




# BMJ Open Development of an Australia and New Zealand Lung Cancer Clinical Quality Registry: a protocol paper

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## ABSTRACT

**Introduction** Lung cancer is the leading cause of cancer mortality, comprising the largest national cancer disease burden in Australia and New Zealand. Regional reports identify substantial evidence-practice gaps, unwarranted variation from best practice, and variation in processes and outcomes of care between treating centres. The Australia and New Zealand Lung Cancer Registry (ANZLCR) will be developed as a Clinical Quality Registry to monitor the safety, quality and effectiveness of lung cancer care in Australia and New Zealand.

**Methods and analysis** Patient participants will include all adults >18 years of age with a new diagnosis of non-small-cell lung cancer (NSCLC), SCLC, thymoma or mesothelioma. The ANZLCR will register confirmed diagnoses using opt-out consent. Data will address key patient, disease, management processes and outcomes reported as clinical quality indicators. Electronic data collection facilitated by local data collectors and local, state and federal data linkage will enhance completeness and accuracy. Data will be stored and maintained in a secure web-based data platform overseen by registry management. Central governance with binational representation from consumers, patients and carers, governance, administration, health department, health policy bodies, university research and healthcare workers will provide project oversight.

**Ethics and dissemination** The ANZLCR has received national ethics approval under the National Mutual Acceptance scheme. Data will be routinely reported to participating sites describing performance against measures of agreed best practice and nationally to stakeholders including federal, state and territory departments of health. Local, regional and (bi) national benchmarks, augmented with online dashboard indicator reporting will enable local targeting of quality improvement efforts.

## INTRODUCTION

### Lung cancer in Australia and New Zealand

Lung cancer is the fifth most commonly diagnosed cancer in Australia<sup>1</sup> and the fourth in New Zealand,<sup>2</sup> and provides the

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A binational thoracic oncology registry has strong multisectoral and multiorganisational support based on the established track record of the pilot Victorian Lung Cancer Registry.
- ⇒ Harmonisation of national improvement efforts using a standardised and institutionally contextualised communication strategy addresses an important gap to confirm evidence-based practice, identify evidence to practice gaps and to highlight unwarranted practice variation to focus quality, safety and value improvement efforts.
- ⇒ The registry has strong scalability for comprehensive inclusion of metropolitan, regional and remote centres, in public and private facilities to confirm equity and access to healthcare for populations of diverse indigenous, cultural, linguistic, socioeconomic, regional and remote backgrounds.
- ⇒ A national mandate for institutional participation and reporting is needed to support local governance, to strengthen local infrastructure and data collection, to facilitate data linkage and the creation of a learning health system, and to limit potential inclusion bias of over-representation of high performing centres.
- ⇒ National funding remains to be established and yet there remains a strong need to establish a vehicle to enhance data-driven improvement and the creation of a learning health system to address the leading national cancer burden.

leading cause of cancer-related death in both countries. Australia saw 13810 newly diagnosed primary lung cancers projected in 2021,<sup>3</sup> where indigenous Australians suffer an age-standardised lung cancer rate double that of non-indigenous Australians. Similarly in New Zealand, 2381 new cases of lung cancer were seen in 2018<sup>2</sup> with a rate nearly threefold higher in the



Maori population. Some 8379 lung cancer deaths were recorded in 2020 in Australia, and survival from lung cancer remains poor in both males and females with a 5-year survival rate of 20.2%,<sup>3</sup> and lower in New Zealand at 11%.<sup>2</sup> Lung cancer imposes the greatest cancer disease burden, chiefly through years of life lost<sup>4</sup> and direct management costs<sup>5</sup> and is predicted to increase over time.<sup>6</sup>

Encouragingly, lung cancer research has seen major advances across the multidisciplinary spectrum over the past decade. Molecular pathology has revolutionised understanding of lung cancer pathogenesis and opened the door to targeted treatment.<sup>7</sup> Endobronchial ultrasound has largely eliminated the need for mediastinoscopy in lung cancer staging.<sup>8</sup> Surgical enhancements including video-assisted thoracoscopic surgery have led to fewer postoperative complications, reduced length of stay and improved quality of life.<sup>9,10</sup> Stereotactic body radiotherapy (SBRT) has extended capacity to treat medically inoperable patients with curative intent.<sup>11</sup> The breakthrough discovery and availability of almost 20 new systemic therapy agents including targeted therapies and immune checkpoint inhibitors have transformed the treatment landscape for patients with locally advanced and metastatic disease.<sup>12</sup> The importance of early referral to palliative care in improving quality of life, reducing aggressive end-of-life care, and, for some patients, prolonging survival, has also been highlighted.<sup>13</sup>

Additional challenges to modern lung cancer management include the importance of patient-centred and value-based healthcare, rising hospitalisation, management and treatment costs,<sup>4</sup> and an ageing population predicted to continue to increase.<sup>5,14,15</sup> The opportunities provided by improved diagnostics and therapeutics are in a phase of rapid evolution and for patients to fully benefit from these advances in research evidence there is need for urgent translation of this evidence to routine clinical practice and to acknowledge population health systems in demanding evidence to confirm and guide this translation [box 1](#).

### Challenges

While new diagnostic tools and novel treatments have the potential to improve patient outcomes, optimal management of lung cancer has become increasingly

#### Box 1 Terri Byrne (Queensland), lung cancer patient advocate

As a woman living with lung cancer in a rural and remote part of Australia, I believe having a National Lung Cancer Registry would help all hospitals deliver the same quality of care. This would make a huge difference and ensure we get a standardisation of information and treatment across Australia, not just in metropolitan areas. Having the same access to treatment in our hometowns would mean no delays and we can have our family close by—giving us the hope we need.

complex, creating challenges for the implementation and monitoring of best practice. There is an urgent need to monitor outcomes related to this disease to improve efficiency, effectiveness and sustainability by ensuring the provision of patient centred, high-quality, evidence-based care that optimises value to the health-care system.

### Variation in care

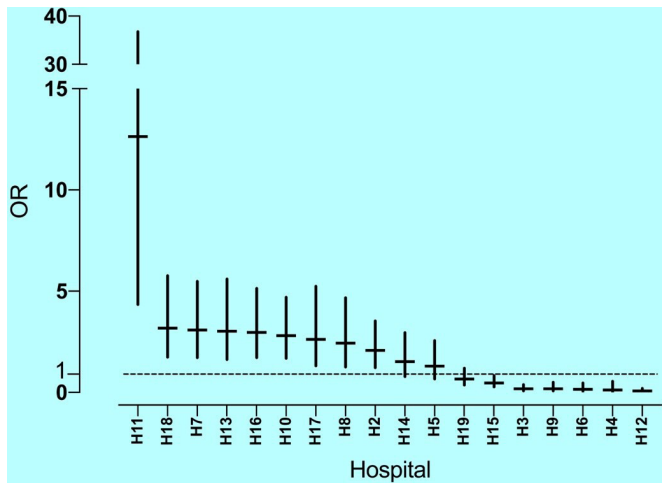
Unwarranted variation in healthcare delivery represents a major opportunity for care improvement. Such variation may present both as gaps between delivered care relative to evidence-based best practice, as well as variation in the use of health services between healthcare providers which are unaccounted for by patients' needs or preferences. The reduction of unwarranted variation in care is a major Australian policy objective to protect patients from harm and to improve the quality of care delivered.<sup>16</sup>

There is substantial institutional and regional evidence of unwarranted variation in both processes of care and outcomes for Australians diagnosed with lung cancer ([figure 1](#)). A study of 4854 Victorian NSCLC and SCLC patients revealed guideline concordant treatment delivered to just 60.36% of patients with variation across geographic areas and over time associated with poor performance status, advanced clinical stages, NSCLC subtypes, public hospital insurance, area-level deprivation and comorbidities.<sup>17,18</sup> Regional variation in 2-year mortality for NSCLC has been demonstrated where those with timely first definitive treatment (OR 0.73; 95% CI 0.56 to 0.94) and multidisciplinary meeting presentation (OR 0.74; 95% CI 0.59 to 0.93) were significantly less likely to die within 2 years of diagnosis.<sup>19</sup> Variation in processes of care is evident in timeliness of care,<sup>20–22</sup> pathological confirmation of diagnosis,<sup>23</sup> utilisation of multidisciplinary meetings<sup>23,24</sup> ([figure 2](#)), patterns of care delivery<sup>25–28</sup> and follow-up after cancer treatment.<sup>29</sup> Substantial variation is also evident in key outcomes of care including the utilisation of active anticancer treatment<sup>17,23,30–32</sup> and survival.<sup>19,32,33</sup>

Evidence of unwarranted variation in equity and access outcomes is also reported for vulnerable populations including Aboriginal and Torres Straits Islanders,<sup>34,35</sup> Maori,<sup>36,37</sup> geographically remote,<sup>38,39</sup> lower socioeconomic status<sup>40,41</sup> and the elderly<sup>42</sup> raising significant concerns regarding equity of access to effective cancer prevention and treatment.

### Measurement for quality improvement

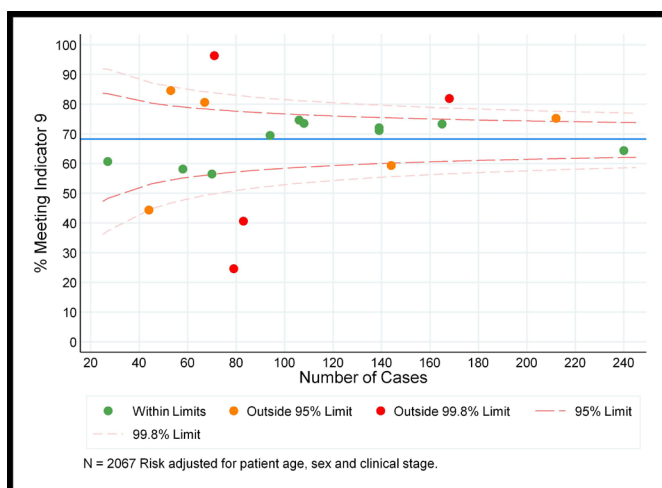
Improvement in quality of care is a critical objective in healthcare policy. Clinical performance indicators may be designed to measure the structure, process and quality of care.<sup>43</sup> Quality indicators may be used as quantitative measures that provide information about the effectiveness, safety and/or people-centredness of care.<sup>44</sup> Design of quality indicators enables definition



**Figure 1** Likelihood of patients having documented screening for supportive care within 18 Victorian health services (OR; 95% CIs) VLCCR 2019 varied between 0.07;0.02 to 0.20 and 12.63;4.34 to 36.79. VLCCR, Victorian Lung Cancer Registry.

of the quality improvement goal, the method for measurement and opportunities for appraisal of quality outcomes. The use of quality measures may be undertaken for quality assurance and demonstration of equity in access to care and outcomes. The examination of unwarranted variation in process and outcomes in care is also critical in meeting stakeholder needs and expectations and to provide accountability for consumers, providers and payors.

The longitudinal measurement and reporting of quality indicators provides opportunities to iteratively improve the quality of care. It also provides and facilitates the integration of novel evidence-based practice knowledge and clinical system performance knowledge



**Figure 2** Funnel plot of proportion of patients with documented evidence of presentation to a multidisciplinary meeting, Victorian Lung Cancer Registry 2019, n=2114 subjects. Mean 68% with 95% (heavy dotted line) and 99.8% (light dotted line) CIs. Green dots within confidence limits, red dots represent outlier status.

to improve clinical decision making and to enhance the dissemination and implementation of evidence-based practice in a learning health system.<sup>45 46</sup> The longitudinal measurement of disease diagnosis, treatment and outcome may further provide critical monitoring during health system shocks, such as those experienced during the COVID-19 pandemic.

### Clinical quality registries in measurement of quality of lung cancer care

The feasibility and effectiveness of national lung cancer registries for quality improvement have been demonstrated internationally.<sup>47-51</sup> The Danish Lung Cancer Registry was established in 2000<sup>52</sup> with nationally mandated participation, reporting 14 indicators to stakeholders providing both online real-time hospital and annual reports.<sup>53</sup> Important improvements following registry development included improved referral to treatment timeliness, improved staging quality, increased lobectomy rates, reduction in 30-day postoperative mortality and improvement in 1-year, 2-year and 5 years survival rates.<sup>54</sup>

The UK National Lung Cancer Audit (UK-NLCA) was established in 2004 providing quarterly feedback reports to hospitals and networks using a 112-item dataset confirmed in 2007 and now captures data from all UK hospitals providing lung cancer care.<sup>55</sup> Following the commencement of the audit there have been significant changes in process measures including histological confirmation rate (64% in 2005 to 76% in 2009) and multidisciplinary meeting presentation (78% in 2005 to 94% in 2009). The reports confirm wide variation in process and outcome measures including receipt of treatment and survival in participating centres.<sup>56</sup>

Data linkage of the UK-NLCA with administrative, treatment and patient experience datasets has provided important opportunities for evaluation of equity in access<sup>57</sup> hypothesis generation, gap analysis,<sup>58 59</sup> confirmation of real-world treatment effectiveness<sup>60 61</sup> and opportunities for patient experience improvement.<sup>62</sup> Further, the UK-NLCA has been successfully implemented as an explicit tool for quality improvement in nationally coordinated projects targeting the reduction of unwarranted variation in clinical care outcomes.<sup>63 64</sup>

The Dutch Lung Cancer registry is comprised of three independent surgery, radiotherapy and systemic therapy subgroups facilitated by the Dutch Institute for Clinical Auditing. Dutch legislation mandates patient inclusion, providing a national consent enabling all Dutch hospitals to contribute to the registry.<sup>51</sup> The Dutch registry has thereby established high level completeness and participation and results for 15 indicators are discussed quarterly and provided to hospitals and made publicly available.

### Rationale for registry development

A range of Australian regional and state-based initiatives have been developed for improving outcomes in

lung cancer care through the use of clinical quality indicators<sup>20 65–68</sup> including the Performance Index of the Cancer Institute New South Wales,<sup>69</sup> The Queensland Lung Cancer Quality Index,<sup>70</sup> Cancer Alliance Queensland<sup>71</sup> and the Victorian Lung Cancer Registry (VLCR).<sup>72</sup> These reports include clinical indicators as tools providing methodologically consistent comparators of service provision across institutions and within various jurisdictions and enable delivery of risk adjusted benchmarking.<sup>73</sup>

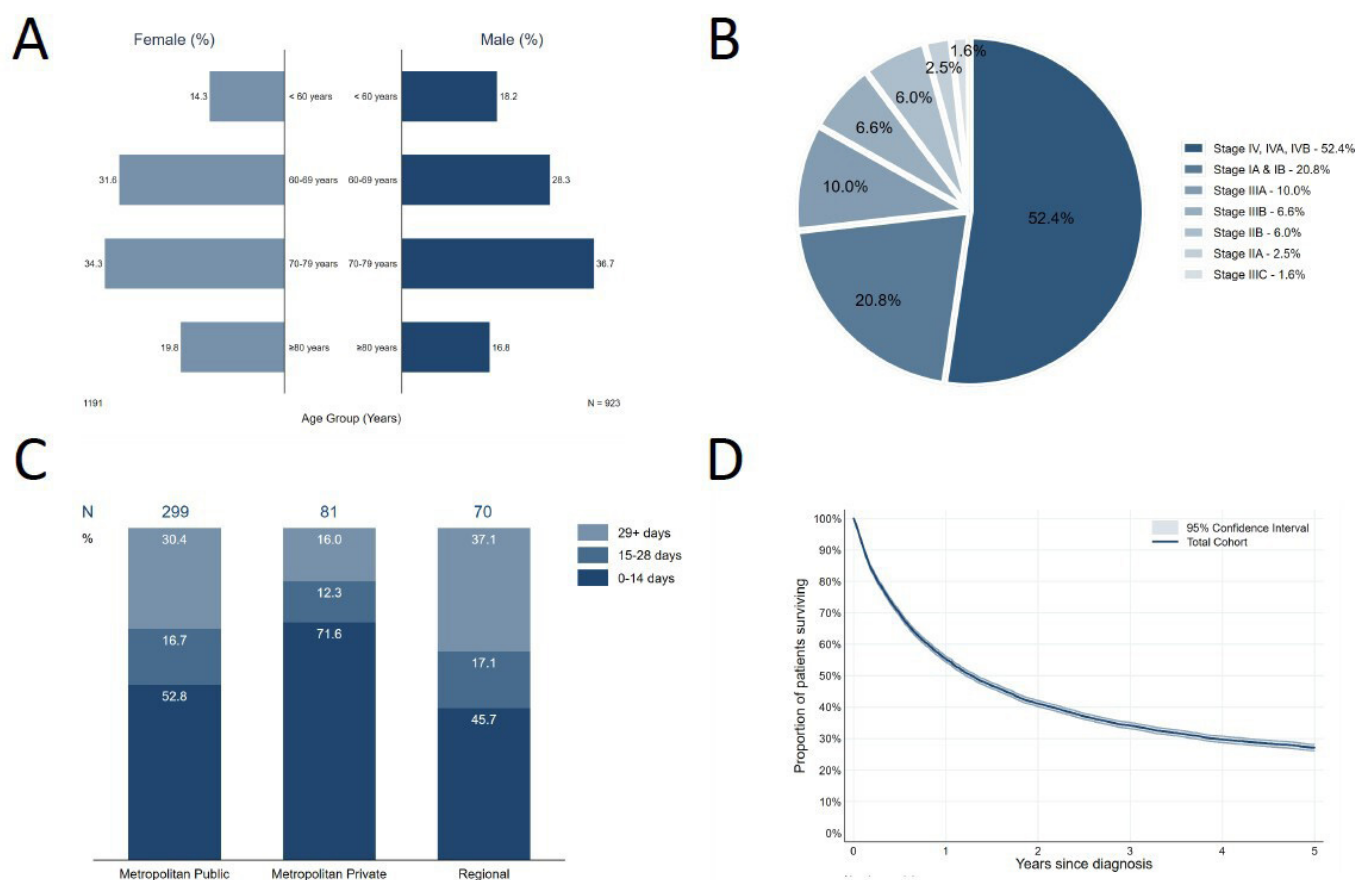
Performance indicators reported by these state initiatives share a broadly aligned purpose, and measure quality of care using the six dimensions of the Institute of Medicine's Quality of Healthcare framework: safety, effectiveness, patient-centred care, timeliness, efficiency and equity.<sup>74</sup> However, there remains a lack of harmonisation across the states. An opportunity exists to implement an index of standardised and validated indicators to enable nationwide monitoring of clinical practice and benchmarking in lung cancer care.

Braithwaite *et al* describe the 60:30:10 phenomenon in modern medical care where on average 60% of care is in line with evidence or consensus-based guidelines (confirmed in Victorian lung cancer<sup>17</sup>), 30% represents some form of waste or low value care and 10% of care leads to patient harm.<sup>75</sup> The ability to improve evidence-based best practice, to reduce low

value care and to minimise patient harm provides three clear improvement objectives and demands performance measurement, reporting and data availability for knowledge translation, and improvement in quality and value of delivered care.

### Proof of concept in the VLCR

The VLCR was developed in 2011<sup>67</sup> in accordance with the operating principles of the Australian Commission on Safety and Quality in Healthcare (ACSQHC) Framework for Clinical Quality Registry Development,<sup>76</sup> is registered with the Australian Register of Clinical Registries (ACSQHC-ARCR-432) and is closely aligned with the National Clinical Quality Registry and Virtual Registry Strategy 2020–2030.<sup>77</sup> The registry has captured data on >14 500 newly diagnosed Victorian cases of NSCLC and SCLC and provides annual risk-adjusted benchmark reports on 21 performance indicator measures to 19 health services, representing 50 hospitals and accounting for >85% of all new diagnoses in Victoria. A dataset has been developed containing key quality process and outcome measures with descriptors of patient, disease, management and outcomes for Victorian patients with lung cancer (figure 3). The registry has provided a framework to facilitate quality improvement collaboratives in a learning health system to drive multisite data-driven



**Figure 3** The Victorian Lung Cancer Registry 2019 provides capability to describe patient (A), disease (B), management (treatment timeliness) (C) and survival outcomes (D) for 10552 newly diagnosed patients.

improvement in lung cancer management.<sup>78</sup> The VLCCR is located within the Department of Epidemiology and Preventive Medicine at Monash University which manages the registry's core activities under the direction of the VLCCR Steering Committee. The Monash Clinical Registry Unit currently houses 35 clinical quality registries,<sup>79</sup> including 6 national cancer registries in the School of Public Health and Preventive Medicine, and has established robust protocols for data capture, transmission, security and custodianship, as well as outlier management and accountability for the privacy, security and integrity of patient information held within the registry.

### Opportunities in clinical quality registry development

Lung cancer in Australia and New Zealand is characterised by high prevalence, high morbidity and poor survival and comprises the leading national cancer burden. Unwarranted variation in processes and outcomes of lung cancer care are widely demonstrated and demand demonstration and evaluation to address evidence to practice gaps in lung cancer management. Multidisciplinary research evidence in lung cancer care is rapidly evolving and measurement of the integration and translation of this evidence into clinical performance is highly desirable. The provision of harmonised, risk adjusted benchmark reporting of lung cancer management and outcome performance provides the information necessary for an informed national cancer control programme.

## METHODS AND ANALYSIS

### Australia and New Zealand Lung Cancer Registry objectives

The development of the Australia and New Zealand Lung Cancer Registry (ANZLCR) has four main objectives:

1. Measure and report benchmarked outcomes of clinical quality indicators reflecting the quality of lung cancer management in participating hospitals.
2. Describe unwarranted variation in management and outcomes in lung cancer care.
3. Provide a data infrastructure to enable a learning health system for data-driven improvement in health-care.
4. Develop a clinical data repository to inform collaborative lung cancer research.

## COHORT DESCRIPTION

### Overview

Established in 2021–2022, the ANZLCR will be a binational, multicentred, population-based clinical quality registry. Confirmation of ethics has been undertaken in Victoria, South Australia, Tasmania and the ACT and further enrolment is facilitated under a National Mutual Acceptance (NMA) agreement.

## Governance and oversight

### Coordinating centre

The operations of the ANZLCR and coordinating centre location will be determined following consultation with the central governance body, with due consideration of relevant skills, experience and costs required to operate a national registry.

### Site investigators

The ANZLCR is a multicentred, investigator-driven endeavour with a local primary investigator(s) at each site responsible for local coordination, including data collection oversight and the feedback and dissemination of report data to institutional stakeholders. Research activities undertaken at their site are conducted in accordance with HREC approval, the research protocol, site registry agreements and related policy documentation.

### Governance structure

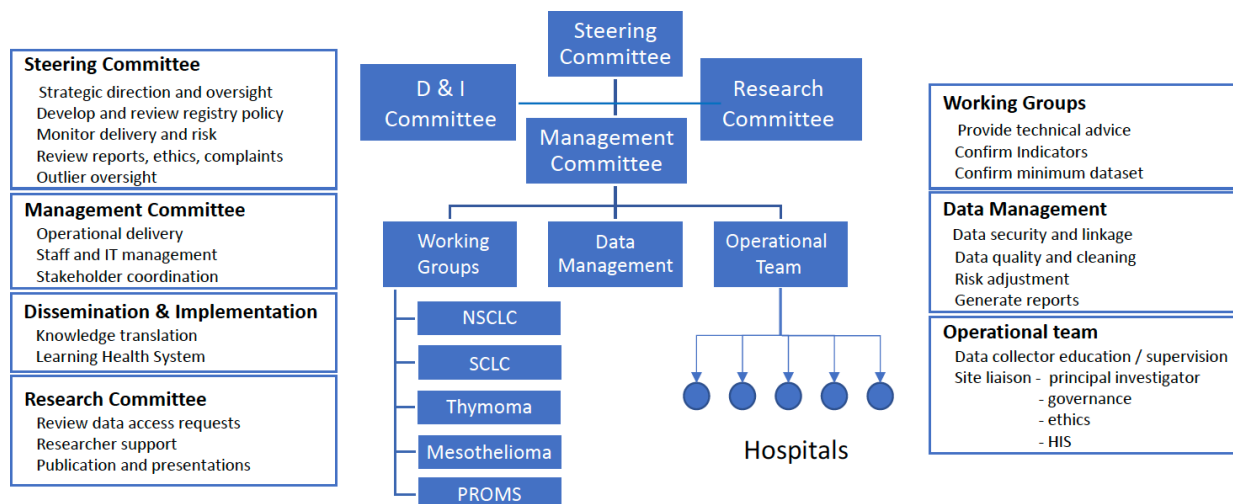
ANZLCR oversight will be provided by a multidisciplinary steering committee in accordance with the Australian Framework for CQRs.<sup>76</sup> Chaired by the clinical leads, the group is composed of patient and carer consumers, specialist lung cancer nurses, thoracic surgeons, medical oncologists, radiation oncologists, respiratory physicians, palliative care specialists, pathologists, radiologists, biostatisticians, informaticists, epidemiologists, public health practitioners, health economists, hospital governance and administration staff, and representatives from state and federal departments of health (figure 4). The committee will seek representation from key national organisations with an interest in improving outcomes for those affected by lung cancer including Lung Foundation Australia, Thoracic Oncology Group of Australasia, Medical Oncology Group of Australia, Clinical Oncology Society of Australia, state and federal Cancer Councils, Cancer Australia and tumour biobank services where available. The steering committee will meet quarterly, providing a significant role in guiding registry strategy and policy, monitoring data collection and quality assurance, reviewing data requests and producing data reports and publications, as per the Australian Operating Principles for Clinical Quality Registries.

### Management committee

A central management committee comprised of a project manager, data custodian, data collector supervisors and data analysts will meet weekly and oversee the day-to-day running of the registry. Further subcommittees and working groups including a data access subcommittee will be established as required.

### Patient and public involvement

No less than two consumers with lived experience of cancer, including lung cancer patients and carers, will inform process as members of the ANZLCR steering committee. A consumer engagement working group will explore opportunities to optimise priorities and measures



**Figure 4** Governance structure for an Australia New Zealand Lung Cancer Registry. HIS, Health Information Services; NSCLC, non-small-cell lung cancer; Patient Reported Outcome Measures (PROMs).

of patient centred care as well as provide direction for registry based collaborative research projects.

### Participant recruitment and consent

#### Registry population

All patients with a confirmed diagnosis of primary thoracic malignancy (NSCLC, SCLC, mesothelioma or thymoma) over  $\geq 18$  years of age who have been diagnosed, assessed and/or treated at a participating site are eligible to participate in the registry. Participants may be included with either clinically diagnosed or tissue confirmed lung cancer.

#### Opt-out process

To minimise recruitment bias and achieve whole population coverage, the ANZLCR employs an opt-out process. This approach has been successfully applied in over 75% of CQRs in Australia and accounts for sicker, disadvantaged and minority groups who would otherwise not be included due to their incapacity to consent.<sup>80</sup> An opt-out process reduces selection bias, which would otherwise be detected by omitting sub-populations, increases clinical validity, thus permitting meaningful outcome assessment with representation from all groups. A waiver of consent applies where patients deemed eligible have died by the time the registry is informed of their diagnosis. The recruitment schema is outlined in [figure 5](#).

#### Participant recruitment

Eligible patients are identified from institutional discharge lung cancer coding, including International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australia Modification (ICD-10-AM) codes C34.0–C34.9, Z85.1–Z85.2 and R91 and adopted in New Zealand.<sup>81</sup> Health Information Services (HIS) at each participating health service provide monthly reports, via password-protected secure file transfer, for eligibility screening of potential participants by ANZLCR site data collectors. After notification, patient details are received

and stored in the custom-built ANZLCR database, hosted securely at Monash University. Eligible patients must have a diagnosis confirmed by either pathology examination or imaging, occurring after the institution enrolment and commencement of data capture. On receipt of notification, patient health status is verified before further contact is made.

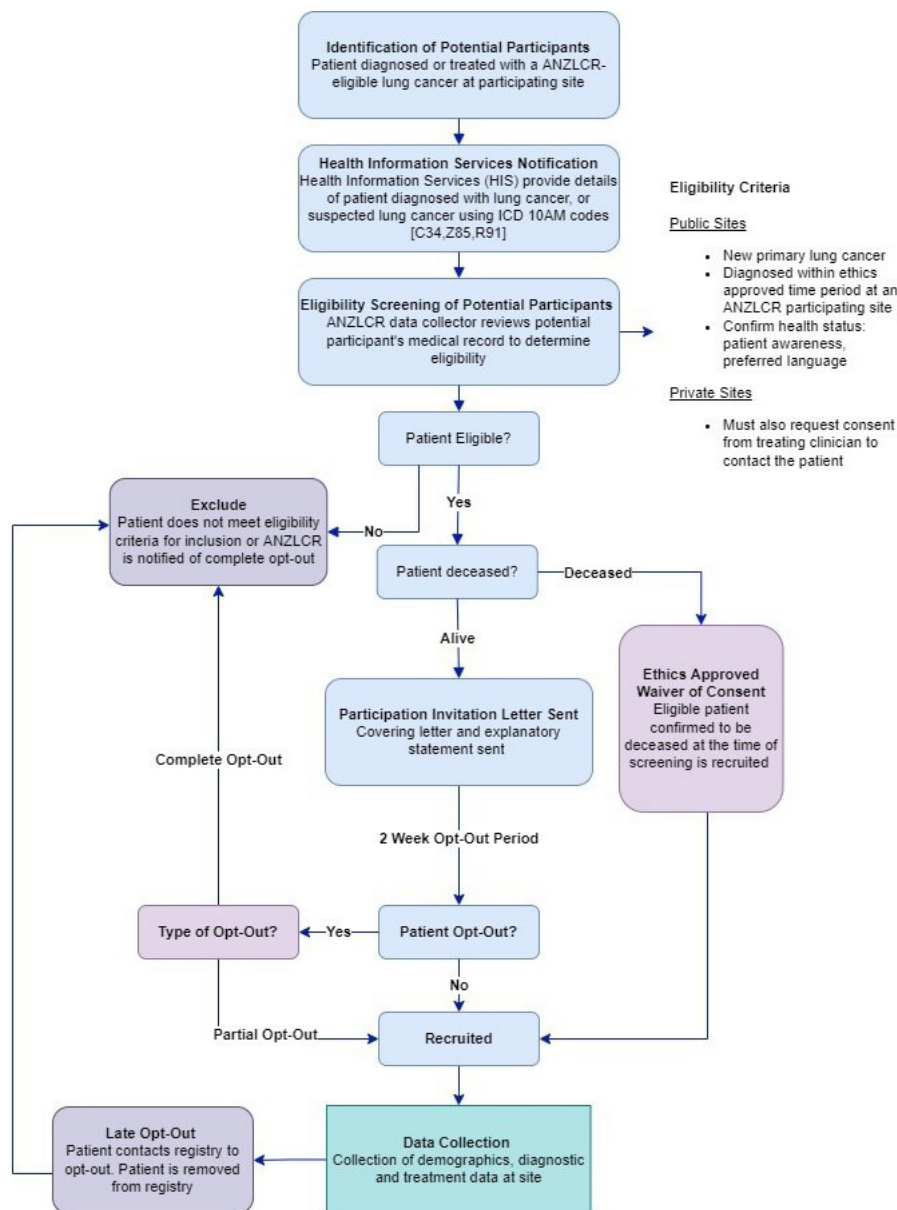
Following screening for eligibility, a patient explanatory statement and informed consent information is provided with a covering letter explaining the registry, data collection and options for opting-out of participation. Patients are given 2 weeks before their participation is assumed, after which, data collection commences. Participants can subsequently opt-out of the registry at any time. Alignment of consent and ethics across jurisdictions to ensure data sovereignty will be confirmed.

#### Quality indicators

Quality indicators have been designed and framed with the objective of reflection of the Institute of Medicine targets for quality care, namely that care be safe, timely, effective, efficient, evidence-based, patient-centred and aligned with current clinical practice guidelines.<sup>74 82–85</sup> Indicators frame the principles of the Lung Cancer Optimal Care Pathways of the Cancer Councils Australia.<sup>86</sup> Indicators are to be further ratified and extended using a three step Delphi process for national endorsement. This process will specifically consider the inclusion of novel/emerging or under-represented measures eg molecular pathological assessment and subsequent treatment, SBRT in early-stage disease and clinical trial participation. Current NSCLC indicators of the VLCR and 2019 performance are represented in [table 1](#).

#### Data collection

Data collection is commenced on receipt of consent first informed by electronic data extracts received from HIS departments at each health service. Patient



**Figure 5** Participant recruitment and data utilisation in the ANZLCR. ANZLCR, Australia and New Zealand Lung Cancer Registry; ICD-10-AM, International Statistical Classification of Diseases, 10th Revision, Australia Modification.

demographics, diagnostic and therapeutic ICD-10-AM coding are captured passively, defined and categorised within the registry database. Clinical treatment and supportive care management data are actively recorded at the site level by data collectors centrally trained and supervised with local direction provided by site principal investigators. Data are primarily submitted via direct data entry using the custom-built secure web-based ANZLCR database. Additional data are obtained from site pharmacy reports, pathology reports and other data sources such as state-level death and cancer-related registries, and government datasets. Site data collectors are trained to use the database, provided with a data dictionary and data entry manual to ensure high-quality data collection. Site data collectors are supported by attendance at quarterly data collection workshops delivered by the central

team to ensure ongoing development, refinement and congruence of data collection skills. Direct data linkage with available multidisciplinary support tools including Queensland Oncology On Line<sup>87</sup> developed by Cancer Alliance Queensland, and oncology data management systems including CHARM<sup>88</sup> and MOSAIQ<sup>89</sup> and state cancer registries<sup>90</sup> will be explored to further support data linkage.

## ETHICS AND DISSEMINATION

### Data privacy

Data collected will be stored within Australia at a data centre in Melbourne, managed by eSolutions of Monash University (onshore and private server). To protect sensitive information, data in transit or at rest will be encrypted.

**Table 1** VLCR clinical quality indicators mapped to the optimal care pathway 2019

<b>Step 1: Prevention and early detection</b>	
Step 2: Presentation, initial investigations and referral	
<b>Quality indicators</b>	<b>Mean 2019</b>
Proportion where time from referral for assessment to diagnosis is $\leq 28$ days	70%
Proportion with documented screening for supportive care	33%
Proportion with documented ECOG status	69%
Step 3: Diagnosis, staging and treatment planning	
Proportion with confirmed tissue diagnosis (malignant cytology or histology)	92%
Proportion with clearly documented cTNM staging	89%
Proportion undergoing resection with clearly documented PET scan	97%
Proportion with documented presentation at a lung MDM	67%
Proportion where time from diagnosis date to first treatment date (any intent) is $\leq 14$ days	41%
Proportion with NSCLC where time from diagnosis date to surgical resection date is $\leq 14$ days	53%
Proportion where time from referral date to first treatment (any intent) is $\leq 42$ days	47%
Step 4: Treatment	
Proportion with NSCLC (clinical stage I, II) who have had surgical resection	61%
Proportion with NSCLC (clinical stage I or II) and resection with $\geq 5$ lymph nodes dissected	70%
Proportion with NSCLC (clinical stage I or II) undergoing resection with VATS approach	80%
Proportion receiving anticancer treatment (surgery, radiotherapy, chemotherapy or systemic therapy)	85%
Proportion with NSCLC (stage IIIB or IV) who have ECOG (0–1) and have commenced chemotherapy	73%
Proportion of NSCLC (pathological stage II) receiving platinum-based chemotherapy after resection	54%
Step 5: Care after initial treatment and recovery	
Proportion of NSCLC undergoing surgical resection with clearly documented pTN	97%
Proportion of NSCLC patients undergoing surgical resection where cTN agrees with pTN	84%
Proportion of patients with NSCLC who have had a surgical resection and died within 30 days of surgery	1.1%
Proportion of patients with NSCLC who have had a surgical resection and died within 90 days of surgery	1.3%
Step 6: Managing recurrent, residual or metastatic disease	
Proportion of patients with NSCLC (stage IV) referred to any palliative care services within 8 weeks of diagnosis	42%
Step 7: End-of-life care	
Proportion of patients with lung cancer where time from chemotherapy start date to death date is $\leq 30$ days	5%
Quality indicators are risk-adjusted for clinical stage, age and sex. cTN, Clinival stage TNM staging system; cTNM, Clinival stage TNM staging system; ECOG, Eastern Cooperative Oncology Group Performance Status; MDM, Multidisciplinary Meeting; NSCLC, non-small-cell lung cancer; pTN, Pathological stage TNM staging system; VATS, video-assisted thoracoscopic surgery; VLCR, Victorian Lung Cancer Registry.	

### Ethics

Each participating site will require approval from local HRECs. National approval has been granted from the Alfred Health HREC under the NMA scheme (HREC/16/Alfred/84).

### Data cleaning, analysis and reporting

Collected data will be cleaned and checked for completeness by central registry data analysts. Quality indicator data will be risk adjusted accounting for sex, age, clinical stage and performance status. Deidentified, risk-adjusted benchmark reports will be distributed to participating site principal investigators, hospital ethics and research

committees and hospital governance and administration on an annual basis with ongoing development of an online QI dashboard for local real time reporting of QI performance. Clinical indicators will be reported using funnel plots,<sup>91</sup> a form of scatter plot in which observed institutional indicator outcomes are plotted demonstrating site volume of activity and outcome (figure 2). Control limits are provided demonstrating 95% and 99.8% CIs and are overlaid on the scatter plot. These control limits represent expected variation in rates assuming random variation and may be used to describe common-cause and special-cause variation.<sup>92</sup> Funnel plots



allow the identification of ‘outlier status’ for an institution which may represent indicator performance that is statistically superior or inferior to included peers. An outlier management policy developed by the ANZLCR Steering Committee will provide a response management strategy for the verification, investigation and resolution of persisting poor hospital performance against reported indicators.

### Data access and release for research

Site principal investigators can request their health services data at any time. In this view, the Registry Coordinator will generate the data ready for secure transfer. The ANZLCR has a data access policy and any researchers wishing to access data will be required to submit a data request form detailing their research proposal to the ANZLCR steering committee. Based on proposal and design, feasibility and impact on healthcare, and following receipt of relevant ethics approval certificates, accepted requests will receive a non-identifiable dataset including the fields specifically requested.

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### REFERENCES

- 1 Cancer data in Australia 2021 AIHW: Australian Institute of health and welfare Australian government; 2021. Available: <https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/contents/about>
- 2 Ministry of Health Manatū Hauora. *New cancer registrations 2018*. Wellington: New Zealand Ministry of Health Manatū Hauora, 2020.
- 3 Welfare AloHa. *Cancer data in Australia*. Canberra: Australian Government, 2021.
- 4 Morampudi S, Das N, Gowda A, *et al*. Estimation of lung cancer burden in Australia, the Philippines, and Singapore: an evaluation of disability adjusted life years. *Cancer Biol Med* 2017;14:74–82.
- 5 Goldsbury DE, Weber MF, Yap S, *et al*. Health services costs for lung cancer care in Australia: estimates from the 45 and up study. *PLoS One* 2020;15:e0238018.
- 6 Carey RN, Whiteman DC, Webb PM, *et al*. The future excess fraction of cancer due to lifestyle factors in Australia. *Cancer Epidemiol* 2021;75:102049.
- 7 Lindeman NI, Cagle PT, Aisner DL, *et al*. Updated molecular testing guideline for the selection of lung cancer patients for treatment with targeted tyrosine kinase inhibitors: guideline from the College of American pathologists, the International association for the study of lung cancer, and the association for molecular pathology. *Arch Pathol Lab Med* 2018;142:321–46.
- 8 Marcoux M, Ost DE. What’s new in endobronchial ultrasound for mediastinal staging? *Curr Opin Pulm Med* 2020;26:346–58.
- 9 Cao C, Frick AE, Ilonen I, *et al*. European questionnaire on the clinical use of video-assisted thoracoscopic surgery. *Interact Cardiovasc Thorac Surg* 2018;27:379–83.
- 10 Bendixen M, Jørgensen OD, Kronborg C, *et al*. Postoperative pain and quality of life after lobectomy via video-assisted thoracoscopic surgery or anterolateral thoracotomy for early stage lung cancer: a randomised controlled trial. *Lancet Oncol* 2016;17:836–44.
- 11 Videtic GMM, Donington J, Giuliani M, *et al*. Stereotactic body radiation therapy for early-stage non-small cell lung cancer: Executive summary of an ASTRO evidence-based guideline. *Pract Radiat Oncol* 2017;7:295–301.

- 12 Yuan M, Huang L-L, Chen J-H, et al. The emerging treatment landscape of targeted therapy in non-small-cell lung cancer. *Signal Transduct Target Ther* 2019;4:61.
- 13 Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med* 2010;363:733–42.
- 14 Cameron JK, Baade P. Projections of the future burden of cancer in Australia using Bayesian age-period-cohort models. *Cancer Epidemiol* 2021;72:101935.
- 15 Wah W, Stirling RG, Ahern S, et al. Forecasting of lung cancer incident cases at the Small-Area level in Victoria, Australia. *Int J Environ Res Public Health* 2021;18. doi:10.3390/ijerph18105069. [Epub ahead of print: 11 05 2021].
- 16 ACSQHC. *Australian Commission on safety and quality in health care. National safety and quality health service standards: user guide for the review of clinical variation in health care*. Sydney: ACSQHC, 2020.
- 17 Wah W, Stirling RG, Ahern S, et al. Association between receipt of Guideline-Concordant lung cancer treatment and Individual- and Area-Level factors: a spatio-temporal analysis. *Cancer Epidemiol Biomarkers Prev* 2020;29:2669–79.
- 18 Ngo P, Goldsbury DE, Karikiotis D, et al. Lung cancer treatment patterns and factors relating to systemic therapy use in Australia. *Asia Pac J Clin Oncol* 2021. doi:10.1111/ajco.13637. [Epub ahead of print: 12 Jul 2021].
- 19 Wah W, Stirling RG, Ahern S, et al. Influence of timeliness and receipt of first treatment on geographic variation in non-small cell lung cancer mortality. *Int J Cancer* 2021;148:1828–1838.
- 20 Matheson LM, Pitson G, Yap CH, et al. Measuring the quality of cancer care in the Barwon South Western region, Victoria, Australia. *Int J Qual Health Care* 2021;33.
- 21 Evans SM, Earnest A, Bower W, et al. Timeliness of lung cancer care in Victoria: a retrospective cohort study. *Med J Aust* 2016;204:75.
- 22 Verma R, Pathmanathan S, Ohty ZA, et al. Delays in lung cancer management pathways between rural and urban patients in North Queensland: a mixed methods study. *Intern Med J* 2018;48:1228–33.
- 23 Mitchell PLR, Thursfield VJ, Ball DL, et al. Lung cancer in Victoria: are we making progress? *Med J Aust* 2013;199:674–9.
- 24 Lin T, Pham J, Paul E, et al. Impacts of lung cancer multidisciplinary meeting presentation: drivers and outcomes from a population registry retrospective cohort study. *Lung Cancer* 2022;163:69–76.
- 25 Batumalai V, Descallar J, Delaney GP, et al. Patterns of palliative radiotherapy fractionation for brain metastases patients in New South Wales, Australia. *Radiother Oncol* 2021;156:174–80.
- 26 Tran B, Sedrakyan A, Flynn P, et al. Reintervention and survival after limited lung resection for lung cancer treatment in Australia. *Ann Thorac Surg* 2019;107:1507–14.
- 27 Allen MJ, Dunn N, Guan T, et al. End-Of-Life intravenous chemotherapy administration patterns in the treatment of Queensland lung and pancreas cancer patients: a 10-year retrospective analysis. *Intern Med J* 2022;52:623–32.
- 28 Rankin NM, McGregor D, Stone E, et al. Evidence-Practice gaps in lung cancer: a scoping review. *Eur J Cancer Care* 2018;27:e12588.
- 29 Mohan S, Beydoun N, Nasser E, et al. Patterns of follow-up care after curative radiotherapy ± chemotherapy for stage I-III non-small cell lung cancer. *Asia Pac J Clin Oncol* 2019;15:172–80.
- 30 Simonella L, O'Connell DL, Vinod SK, et al. No improvement in lung cancer care: the management of lung cancer in 1996 and 2002 in New South Wales. *Intern Med J* 2009;39:453–8.
- 31 Vinod SK, O'Connell DL, Simonella L, et al. Gaps in optimal care for lung cancer. *J Thorac Oncol* 2008;3:871–9.
- 32 Kahu TAoT. *Lung cancer quality improvement monitoring report 2021*. Wellington NZ, 2021.
- 33 Cramb SM, Moraga P, Mengersen KL, et al. Spatial variation in cancer incidence and survival over time across Queensland, Australia. *Spat Spatiotemporal Epidemiol* 2017;23:59–67.
- 34 Olver I, Marine F, Grogan P. Disparities in cancer care in Australia and the Pacific. *Oncologist* 2011;16:930–4.
- 35 Coory MD, Green AC, Stirling J, et al. Survival of Indigenous and non-Indigenous Queenslanders after a diagnosis of lung cancer: a matched cohort study. *Med J Aust* 2008;188:562–6.
- 36 Teng AM, Atkinson J, Disney G, et al. Ethnic inequalities in cancer incidence and mortality: census-linked cohort studies with 87 million years of person-time follow-up. *BMC Cancer* 2016;16:755.
- 37 Costilla R, Tobias M, Blakely T. The burden of cancer in New Zealand: a comparison of incidence and DALY metrics and its relevance for ethnic disparities. *Aust N Z J Public Health* 2013;37:218–25.
- 38 Heathcote KE, Armstrong BK. Disparities in cancer outcomes in regional and rural Australia. *Cancer forum* 2007;31:70–4.
- 39 Chen TYT, Morrell S, Thomson W, et al. Survival from breast, colon, lung, ovarian and rectal cancer by geographical remoteness in New South Wales, Australia, 2000–2008. *Aust J Rural Health* 2015;23:49–56.
- 40 Yu XQ, O'Connell DL, Gibberd RW, et al. Assessing the impact of socio-economic status on cancer survival in New South Wales, Australia 1996–2001. *Cancer Causes Control* 2008;19:1383–90.
- 41 Yu XQ, Luo Q, Kahn C, et al. Widening socioeconomic disparity in lung cancer incidence among men in New South Wales, Australia, 1987–2011. *Chin J Cancer Res* 2017;29:395–401.
- 42 Pham J, Conron M, Wright G, et al. Excess mortality and undertreatment in elderly lung cancer patients: treatment nihilism in the modern era? *ERJ Open Res* 2021;7. doi:10.1183/23120541.00393-2020. [Epub ahead of print: 24 05 2021].
- 43 Mainz J. Defining and classifying clinical indicators for quality improvement. *Int J Qual Health Care* 2003;15:523–30.
- 44 Quentin WPV, Brownwood I, et al. Measuring healthcare quality. In: Busse RKN, Panteli D, eds. *Improving healthcare quality in Europe: characteristics, effectiveness and implementation of different strategies. health policy series, no. 53*. Copenhagen (Denmark): European Observatory on Health Systems and Policies, 2019.
- 45 Friedman CP, Wong AK, Blumenthal D. Achieving a nationwide learning health system. *Sci Transl Med* 2010;2:cm29.
- 46 Guise J-M, Savitz LA, Friedman CP. Mind the gap: putting evidence into practice in the era of learning health systems. *J Gen Intern Med* 2018;33:2237–9.
- 47 cancercentrum R. *Lungcancerregistret [Swedish National Lung Cancer Register]*, 2017.
- 48 Beck N, Hoeijmakers F, Wiegman EM, et al. Lessons learned from the Dutch Institute for clinical auditing: the Dutch model for quality assurance in lung cancer treatment. *J Thorac Dis* 2018;10:S3472–85.
- 49 Jakobsen E, Green A, Oesterlind K, et al. Nationwide quality improvement in lung cancer care: the role of the Danish lung cancer group and registry. *J Thorac Oncol* 2013;8:1238–47.
- 50 Rich AL, Tata LJ, Stanley RA, et al. Lung cancer in England: information from the National lung cancer audit (LUCADA). *Lung Cancer* 2011;72:16–22.
- 51 Ismail RK, Schramel FMNH, van Dartel M, et al. The Dutch lung cancer audit: nationwide quality of care evaluation of lung cancer patients. *Lung Cancer* 2020;149:68–77.
- 52 Jakobsen E, Rasmussen TR. The Danish lung cancer registry. *Clin Epidemiol* 2016;8:537–41.
- 53 Jakobsen E, Palshof T, Oesterlind K, et al. Data from a national lung cancer registry contributes to improve outcome and quality of surgery: Danish results. *Eur J Cardiothorac Surg* 2009;35:348–52.
- 54 Jakobsen E, Rasmussen TR, Green A. Mortality and survival of lung cancer in Denmark: results from the Danish lung cancer group 2000–2012. *Acta Oncol* 2016;55 Suppl 2:2–9.
- 55 Beckett P, Woolhouse I, Stanley R, et al. Exploring variations in lung cancer care across the UK--the 'story so far' for the National Lung Cancer Audit. *Clin Med* 2012;12:14–18.
- 56 Khakwani A, Rich AL, Powell HA, et 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.
- 57 Iyen-Omofoman B, Hubbard RB, Smith CJP, et al. The distribution of lung cancer across sectors of society in the United Kingdom: a study using national primary care data. *BMC Public Health* 2011;11:857.
- 58 Khakwani A, Hubbard RB, Beckett P, et al. Which patients are assessed by lung cancer nurse specialists? a national lung cancer audit study of over 128,000 patients across England. *Lung Cancer* 2016;96:33–40.
- 59 Cusworth K, O'Dowd E, Hubbard R, et al. Variation in lung cancer resources and workload: results from the first National lung cancer organisational audit. *Thorax* 2015;70:1001–3.
- 60 Khakwani A, Harden S, Beckett P, et al. Post-Treatment survival difference between lobectomy and stereotactic ablative radiotherapy in stage I non-small cell lung cancer in England. *Thorax* 2020;75:237–43.
- 61 Phillips I, Sandhu S, Lichtenborg M, et al. Stereotactic ablative body radiotherapy versus radical radiotherapy: comparing real-world outcomes in stage I lung cancer. *Clin Oncol* 2019;31:681–7.
- 62 Nartey Y, Stewart I, Khakwani A, et al. Is the English cancer patient experience survey representative? A comparative analysis with the National lung cancer audit. *Lung Cancer* 2020;140:27–34.
- 63 Aveling E-L, Martin G, Jiménez García S, et al. Reciprocal peer review for quality improvement: an ethnographic case study of the improving lung cancer outcomes project. *BMJ Qual Saf* 2012;21:1034–41.

- 64 Russell GK, Jimenez S, Martin L, *et al.* A multicentre randomised controlled trial of reciprocal lung cancer peer review and supported quality improvement: results from the improving lung cancer outcomes project. *Br J Cancer* 2014;110:1936–42.
- 65 Walpole ET, Theile DE, Philpot S, *et al.* Development and implementation of a cancer quality index in Queensland, Australia: a tool for monitoring cancer care. *J Oncol Pract* 2019;15:e636–43.
- 66 Kim ML, Matheson L, Garrard B, *et al.* Use of clinical quality indicators to improve lung cancer care in a regional/rural network of health services. *Aust J Rural Health* 2019;27:183–7.
- 67 Stirling RG, Evans SM, McLaughlin P, *et al.* The Victorian lung cancer registry pilot: improving the quality of lung cancer care through the use of a disease quality registry. *Lung* 2014;192:749–58.
- 68 Health Q. *Queensland lung cancer quality index, indicators of safe, quality cancer care, lung cancer care in public and private hospitals, 2011–2016*. Brisbane: Queensland Government, 2020.
- 69 Performance index of the cancer Institute NSW 2021. Available: <https://www.cancer.nsw.gov.au/what-we-do/nsw-cancer-plan/performance-index>
- 70 The Queensland lung cancer quality index 2021. Available: <https://cancerallianceqld.health.qld.gov.au/media/1904/queensland-lung-cancer-quality-index-2011-2016.pdf>
- 71 Cancer alliance Queensland 2021. Available: <https://cancerallianceqld.health.qld.gov.au/>
- 72 Victorian lung cancer registry 2021. Available: <https://vlcr.org.au/>
- 73 Segelov E, Carrington C, Aranda S, *et al.* Developing clinical indicators for oncology: the inaugural cancer care indicator set for the Australian Council on healthcare standards. *Med J Aust* 2021;214:528–31.
- 74 Institute of Medicine Committee on Quality of Health Care in A. *Crossing the quality chasm: a new health system for the 21st century*. Washington (DC: National Academies Press (US) Copyright 2001 by the National Academy of Sciences, 2001.
- 75 Braithwaite J, Glasziou P, Westbrook J. The three numbers you need to know about healthcare: the 60-30-10 challenge. *BMC Med* 2020;18:102.
- 76 ACSQHC. *Framework for Australian clinical quality registries*. Sydney: Australian Commission on Safety and Quality in Health Care, 2014.
- 77 Australia DoHCo. *National clinical quality registry and virtual registry strategy 2020–2030*. 2020. Contract No: Publications Number: 12732, 2020.
- 78 Largey G, Briggs P, Davies H, *et al.* Victorian lung cancer service redesign project: impacts of a quality improvement collaborative on timeliness and management in lung cancer. *Intern Med J* 2021;51:2061–8.
- 79 Monash clinical registries 2021. Available: <https://www.monash.edu/medicine/sphpm/registries>
- 80 Evans SM, Loff B, Cameron PA. Clinical registries: the urgent need to address ethical hurdles. *Med J Aust* 2013;198:134–5.
- 81 NZ MoHMH. Ministry of health Manatū Hauora NZ, 2021. Available: <https://www.health.govt.nz/nz-health-statistics/classification-and-terminology/icd-10-am-achi-ac>
- 82 Australia CC. *Clinical practice guidelines for the treatment of lung cancer*. Sydney: Cancer Council Australia, 2016.
- 83 Planchard D, Popat S, Kerr K, *et al.* Correction to: "Metastatic non-small cell lung cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up". *Ann Oncol* 2019;30:863–70.
- 84 Postmus PE, Kerr KM, Oudkerk M, *et al.* Early and locally advanced non-small-cell lung cancer (NSCLC): ESMO clinical practice guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2017;28:iv1–21.
- 85 NCCN. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®) Non-Small Cell Lung Cancer 2017 [Version 9.2017 – September 28, 2017]. Available: [https://www.nccn.org/professionals/physician\\_gls/PDF/nscl.pdf](https://www.nccn.org/professionals/physician_gls/PDF/nscl.pdf)
- 86 Health CCVaDo. *Optimal care pathway for people with lung cancer*. Melbourne: Cancer Council, 2021.
- 87 Queensland oncology on line (QOOL) 2021. Available: <https://cancerallianceqld.health.qld.gov.au/applications/qool/>
- 88 CHARM medical oncology data management system 2021. Available: <https://citadelhealth.com.au/solutions/product/charm/>
- 89 MOSAIQ medical oncology data management system 2021. Available: <https://www.elekta.com/software-solutions/care-management/mosaiq-medical-oncology/>
- 90 Victorian cancer registry 2021. Available: <https://www.cancervic.org.au/research/vcr>
- 91 Dover DC, Schopflocher DP. Using funnel plots in public health surveillance. *Popul Health Metr* 2011;9:58.
- 92 Gale CP, Roberts AP, Batin PD, *et al.* Funnel plots, performance variation and the myocardial infarction national audit project 2003–2004. *BMC Cardiovasc Disord* 2006;6:34.