinary meetings, cancer type and stage, treatment received, nursing care and clinical outcomes. Institutional ethics approval for the project was obtained at each site.

A data dictionary was created in order to capture the individual data items from the NLCA, adapted for the Australian context by an expert steering committee. Where possible, we sought to collect information from pre-existing data sets, including the Victorian Cancer Registry, the Victorian Admitted Episodes Dataset, individual hospital databases and the radiotherapy dataset from the Peter MacCallum Cancer Centre. The Victorian Cancer Registry is a state-wide population-based cancer registry collating notifications from 240 participating hospitals, 30 pathology laboratories and cancer screening registers. The Victorian Admitted Episodes Dataset records data for each patient admission or encounters across all Victorian private and public hospitals, rehabilitation centres and day procedure facilities and provides comprehensive information on the nature of the episode through demographic data and codes for principal diagnoses and procedures undertaken. To avoid possible discrepancies between datasets, they were assessed in a hierarchical order from the Victorian Cancer Registry, the Victorian Admitted Episodes Dataset, individual hospital databases and the radiotherapy data set from Peter MacCallum Cancer Centre. These data were used to pre-populate the custom audit database, and following this a team of trained auditors manually entered missing data into remaining fields from individual hospital medical records. Eligible patients included those made known to the Victorian Cancer Registry with a lung cancer diagnosis date in 2013, those with a Victorian Admitted Episodes Dataset episode and lung cancer diagnosis code in 2013 or those identified by participating hospital data sets or radiotherapy data sets with diagnosis or treatment dates in 2013. Some patients initially considered to be eligible were subsequently excluded because it became apparent with additional data that they did not meet audit requirements.

The data were grouped and analysed by age, socioeconomic status (derived from the index of relative socioeconomic disadvantage linked to patient postcode), histology, stage, Eastern Cooperative Oncology Group performance status and treatment intent. Descriptive statistics were used to describe the findings.

Results

Case mix

As shown in Table 1, examination of all patient records by data source (and whether they were subsequently included in analysis or not) showed the Victorian Cancer

Registry dataset was the primary source of patient identification. As well as identifying patients, Victorian Admitted Episodes Dataset data provided additional data fields to Victorian Cancer Registry identified patients and was used to include a list of known procedures and treatments undertaken.

There were 1303 patients across the six participating hospitals identified as having a new diagnosis of lung cancer or mesothelioma in 2013; 112 duplicate cases were removed, and five records unable to be audited within the time period were discounted. A further 341 records were considered out of scope if it was subsequently determined that they were diagnosed outside of 2013 or if they received no lung cancer treatment at a participating site. Of the remaining 1186 cases, 845 were found to be within the scope of the audit.

The characteristics of the 845 patients are shown in Table 2. Approximately two-thirds of the patients were male (526 patients, 62%) and one-third female (317 patients, 38%), with no documentation made for two patients. Age at diagnosis ranged from 20 to 93 years, with the majority aged between 65 and 80 years (452, 52%).

Results regarding patient cancer type and stage are shown in Table 3 and Figure 1. The most common histological diagnosis was non-small-cell lung cancer (NSCLC) (685 patients, 81%). The remaining patients were diagnosed with small cell lung cancer (SCLC) (76, 9%), mesothelioma (21, 2%) or carcinoid (19, 2%). A small proportion of patients had no cancer type documented (48, 6%). Staging information was not recorded for 327 patients (39%). We found that TNM Classification of Malignant Tumours (TNM) reporting was limited in the medical records and often if available was difficult to determine if the reference was pre- or post-treatment. The TNM version number was rarely recorded in the medical record.

Table 2 Clinical and demographic features

Characteristic	*n*	%
Hospital of first diagnosis		
Royal Melbourne	238	28%
Austin Health	180	21%
St Vincent's Hospital	144	17%
Western Health	132	16%
Peter MacCallum Cancer Centre	126	15%
Werribee Mercy	14	2%
Other	11	1%
Age (years)		
<65	284	34%
65–80	452	53%
>80	100	12%
Unknown	4	0.005%
Gender		
Male	526	62%
Female	317	38%
Unknown	2	0.005%
Histology		
NSCLC	685	81%
SCLC	76	9%
Mesothelioma	21	2%
Carcinoid	15	2%
Other/NOS	48	6%

RMH, Royal Melbourne Hospital; AH, Austin Health; NOS, not otherwise specified; NSCLC, non-small-cell lung cancer; PMCC, Peter MacCallum Cancer Centre; SCLC, small-cell lung cancer; SVH, St Vincent's Hospital Melbourne; WH, Western Health; WM, Werribee Mercy.

Treatment with potential curative intent

Treatment documented as being given with curative intent was recorded for 389/845 patients (46%). When adjusted for differences in age, stage, socioeconomic and performance status between sites, there was no significant difference in regard to the rates of treatment being given with curative intent.

Headline indicators

Various clinical benchmarks were compared to the outcomes from the NLCA report from 2013 (Table 4), revealing that our Victorian centres performed favourably in comparison to UK centres across multiple domains.

At all participating health services, there was a histological basis of diagnosis for over 94% of patients, with the exception of Werribee Mercy (79%) which is explained by the small volume of patients first diagnosed at this community hospital (14 patients, 2%) and as

Table 1 Patient records by data source

	Total records		Eligible		Ineligible	
Data source	All records	Less duplicates and insufficient data	*n*	%	*n*	%
VCR	678	675	600	89	75	11
VAED	266	235	118	50	117	50
Hospital data sets	270	222	117	53	105	47
Peter MacCallum radiotherapy data set	89	54	10	19	44	81
Total	1303	1186	845	71	341	29

VCR, Victorian Cancer Registry; VAED, Victorian Admitted Episodes Database.

Table 3 Patient cancer type and stage

Characteristic	Carcinoid	Mesothelioma	NSCLC	SCLC	Unknown	Total	%
<II	6	1	169		3	179	21%
IIIA			67	10	2	79	9%
IIIB		1	40	6	1	48	6%
IV		2	159	18	10	189	22%
SCLC limited			2	6		8	1%
SCLC extensive			4	11		15	2%
Unknown stage	9	17	244	25	32	327	39%
Total	15	21	685	76	48	845	100%
%	2%	2%	81%	9%	6%	100%	

NSCLC, non-small-cell lung cancer.

many of these patients require the services of a tertiary hospital to obtain a tissue diagnosis. About 73% of NSCLC patients received a staging PET scan, compared with 35% in the NLCA. A higher proportion of VCCC/WCMICS patients received active therapy (76 vs 60%), including surgery (29 vs 15%) and radiotherapy (55 vs 29%). While there were fewer VCCC/WCMICS patients recorded as having received chemotherapy (51 vs 70%), there were missing data for 311 patients, and it is possible that chemotherapy may have been delivered at an external site such as in the private sector or returning to a regional centre for chemotherapy treatment after a diagnosis and treatment plan was made.

Similarly, fewer of our patients were seen by specialised palliative care (21 vs 30%), although nearly half of the in-scope patients had no documentation. A further area of concern was the lack of contact with a lung cancer nurse specialist either at time of diagnosis (0 vs 65%) or throughout the disease trajectory (13 vs 84%), although again data completeness was low for these fields (51%).

As some of the VCCC/WCMICS data fields used to derive these headline indicators had large amounts of unknown or missing data for non-procedure related items, this limits interpretation. This was particularly the case for documentation of palliative care or lung cancer nurse involvement in care where interactions with patients may have occurred but not been documented.

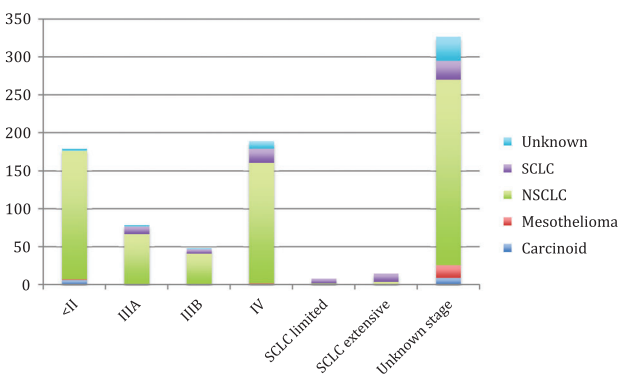

Figure 1 Patient cancer type and stage. NSCLC, non-small-cell lung cancer; SCLC, small-cell lung cancer.

Discussion

This audit was the first Australian attempt to duplicate the NLCA data, which has been instrumental in assessing the quality of lung cancer care and identifying areas for improvement in the UK since 2004. In addition to reviewing current local practice, we critically aimed to evaluate barriers to successful auditing, with a view to facilitating prospective data collection synchronised across Victorian sites.

Table 4 Comparison on VCCC/WCMICS headline indicators to UK NLCA data 2013

Benchmark	VCCC/WCMICS audit, *n* (%)	NLCA 2013%
Patients with histological diagnosis	810/845 (96%)	75%
Patient with CT prior to bronchoscopy†	384/492 (78%)	91%
NSCLC patients receiving PET scan‡	544/748 (73%)	35%
Patients with stage documented	518/845 (61%)	93%
Patients discussed at a multi-disciplinary meeting	585/845 (69%)	96%
Patients documented as seen by a lung cancer nurse specialist	110/845 (13%)	84%
Lung cancer nurse specialist present at diagnosis	0/845 (0%)	65%
Patients receiving active treatment	643/845 (76%)	60%
Patients treated with surgery	242/845 (29%)	15%
Patients treated with radiotherapy§	370/669 (55%)	29%
Patients treated with chemotherapy¶	327/638 (51%)	70%
Patients seen by specialist palliative care	179/845 (21%)	30%

†Derived field as total 492 patients had bronchoscopy. ‡Derived field as patients by stage less SCLC and mesothelioma. §Derived field as 176 patients had no available data. ¶Derived field as 207 patients not applicable. NLCA, National Lung Cancer Audit; NSCLC, non-small-cell lung cancer; PET, positron emission tomography; VCCC, Victorian Comprehensive Cancer Centre; WCMICS , Western and Central Melbourne Integrated Cancer Service.

Process and learnings

Unlike the NLCA, this audit was performed retrospectively, with significant challenges associated with the manual evaluation of individual medical records. We encountered a variety of different medical records across the six sites, including multiple online systems, paper-based medical records and separate surgical and radiotherapy databases. There were discrepancies in the data fields between hospital datasets and the data field definitions outlined in this audit. For example, hospital databases may not distinguish between a diagnostic surgical procedure and surgical treatment, and the manual process of reviewing these fields carries risk of introduced error. Similarly, although TNM staging data may have been collected in more patients than we identified, it may be documented in separate surgical databases rather than the patient medical record. Despite training and access to a data dictionary, the team of auditors encountered significant challenges in the interpretation of various items for these reasons.

Moreover, unlike the national scope of the NLCA, only the investigation and management completed in the six participating hospitals was captured in the analysis; a proportion of patients would have had components of their cancer care pathway delivered elsewhere. In an Australian context, this is particularly pertinent for patients subsequently attending private hospitals, or for those from regional or interstate centres opting to have their ongoing care delivered closer to home. As several items were associated with large amounts of missing data, future audits should collect prospective data harmonised across sites to allow correlation of cancer outcomes.

Headline indicators

Overall, the audit revealed that the sites are performing at a similar level or better than the UK for many of the headline indicators. A greater proportion of our patients had a clear histological diagnosis, a staging computed tomography and positron emission tomography for NSCLC, and a plan for active treatment with surgery or radiotherapy. Comparison between some headline indicators was limited by poor rates of data completeness, including rates of TNM staging, documentation of those receiving chemotherapy, access to lung cancer nurse specialists and referrals for palliative care.

Limitations aside, it is likely that Victorian lung cancer patients receive far less input from lung cancer nurse specialists, both at time of diagnosis and subsequently. None of our patients was documented to have had a lung cancer nurse present at diagnosis, and only 13% were contacted subsequently. Specialised nursing care has improved dramatically in the UK since the NLCA inception in 2004; with 84% of patients assigned a lung cancer nurse specialist in 2013 compared with 35% in 2007. Qualitative data reveal that this role is crucial in the early diagnostic process, coordination of multidisciplinary meetings, assessment and management of symptoms, provision of psychological support and the dissemination of health information.[7,8] NLCA data suggest that involvement of a nurse specialist may result in significantly higher rates of active treatment (60 vs 30%), and high levels of consumer satisfaction.[9]

Similarly, several recent studies highlight the value of early and routine involvement with palliative care services for patients with advanced lung cancer.[10] While it is possible that nursing and palliative care involvement occurred at somewhat higher rates than was documented in the medical records, we cannot be certain of this, and this underlines the importance of having prospective unified data collection from sites in the future.

Conclusion

Within the limitations of this retrospective study, the six Victorian hospitals performed at a standard comparable with the national standard of the UK in 2013. A prospective, standardised registry across sites would permit ongoing routine benchmarking against established clinical standards. In stark contrast to the UK, Victorian patients appear to have limited access to lung cancer nurse specialists, and strengthening these services may in turn increase proportion of patients with complete work up, active treatment and referral to palliative care.

References

1 Australian Institute of Health and Welfare. Cancer in Australia 2017. Canberra: Australian Institute of Health and Welfare.

2 Mitchell PLR, Thursfield VJ, Ball DL, Richardson GE, Irving LB, Torn-Broers Y *et al*. Lung Cancer Care in Victoria: are we making progress? *Med J Aust* 2013; **199**: 674–9.

3 Vinod SK, Hui AC, Esmali M, Hensley MJ, Barton MB. Comparisons of patterns of care in lung cancer in three area health services in New South Wales, Australia. *Intern Med J* 2004; **34**: 677–83.

4 Tracey E, McCaughan B, Badgery-Parker T, Young J, Armstrong B. Survival of Australian lung cancer patients and the impact of distance from and attendance at a thoracic specialist centre: a data linkage study. *Thorax* 2014; **85**: 658–63.

5 Vinod SK, Simonella L, Goldsbury D, Delaney GP, Armstrong B, O'Connell DL. Underutilization of radiotherapy for lung cancer in New South Wales, Australia. *Cancer* 2010; **116**: 686–94.

6 Khakwani A, Powell H, Rich AL. Lung cancer survival in England: trends in non-small-cell lung cancer survival over the duration of the National Lung

Cancer Audit. *Br J Cancer* 2013; **109**: 2058–65.
7 Tod AM, Redman J, McDonnell A, Borthwick D, White J. Lung cancer treatment rates and the role of the lung cancer nurse specialist: a qualitative study. *BMJ Open* 2015; **5**: e008587.
8 Roy Castle Lung Cancer Foundation. Understanding the Value of Lung Cancer Nurse Specialists. 2013 [cited 2018 May 15]. Available from URL: http://www.roycastle.org/Resources/Roy%20Castle/Documents/PDF/UnderstandingthevalueoflungcancernursespecialistsV03.pdf
9 Sethi T, Lim E, Peake M, Field J, White J, Nicolson M. Improving care for patients with lung cancer in the UK. *Thorax* 2013; **68**: 1181–5.
10 Temel JS, Greer JA, Muzikansky A, Gallagher ER, Admane S, Jackson VA *et al*. Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med* 2012; **363**: 733–42.

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Effects of empagliflozin treatment on cardiac function and structure in patients with type 2 diabetes: a cardiac magnetic resonance study

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Abstract

Background: The effects of empagliflozin on cardiac structure and function are not known.
Aims: To examine the changes in cardiac structure and function following the addition of empagliflozin in patients with type 2 (T2D) diabetes using cardiac magnetic resonance (CMR) imaging.
Methods: Twenty patients attending a specialist diabetes service recommended for treatment with empagliflozin, and 8 control patients with T2D on stable glucose lowering therapy were recruited for cardiac imaging. Participants underwent CMR scans at baseline and 6 months. Inclusion criteria were established T2D, age < 75 years, estimated glomerular filtration rate ≥45 mL/min/1.73 m^2.
Results: 17 of 20 in the empagliflozin group, and all of 8 in the control group completed the study. Empagliflozin therapy was associated with reduction in left ventricular end diastolic volume 155 mL (137 mL, 174 mL) at baseline to 145 mL (125 mL, 165 mL) at 6 months, $P < 0.01$, compared with the control group 153 mL (128 mL, 179 mL) at baseline and 158 mL (128 mL, 190 mL), not significant. There were no differences in measures of left ventricular mass, ejection fraction, heart rate or markers of cardiac fibrosis at baseline and 6 months in either group.
Conclusions: This is the first CMR study to examine the effects of empagliflozin on cardiac function and structure, showing evidence of reduced end diastolic volume. This is likely to reflect change in plasma volume, and may explain the reduced cardiovascular death and heart failure seen in the EMPA-REG OUTCOME trial.

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Conflict of interest: N. D. Cohen has received fees for consulting, lecturing and/or being part of an advisory board from Boehringer Ingelheim, AstraZeneca, Bristol-Myers Squibb, Eli Lilly, Merck Sharp & Dohme, Novo Nordisk, Novartis, Sanofi, Medtronic, Abbott, Roche and is the principal investigator of studies sponsored by research grants from Astra Zeneca, Novartis. E. M. Briganti has received fees for consulting, lecturing and/or sponsorship from Novo Nordisk, Boehringer Ingelheim, Eli Lilly, Amgen, Teva Pharma.

Introduction

The Empagliflozin, Cardiovascular Outcomes and Mortality in Type 2 Diabetes trial (EMPA-REG OUTCOME) was a landmark clinical trial which demonstrated a reduction in cardiovascular death and hospitalisation for heart failure in patients with type 2 diabetes and pre-existing cardiovascular disease treated with the sodium glucose transporter 2 (SGLT 2) inhibitor, empagliflozin.[1] However, the mechanisms, behind the early and