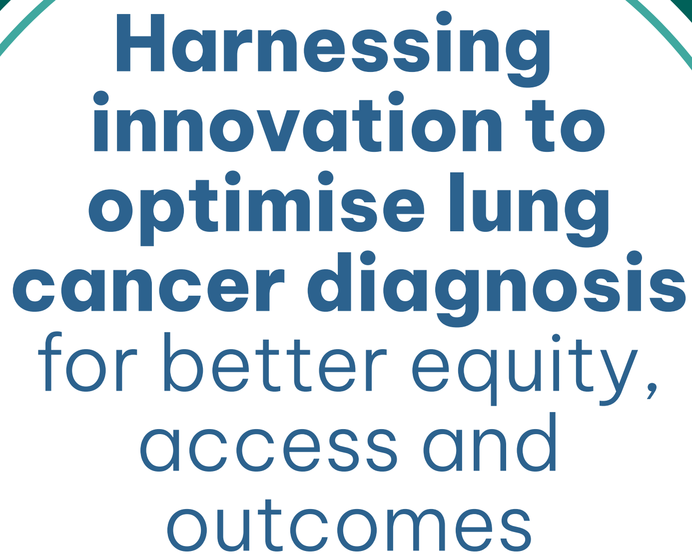
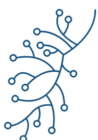
Harnessing innovation to optimise lung cancer diagnosis for better equity, access and outcomes

November 2025





The Lung Cancer Policy Network is a global multidisciplinary network of experts from across the lung cancer community, which includes clinicians, researchers, patient organisations and industry partners. The Network is funded by Amgen, AstraZeneca, Bristol Myers Squibb Foundation, Johnson & Johnson, MSD, Pfizer, Siemens Healthineers, Guardant Health and GE HealthCare. Lilly has also provided funding to the Network on an arm's-length basis and has no control or influence over the Network or its outputs. Secretariat is provided by The Health Policy Partnership, an independent health research and policy consultancy. All Network outputs are non-promotional, evidence based and shaped by the members, who provide their time for free.

Acknowledgements

This report was written by the Lung Cancer Policy Network Secretariat in close consultation with Network members and additional experts. We would like to acknowledge all Network members (see *Appendix*) for their contributions, as well as member organisations for supporting the development of this report:

We thank the following experts for sharing their perspectives with us through interviews:

- **Dr Chiara Antoniani,** Community Engagement and EU Project, Lung Cancer Europe, Italy
- **Andy Duda,** Director, Patient Advocacy – Oncology, Guardant Health, US
- **Dr Craig Dyer,** Respiratory Consultant, University Hospital of Wales, UK
- **Prof. Jon Emery,** Professor of Family Medicine, Nanyang Technological University, Singapore
- **Dr Roberto Gasparri,** Division of Thoracic Surgery, European Institute of Oncology, Italy
- **Dr Swasti Mishra,** Interim Head of Operations and EU Policy & Engagement Advisor, Lung Cancer Europe, the Netherlands
- **Debra Montague,** Founder and Chair, ALK Positive Lung Cancer UK; President, Lung Cancer Europe, UK
- **Dr Zulfiquer Otty,** Medical Oncologist, Townsville University Hospital; Senior Lecturer, James Cook University, Australia
- **Dr Angela Sabalic,** Division of Thoracic Surgery, European Institute of Oncology, Italy
- **Prof. Anand Sachithanandan,** Co-Founder and Immediate Past President, Lung Cancer Network Malaysia; Consultant Cardiothoracic Surgeon, Sunway and Subang Jaya Medical Centres, Malaysia
- **Angeliki Souri,** Member of the Advisory Committee, FairLife Lung Cancer Care, Greece; Vice President, Lung Cancer Europe
- **Prof. Fiona Walter,** Director, Wolfson Institute of Population Health; Professor of Primary Care Cancer Research, Queen Mary University of London, UK

We also thank **Korina Pateli-Bell**, Founder and President of FairLife Lung Cancer Care, Greece, for contributing her insights.

Contents

Executive summary 5

Why is timely and accurate lung cancer diagnosis not widely available? 7

How can the diagnostic process be optimised in each phase of care? 11

- **Pre-diagnosis 13**
- **Diagnosis 16**
- **Post-diagnosis 26**

Key actions to optimise lung cancer diagnosis 28

References 29

Appendix. Lung Cancer Policy Network members 34

Executive summary

Globally, the timeliness and quality of lung cancer diagnosis remain suboptimal, contributing to poor outcomes and unnecessary loss of life. Despite significant advancements in research and practice,[1] lung cancer remains the leading cause of cancer deaths worldwide.[2] This is largely because most people are diagnosed at a late stage, when survival prospects are lowest and management is more complex and costly.[3] Earlier and more accurate diagnosis has the potential to transform outcomes, but limited implementation of screening programmes, combined with persistent limitations in current diagnostic methods and specific techniques, continue to constrain progress.[4 5]

The diagnostic landscape for lung cancer is evolving, creating both new opportunities and challenges. Recent advances in our knowledge of the molecular mechanisms underlying the disease, alongside the discovery of several biomarkers, are reshaping how lung cancer is understood.[6] Policy commitments also signal growing recognition of the importance of an efficient diagnostic process, as shown by the adoption of a lung health resolution at the 2025 World Health Assembly and inclusion of several initiatives for improving cancer diagnosis and treatment in *Europe's Beating Cancer Plan*.[7 8] This momentum must be translated into action: health systems need to be ready to adapt to an ever-changing landscape, otherwise these opportunities risk being squandered.

Innovation across the entire diagnostic process offers a route to better outcomes in lung cancer. Embedding novel approaches to diagnosis can improve its accuracy, efficiency and timeliness. Innovations should be tailored to each country's health system to help reduce existing disparities, and enhance survival and quality of life for people with lung cancer.

To support health system leaders and decision-makers in optimising lung cancer diagnosis, we recommend streamlining all phases of the diagnostic process (pre-diagnosis, diagnostic testing and staging, post-diagnosis) through a multi-pronged approach. The goal is to achieve efficient and equitable referral, treatment and care through the following actions:

Identify and address gaps in research and implementation that contribute to key challenges:

- provide dedicated funding to address gaps in diagnosis research and implementation
- explore known and emerging diagnostic biomarkers and technologies, and investigate how they can be integrated effectively and equitably into practice.

Implement approaches to **recognise and reduce diagnostic errors, delays and costs:**

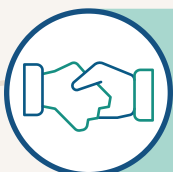
- implement innovative approaches to reduce diagnostic error and streamline diagnostic processes
- incorporate cost-effectiveness analyses and systematic consideration of health system resources and priorities when developing strategies to optimise diagnosis.

Facilitate **effective teamwork** among healthcare professionals across the diagnostic process:

- support effective collaboration and communication within and between multidisciplinary teams.

Enhance **guidance, education and training** for healthcare professionals, informed by the latest evidence and diagnostic tools:

- ensure guidance and recommendations for diagnosis reflect the latest evidence, to help improve care experiences and outcomes
- implement a variety of resources to help train and equip healthcare professionals so they can support optimal diagnosis.



Establish a **payment and care delivery environment** that supports accessibility to the latest innovations:

- address challenges around reimbursement and knowledge of diagnostic tests to reduce inequalities in access.

Why is timely and accurate lung cancer diagnosis not widely available?

Delayed diagnosis is a major contributing factor to widespread poor outcomes and survival in lung cancer. Recent progress in the diagnosis, assessment and management of lung cancer is not being fully translated into improvements in outcomes and survival.[1] Inadequate early detection and tobacco control efforts, as well as limitations in current diagnostic methods and specific techniques – such as their high costs, invasiveness and time-consuming processes – mean most people are diagnosed at an advanced stage.[5 9 10] At this late stage, curative treatment is often not feasible,[11] chances of survival are lowest and clinical management becomes more complex – all of which contribute to higher healthcare costs.[3 12]

'More attention must be paid to diagnosing lung cancer when it is curable. Prompt and accurate diagnoses will not only reduce mortality but also save money for health systems and ease the psychological challenges people with cancer face.'

Dr Roberto Gasparri, European Institute of Oncology, Italy

Lung cancer is an inequitable disease, with differences in survival associated with location, sex and socioeconomic position, while other biological and demographic factors add further complexity to disparities. Based on 2022 data, the highest lung cancer incidence and mortality rates are observed in Eastern Asia, in countries with a high level of development,

and in men.[9]* These rates have also increased globally among women in the past few decades.[13] Different risk factors for lung cancer affect population groups disproportionately; for instance, smoking prevalence is notably higher among people from a lower socioeconomic position, disabled people, people with mental health conditions,women who have sex with women, and men who have sex with men.[14-17] Significant differences in disease characteristics, such as how quickly a tumour grows, have been linked to ethnicity, deprivation and other demographic factors.[18]

Accurate diagnosis offers a way to ensure these disparities are not exacerbated through suboptimal care. Widespread gaps in access to diagnostic testing and innovations reduce diagnostic accuracy, delay detection and contribute to long-observed inequalities in outcomes for people with lung cancer.[19-21] For example, while biomarker testing rates for lung cancer have increased globally in recent years (*Box 1*), these vary widely between countries and barriers to access are widespread.[22] Optimising diagnostic strategies in the context of each country's unique population and health system is therefore essential to realising the benefits of innovation fairly and effectively.

Box 1. The evolution of diagnostic testing for lung cancer

Traditionally, confirmation of a lung cancer diagnosis has relied heavily on **pathological testing**, which involves examining cells and tissues under a microscope and collecting information on features of the cancer.[23 24]

More recently, **biomarker testing** – also known as **molecular**, **mutation** or **genomic testing** – has emerged to supplement the diagnostic process.[23 25] It involves studying biological molecules in tissue or fluid.[26]

By providing measurable indicators of disease characteristics, biomarker testing can play a crucial role in precision medicine and enable tailored treatments.[27] Of the two main types of lung cancer, there are several biomarkers identified for testing in non-small cell lung cancer (NSCLC), but biomarkers for small cell lung cancer (SCLC) are only just emerging.[28 29]

* Countries with a 'high level of development' refers to a high human development index (Zhou *et al*, 2024).

‘To address the disparities in diagnostic testing and work towards implementing best practice, we need to account for the role of cross-policy issues such as the differences in regional risk profiles, which determine who gets tested, when and how.’

Dr Swasti Mishra, Lung Cancer Europe, the Netherlands

Policymakers increasingly recognise the value of efficient diagnostic processes, but more work is needed to translate this to local strategies. Lung health has recently been raised as a policy priority at a global level; in May 2025, the World Health Assembly put forward a resolution that recognises the importance of identifying and addressing gaps in the diagnosis of lung conditions.[7] Alongside this, regional commitments are being made to optimise diagnosis, such as the inclusion of several initiatives in *Europe’s Beating Cancer Plan*.[8] National cancer control plans (NCCPs) are also changing to reflect the latest knowledge and to shift towards person-centred care.[30] A recent study found that, so far, 64 out of 96 NCCPs (67%) included strategies related to the use of cancer diagnosis guidelines, and 37 out of 98 NCCPs (38%) referred to a pathology or laboratory assessment or plan.[30] To ensure appropriate allocation of resources and high-quality care delivery, national strategies must reflect the latest evidence, outline priorities for diagnosis and be accompanied by appropriate funding models.

‘There are delays in tests being carried out and in tests being reported. As patients we can be left wondering about the impact of a possible diagnosis and that our condition may be progressing the more we have to wait.’

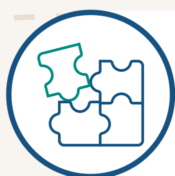
Debra Montague, ALK Positive Lung Cancer UK

Optimising lung cancer diagnosis requires a multifactorial and multidisciplinary approach to lessen the impact of the disease on people, health systems and society. Owing to the global diversity of health systems, economies and social contexts, optimal diagnostic processes will vary, but should be underpinned by globally accepted minimum standards. Optimisation means continuously refining processes and implementation so that interventions deliver the greatest possible benefit within resource constraints.[31]

For lung cancer diagnosis, optimisation efforts should span the following key domains:

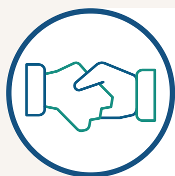
identifying and addressing gaps in research and implementation that contribute to key challenges

implementing approaches to **recognise and reduce diagnostic errors, delays and costs**



facilitating **effective teamwork** among healthcare professionals across the diagnostic process

enhancing **guidance, education and training** for healthcare professionals, informed by the latest evidence and diagnostic tools



establishing a **payment and care delivery environment** that supports accessibility to the latest innovations

How can the diagnostic process be optimised in each phase of care?

'It can be difficult for people to get a lung cancer diagnosis, and once they do, there is a sense they are entering a pathway where there is little clarity on what is going on.'

Dr Chiara Antoniani, Lung Cancer Europe, Italy

A comprehensive approach to diagnosis must be recognised as a critical component of lung cancer care. The diagnostic pathway starts from a person's first interaction with a healthcare professional, all the way through to confirmation of a disease or condition.[32] Optimisation should not be limited to the exact moment a person is diagnosed; there are a variety of opportunities to do so that must also be taken up pre- and post-diagnosis (*Fig. 1*). And systematic evaluation of the quality of care across the diagnostic process is essential (*Box 2*).

Box 2. Evaluating care quality across the diagnostic process

The quality of care across the diagnostic process should be evaluated in order to inform practice and improve outcomes for people with lung cancer.

Quality indicators help monitor whether best-practice care is delivered, highlight variations, guide performance improvement and promote accountability.[33] A wide variety of quality indicators for lung cancer diagnosis are already in use.[33] One example is the Australian Embedding Research (and Evidence) in Cancer Healthcare (EnRICH) programme. It comprises ten evidence-based indicators that cover the full diagnostic and care pathway, underscoring the importance of considering every phase of care when seeking to improve outcomes.[34]

Fig. 1. The cancer diagnostic process

Pre-diagnosis

Screening

Emergency presentation

Primary care referral

Other outpatient referral

Inpatient elective referral

Alternative route

Person engages with the health system

Diagnosis

Information gathering and interpretation

Diagnostic testing

Communication of diagnosis and staging, and referral to treatment

Post-diagnosis

Treatment

Onward care

Source: National Academies of Sciences, Engineering, and Medicine. 2015. *Improving Diagnosis in Health Care*. https://doi.org/10.17226/21794. Adapted and reproduced with permission from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, DC

'It is essential to optimise all phases of the diagnostic process to not only improve care, but also reduce stress for the person and increase their trust in the health system.'

Dr Chiara Antoniani, Lung Cancer Europe, Italy

Pre-diagnosis

Deficiencies in early detection hinder timely entry into the diagnostic process. People reach a lung cancer diagnosis via a variety of routes (*Fig. 1*), but a number of persistent obstacles often delay prompt identification and referral.[35] These include:

- limited implementation of screening programmes (*Box 3*)[4]
- hesitancy to engage with the health system due to stigma caused by the perception that lung cancer must be associated with smoking
- inadequate knowledge of lung cancer symptoms among healthcare professionals
- suboptimal communication between healthcare professionals and people seeking care
- low awareness of lung cancer symptoms among the public, with disparities observed by location, gender and age
- fatalistic and stigmatising beliefs about lung cancer outcomes preventing people from seeking help.[36 37]

Box 3. Screening and the early detection of lung cancer

Targeted screening using low-dose computed tomography (LDCT) offers a cost-effective opportunity to significantly improve survival rates through earlier detection of lung cancer among people at high risk.[38-40] When early-stage lung cancer is diagnosed via annual LDCT screening, around 8 in 10 people with the diagnosis are still alive 20 years later.[39]

However, targeted screening programmes are only established in a small number of countries.[4] Countries should seek to implement combined earlier detection strategies that facilitate a comprehensive and equitable approach. These can include screening, appropriate management of incidental pulmonary nodules detected during other care and outside a screening programme, and risk reduction measures.[41 42*]

* Incidental pulmonary nodules are growths in the lungs detected during computed tomography scans of the thorax for reasons other than suspicion of lung cancer (Vindum *et al*, 2023).

Healthcare professionals must have a strong understanding of the different risk factors for, and the impact of, lung cancer within and across populations to ensure faster referral and diagnosis. The risk profiles for lung cancer, and our understanding of these risks, are changing.[43-45] For example, approximately one third of all people with lung cancer in East Asia have never smoked, with many of these individuals found to have genetic mutations associated with the development of cancer.[46] It is important to equip primary care providers in particular with the knowledge to identify all risk factors and recognise symptoms.[47] This can aid with efficient referral, further supported by formalised processes such as diagnostic assessment programmes and rapid referral pathways.[48-50] The latter are often implemented alongside specific referral criteria, waiting time targets and digital platforms to help deliver person-centred, timely diagnosis and care that is aligned with local guidance (*Case study 1*).[50-52]

Case study 1

Optimising lung cancer diagnosis and reducing access inequalities using a referral pathway in rural Australia

In north Queensland, geographical remoteness is one factor associated with delays throughout the lung cancer care pathway.[53]

In 2019, the web-based Townsville Lung Cancer Referral Pathway was established to guide local general practitioners (GPs) in referring people with suspected lung cancer who live in remote areas, and prevent delays in diagnosis.[52] The pathway has reduced the time from initial GP consultation to specialist referral from 15 to 8 days on average.[52] Subsequent advocacy by lung cancer specialists led to the recruitment of more respiratory physicians, an increase in availability of different biopsy services, and the introduction of a lung nodule programme and rapid access clinic.[54]

Implementation of the pathway can be further supported by continuing to expand the number of respiratory specialists, recruiting specialist lung cancer nurses and care coordinators, increasing radiology facilities, and making greater use of telehealth.[55]

'The Townsville Lung Cancer Referral Pathway has helped to create awareness of this disease among all clinicians, streamline the referral process and ultimately get diagnosis done.'

Dr Zulfiquer Otty, Townsville University Hospital, Australia

Better recognition of lung cancer symptoms will help reduce missed and emergency presentation, ultimately improving prognosis, outcomes and survival. Emergency presentation remains a common route to a lung cancer diagnosis that is strongly associated with lower survival rates.[56-59] However, many of these emergency presentations could be avoided, as people often experience symptoms of lung cancer for some time, but do not recognise them as such, or have previously engaged with primary care services for these symptoms before their emergency diagnosis.[57 60] Streamlining diagnostic pathways, strengthening decision-support tools for primary care professionals, and improving communication between primary and secondary care can all help address these missed opportunities.[57]

Awareness campaigns, training and guidance can support better recognition of symptoms among both the general public and healthcare professionals. Lung cancer symptoms (e.g. persistent cough, chest pain, fatigue) – even at a late stage of disease – can be difficult to distinguish from symptoms of other conditions and are sometimes attributed to behaviours such as chronic smoking.[61-63] It is therefore important that both healthcare professionals and the public have a good awareness of lung cancer symptoms. A variety of guidance documents, training programmes and awareness campaigns have been developed in several regions. These include referral guidelines for GPs in the UK; a free, accredited eLearning course for Australian healthcare professionals; and Lung Cancer Europe's 'Get Checked!' campaign.[64-66]

Diagnosis

Advances in science are transforming lung cancer diagnosis into a more precise and tailored process. As the underlying molecular mechanisms of the disease are uncovered, the diagnosis of lung cancer is becoming increasingly intricate, with a growing range of tests (*Fig. 2*).[67] While imaging and biopsy techniques remain the traditional backbone of diagnosis, new and less invasive tests are increasingly being used alongside them.[67-69]

Emerging diagnostic techniques can improve accuracy while reducing delays and costs. Biomarker testing and innovative bronchoscopy techniques are examples of approaches that can complement traditional diagnostic methods.[70]* When integrated effectively, these innovative techniques can help curtail risks, costs and potential delays in diagnosis often associated with invasive procedures.[71] They can also facilitate more personalised assessment, allowing people with suspected lung cancer to be reviewed on a case-by-case basis for further testing and tailored diagnosis.[72]

Despite this progress, systematic efforts are needed to avoid the risk that new technologies add complexity without consistently improving timeliness, accuracy or equity of lung cancer diagnosis. Gaps in research and uneven implementation mean that healthcare professionals often face uncertainty in selecting the most appropriate diagnostic tests, while also needing to balance availability with the individual needs of the person being tested.[73] Decision-making is further complicated by variation in health system resources, inconsistent guidance on best practice, and the challenge of delivering multidisciplinary care when expertise and capacity may differ between settings.

> ‘Variable access to diagnostic tests in primary care results in different thresholds for referral and ultimately contributes to the variations in outcomes observed internationally.’
>
> **Prof. Jon Emery, Nanyang Technological University, Singapore**

* Bronchoscopy techniques examine the airways and lungs using a thin, tube-like instrument inserted through the nose or mouth (National Cancer Institute, 2025).

Fig. 2. Diagnostic tests for lung cancer are growing in number and complexity[25 67 74-76]

History and physical exam	Laboratory	Imaging	Biopsies	Biomarkers
Examination of any signs/symptoms and medical history for risk factors	Testing to help assess a person's overall health that may also support diagnosis	Images of inside the body to help detect the presence of disease	Procedures to confirm the presence and type of lung cancer	Testing to provide more detailed information on a cellular level to inform diagnosis and treatment
Lung function and breathing tests	Blood tests	Bone scan	Bronchoscopy (e.g. white light bronchoscopy, autofluorescence bronchoscopy)	Liquid biopsy
Medical history	Cytology (sputum, pleural fluid)	Chest X-ray	Mediastinoscopy and mediastinotomy	Tissue biopsy
	Histology	CT scan	Thoracentesis (pleural aspiration)	Next-generation sequencing[79]
		Magnetic resonance imaging (MRI) scan	Thoracoscopy	
		Positron emission tomography (PET) scan	Transthoracic needle biopsy	
			Ultrasound (e.g. endobronchial, endoscopic, endoscopic oesophageal)	

People being tested for lung cancer can expect to receive multiple tests from across these categories. While this means the process can be tailored to an individual, the intricacies can prove complex to navigate, impacting healthcare professionals and health systems too.

For example, a variety of biomarkers are already used in diagnostic testing for NSCLC, or show potential for use, including genetic markers, circulating DNA and RNA, proteins, circulating exosomes, DNA methylation patterns, circulating tumour cells, metabolites and volatile organic compounds.[70 77 78]

Ways to optimise diagnosis

Identify and address gaps in research and implementation that contribute to key challenges

There is an urgent need to expand diagnosis research that addresses global diversity in populations and health systems. Knowledge of different subtypes of lung cancer continues to evolve, but the topic is not yet fully understood.[29] Despite being the leading cause of cancer mortality, lung cancer receives less research funding than many other cancer types, and existing research is largely produced by high-income countries.[80 81] Because lung cancer is so complex, research is needed to better understand the right diagnostic approaches and the risks of lung cancer across different populations.[78] To help close evidence gaps, funded research opportunities are increasingly offered by a number of organisations, but the findings must be routinely integrated into common practice.[82 83] This should include more comprehensive research into potential biomarkers, as well as key considerations for effective and equitable implementation – such as how biomarker testing may be integrated in a variety of settings and alongside advanced technologies.[20 22 27]

> 'We must carefully consider how every diagnostic tool may influence the health system, and we need to ask what the impact on patients and clinicians will be.'
>
> **Dr Chiara Antoniani, Lung Cancer Europe, Italy**

Future research must prioritise standardised and scalable innovations in diagnostic testing for lung cancer. The discovery of several lung cancer biomarkers – including targetable genetic alterations – has stimulated additional advances in molecular data collection and computer-aided tools that enhance possibilities for early diagnosis.[6 27] Next-generation sequencing is now established for lung cancer and able to identify genetic alterations, with a variety of new technologies emerging as well, including:[79]

- sensors able to detect lung cancer biomarkers (*Case study 2*)[84]
- nanotechnologies that can assist in early-stage diagnosis[85]
- AI models that provide insights into molecular processes[86]
- tools offering support for clinical decision-making, such as advanced image analysis.[87]

Case study 2

Research into 'electronic nose' devices to help diagnose lung cancer

Over the past two decades, devices called 'electronic noses' have been developed with the aim to help diagnose and monitor lung cancer without invasive procedures.[88]

These devices can detect specific compounds (volatile organic compounds, or VOCs) in a person's breath that are linked to lung cancer with a high level of accuracy.[88-90] These compounds arise due to changes in a person's metabolic processes, such as inflammation, which can be associated with cancer cells.[88 91]

The analytical techniques used by electronic nose devices are simple to perform, use samples that are easy to collect, and provide immediate results.[91] Despite these advantages, however, these devices remain primarily research tools, as there is not yet enough evidence to use them as routine diagnostic tests in clinical practice.[88] Research is ongoing to standardise the testing methods, validate the devices in large studies and use digital technologies to make their diagnoses more reliable.[91]

'Electronic nose devices hold great promise for the diagnosis of lung cancer, using different body specimens. By standardising the devices through further research, we could generate a registry of lung cancer biomarkers to help significantly speed up diagnosis – non-invasively.'

Dr Angela Sabalic, European Institute of Oncology, Italy

Implement approaches to **recognise and reduce diagnostic errors, delays and costs**

Innovative approaches to testing are reducing error and streamlining the diagnostic process. As diagnostic testing for lung cancer has evolved, its complexity has increased, and so demand has grown for efficient specimen collection, highly specific and sensitive biomarkers, and streamlined health system and diagnostic processes.[78 92] A variety of strategies have been identified to meet these needs, which include:

- using less invasive procedures and technologies (e.g. rapid on-site evaluation of tissue biopsies), as well as applying algorithms that complete the required testing regardless of the amount of specimen tissue provided[93-95]
- conducting biomarker testing early in the diagnostic pathway to reduce delays in treatment decision-making and help avoid non-optimal treatment[96]
- effectively integrating AI to combine and analyse patient data, assist lung tumour classification and streamline administrative tasks (e.g. appointment scheduling), while addressing AI model interpretability challenges and privacy considerations[86 97]
- adopting methods to increase diagnostic accuracy and speed (e.g. a multiomics approach or using tools that test for multiple biomarkers simultaneously)[98-100]*
- introducing process improvements for biomarker testing, such as time targets for each activity and laboratory proficiency evaluations[93 101]
- improving operations and workflows by establishing additional professional roles (e.g. biomarker testing navigators).[102]

Cost-effectiveness must guide the adoption of new diagnostic strategies for lung cancer. Cost-effectiveness analyses should consider not only direct costs and health outcomes, but also wider factors such as locations of test sampling, anticipated resource use and the clinical settings where diagnostic tests are performed.[103] Recent findings show next-generation sequencing to be a cost-effective strategy for NSCLC biomarker testing when implemented with specific parameters, with additional benefits such as reduced turnaround times, less time spent by healthcare professionals, fewer hospital visits and lower hospital costs.[104] The relative cost-effectiveness of next-generation sequencing compared with other interventions has been found to be lower, but this needs to be reviewed in the context of individual health system resources and priorities to ensure genomic testing is delivered sustainably (*Case study 3*).[104]

* Multiomics research integrates data from '-omics' technologies (e.g. genomics, transcriptomics, proteomics, metabolomics), which aim to analyse molecules to provide a comprehensive understanding of biological systems (Luo *et al*, 2024).

Case study 3

Recommendations to optimise testing along the genomics pathway in the UK

It is estimated that up to 30,000 people with lung cancer in the UK require genomic testing every year to help determine the most appropriate treatment. Yet, significant resource and capacity challenges within the health system mean people experience delays in some parts of the country, which can cause physical and psychological harm.[105]

To address this, the UK Lung Cancer Coalition has outlined the care to be expected, current best practice and recommendations for change along the genomics pathway. The recommendations include a time target from biopsy to full reporting (maximum 14 calendar days), investment priorities and training requirements. It is projected that their wide implementation will help streamline treatment pathways while being more cost-effective for the health system.[105]

In Wales, implementation of the recommendations has helped optimise the genomics pathway and supported consistent turnaround times for all people diagnosed with lung cancer.[106]

‘The use of a single IT system has been instrumental in streamlining the genomics pathway for people with lung cancer in Wales, supporting equitable and rapid access to effective treatment.’

Dr Craig Dyer, University Hospital of Wales, UK

Facilitate **effective teamwork** among healthcare professionals across the diagnostic process

A multidisciplinary approach is vital to managing the growing complexity of lung cancer diagnosis. Effective care of people with lung cancer increasingly depends on coordinated input from multiple specialists to streamline testing, avoid unnecessary procedures and ultimately reduce costs to both individuals and health systems.[107-109] Alongside dedicated multidisciplinary programmes for lung cancer that have reduced time to diagnosis and treatment,[110 111] different interventions have been introduced to support the integration of a multidisciplinary diagnostic process. These initiatives include: recognition of the importance of a multidisciplinary approach in clinical guidelines and NCCPs; global standards from the International Association for the Study of Lung Cancer (IASLC); and information resources for people with lung cancer to help them understand their care team.[108 112-115] In clinical practice, molecular tumour boards (MTBs) are becoming more commonplace.[116] These are meetings of multidisciplinary specialists dedicated to analysing biomarker test results to provide personalised treatment recommendations.[116]

But there are disparities in access to and availability of multidisciplinary expertise that must be addressed. Unequal access to molecular diagnostics and multidisciplinary teams has created global differences in MTB implementation and effectiveness.[116] The IASLC recommendations for MTB implementation offer a structured framework to help close these gaps by supporting consistency across settings with different levels of expertise and resources.[116]

'A multidisciplinary approach is critical to ensuring a balance is struck between progressing clinical care with an appropriate sense of urgency, and ensuring sufficient attention is paid to the psychological, financial and practical implications of a diagnosis on a person.'

Dr Craig Dyer, University Hospital of Wales, UK

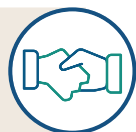
Enhance **guidance, education and training** for healthcare professionals, informed by the latest evidence and diagnostic tools

Diagnostic guidance is not consistently implemented or standardised across different countries and regions. IASLC has developed recommendations and practical guides to support pathological and biomarker testing; these can sit alongside regional (e.g. American Society of Clinical Oncology, European Society of Medical Oncology) and national guidelines for lung cancer diagnosis.[117-121] However, not all countries have national guidance, while key performance indicators vary between those that do. In England, for example, guidelines state that diagnosis should be confirmed within 28 days from first suspicion of lung cancer, whereas the Dutch Lung Cancer Audit outlines different target times depending on diagnostic intervention.[122 123]

Guidance and recommendations for diagnostic testing should be cohesive and incorporate minimum standards. Current evidence indicates people with lung cancer experience diagnosis and treatment delays despite guidelines' recommendations.[124] In part because of such inconsistencies, it is difficult to draw firm conclusions about how delayed care affects outcomes.[124] For decision-makers, a lack of standardisation and robust evidence complicates decisions around care delivery, time frames and the expected impact. To overcome these challenges, health system leaders must understand why delays occur and adopt effective interventions.[124]

Healthcare professionals need a variety of accessible resources to effectively convert guidance into consistent diagnostic practice. In some regions, rapid access initiatives (such as dedicated criteria, clinics and programmes) have already reduced the average wait time for a lung cancer diagnosis and treatment – as seen in Montréal, Canada, where a rapid investigation clinic also increased adherence to clinical guidelines.[50 125] Elsewhere, a variety of resources are being developed at the national, regional and global levels to strengthen workforce capacity and enhance delivery of diagnostic testing. These include:

- training programmes to support healthcare professionals in recognising individual needs, being culturally competent, and delivering optimal and equitable care when diagnosing any person with lung cancer[126-128]
- educational resources (such as webinars, podcasts and eLearning tools) to support efficient and accurate diagnosis[129 130]
- initiatives for early-career clinicians across all aspects of lung cancer diagnosis and care; for example, through ESMO Academy or IASLC Academy programmes[131 132]
- recommendations and best-practice guides for biomarker testing for lung cancer to standardise practice and address professional, technical, organisational and data challenges.[118 133-137]



Establish a **payment and care delivery environment** that supports accessibility to the latest innovations

Health system leaders should seek to reimburse approved diagnostic interventions and prepare to implement emerging, evidence-informed innovations. As biomarker tests have become a crucial component in diagnostic testing, the reimbursement landscape has grown increasingly complex, leading to delays, bottlenecks and competing demand for resources.[138] The result of that is substantial variation in reimbursement across health systems. For example:

- In Europe, there are marked differences in reimbursement between Western, Northern and Eastern Europe.[21] Even where tests are reimbursed, their uptake may be limited due to non-standardised workflows (e.g. variability in testing protocols).[21] To optimise regulatory decision-making in the region, one project is working to develop consensus policy recommendations on health data access and usage, starting with lung cancer.[139]
- In the US, coverage of biomarker tests within health plans often fails to align with clinical guidelines, with only a few health plans extending coverage beyond common genomic alterations.[140] While reimbursement has improved over time, clear and evidence-based tools are needed to facilitate payer decision-making and ensure equitable coverage for biomarker testing.[141]

Beyond reimbursement, the limited understanding of diagnostic tests among people with lung cancer must be addressed to enhance their involvement in care. Low familiarity with biomarker testing and unmet informational needs have been reported by people with lung cancer, indicating they may not have the knowledge necessary to fully understand biomarker testing or how it relates to their care.[142] Addressing this requires improved patient–provider relationships, as well as tools that help raise awareness of diagnostic testing and support decision-making.[142] Such tools include tailored guidelines, educational resources produced by patient organisations for people with specific biomarkers, and innovative communication strategies, for instance via social media campaigns.[143-145]

'As advocates, we must develop evidence-based resources to address the knowledge gap around lung cancer, allowing people to make decisions and feel more in control of their care.'

Debra Montague, ALK Positive Lung Cancer UK

Staging

Prompt and accurate staging is an essential part of lung cancer diagnosis and can help guide clinical decision-making, but it is often complex and highly variable. The stage of lung cancer refers to the extent of cancer, including tumour size and whether it has spread to other parts of the body.[146] Before a person commences treatment, their disease stage is typically determined through an assessment of overall health, together with their pathological and biomarker test results.[23] This process can differ depending on the type of lung cancer, as well as the quality and availability of tests, which can create challenges around consistency and accuracy.[146]

Implementation of evidence-based standards and tools, alongside innovations in diagnostic testing and digital technologies, can help improve staging accuracy and efficiency. Providing a universal framework, the IASLC Staging Project regularly publishes and updates staging protocols for lung cancer that are based on the latest evidence.[147] To reduce healthcare professionals' workload and improve the precision of lung cancer detection, minimally invasive diagnostic techniques and cost-effective staging tools are becoming more commonplace, such as using AI as a second reader for pathology slides and computed tomography (CT) scans.[148-150] These developments offer opportunities to deliver faster, more accurate and equitable staging to all communities.

Post-diagnosis

Timely and appropriate treatment following a lung cancer diagnosis is critical to improving outcomes. After a lung cancer diagnosis and staging are confirmed, treatment should commence without delay. To reduce the negative impact of delays on outcomes and survival, agreed standards in many settings specify accepted maximum waiting times for lung cancer treatment.[151]

'Timely diagnosis and treatment isn't just speed, it's dignity. When we remove barriers, we give people back their time and choices.'

Korina Pateli-Bell, FairLife Lung Cancer Care, Greece

In practice, however, delays from diagnosis to treatment remain common, driven by systemic and organisational barriers. Waiting times for treatment vary significantly across settings and are influenced by factors such as healthcare professionals' workloads, health system organisation and the type of treatment available.[151] These delays not only impact prognosis but can also cause considerable psychological strain.[151] Evidence shows that multidisciplinary approaches can increase adherence to clinical guidelines, which is associated with shorter intervals from diagnosis to treatment for people with lung cancer.[109]

'For people newly diagnosed with lung cancer, physical and psychological support is critical – a well-organised multidisciplinary approach can not only help people cope with the diagnosis, but also ease the transition to treatment and onward care.'

Angeliki Souri, FairLife Lung Cancer Care, Greece

Implementation of the diagnostic and therapeutic advancements in lung cancer must align with health system priorities and population needs, to ensure people efficiently transition along the care pathway. Tailoring treatment based on pathological and molecular characteristics identified during diagnostic testing and staging has become crucial to maximising efficiency

of care and outcomes.[152] But to do so effectively and equitably – ensuring appropriate and cost-effective recommendations are made for a given population – population trends and health disparities must be reflected in guidelines and policies.[153] For example, epidermal growth factor receptor (EGFR) mutations are more prevalent in East Asia than in Western countries, with EGFR testing followed by next-generation sequencing, rather than up-front sequencing, forming a more cost-effective strategy for managing people diagnosed with advanced NSCLC in the region.[154] This demonstrates how policies and guidance can be fine-tuned according to populations.

'The proportion of people with lung cancer with genetic mutations is significantly higher in Asia compared with the West. It is imperative this is reflected in local clinical guidelines and practice, ensuring prompt diagnostic (genomic) reflex testing to guide biomarker-driven treatments.'

Prof. Anand Sachithanandan, Lung Cancer Network Malaysia

Key actions to optimise lung cancer diagnosis

The diagnostic landscape for lung cancer is evolving, creating both new opportunities and challenges. Health system leaders and decision-makers must optimise lung cancer diagnosis to improve equity, access and outcomes.

All phases of the diagnostic process (pre-diagnosis, diagnostic testing and staging, post-diagnosis) should be streamlined through a multi-pronged approach, to ensure efficient and equitable referral, treatment and care.

Provide dedicated funding to address gaps in diagnosis research and implementation.

Explore known and emerging diagnostic biomarkers and technologies, and investigate how they can be integrated effectively and equitably into practice.

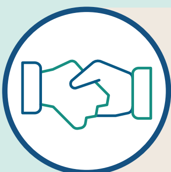
Implement innovative approaches to reduce diagnostic error and streamline diagnostic processes.

Incorporate cost-effectiveness analyses and systematic consideration of health system resources and priorities when developing strategies to optimise diagnosis.

Support effective collaboration and communication within and between multidisciplinary teams.

Ensure guidance and recommendations for diagnosis reflect the latest evidence, to help improve care experiences and outcomes.

Implement a variety of resources to help train and equip healthcare professionals so they can support optimal diagnosis.



Address challenges around reimbursement and knowledge of diagnostic tests to reduce inequalities in access.

References

1. Vicidomini G. 2023. Current Challenges and Future Advances in Lung Cancer: Genetics, Instrumental Diagnosis and Treatment. *Cancers (Basel)* 15(14): 3710
2. Bray F, Laversanne M, Sung H, *et al.* 2024. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 74(3): 229-63
3. de Nijs K, de Koning HJ, van der Aalst C, *et al.* 2024. Medical costs of lung cancer by stage, histology and first-line treatment modality in the Netherlands (2012-2021). *Eur J Cancer* 208: 114231
4. Lung Cancer Policy Network. 2025. Interactive map of lung cancer screening (third edition). Available from: https://www.lungcancerpolicynetwork.com/interactive-map-of-lung-cancer-screening/ [Accessed 02/08/25]
5. Prabhakar B, Shende P, Augustine S. 2018. Current trends and emerging diagnostic techniques for lung cancer. *Biomed Pharmacother* 106: 1586-99
6. Schmitt F, Lozano MD. 2023. Molecular/biomarker testing in lung cytology: A practical approach. *Diagn Cytopathol* 51(1): 59-67
7. World Health Organization. 2025. *Promoting and prioritizing an integrated lung health approach.* Geneva: WHO
8. European Commission. 2021. *Europe's Beating Cancer Plan.* Brussels: European Commission
9. Zhou J, Xu Y, Liu J, *et al.* 2024. Global burden of lung cancer in 2022 and projections to 2050: Incidence and mortality estimates from GLOBOCAN. *Cancer Epidemiol*: 10.1016/j.canep.2024.102693
10. Sands J, Tammemägi MC, Couraud S, *et al.* 2021. Lung screening benefits and challenges: a review of the data and outline for implementation. *J Thorac Oncol* 16(1): 37-53
11. Roy Castle Lung Cancer Foundation. Can lung cancer be cured? Available from: https://roycastle.org/learn-about-lung-cancer/can-lung-cancer-be-cured/ [Accessed 26/09/25]
12. Wood R, Taylor-Stokes G. 2019. Cost burden associated with advanced non-small cell lung cancer in Europe and influence of disease stage. *BMC Cancer* 19(1): 214
13. Kuang Z, Wang J, Liu K, *et al.* 2024. Global, regional, and national burden of tracheal, bronchus, and lung cancer and its risk factors from 1990 to 2021: findings from the global burden of disease study 2021. *eClinicalMedicine*: 10.1016/j.eclinm.2024.102804
14. Garrett BE, Martell BN, Caraballo RS, *et al.* 2019. Socioeconomic Differences in Cigarette Smoking Among Sociodemographic Groups. *Prev Chronic Dis* 16: E74
15. Schulz JA, Parker MA, Villanti AC. 2023. Trends in cigarette smoking prevalence and status among U.S. adults with disabilities, 2015-2019. *Drug Alcohol Depend* 243: 109738
16. Underwood S, Lyratzopoulos G, Saunders CL. 2023. Breast, Prostate, Colorectal, and Lung Cancer Incidence and Risk Factors in Women Who Have Sex with Women and Men Who Have Sex with Men: A Cross-Sectional and Longitudinal Analysis Using UK Biobank. *Cancers (Basel)* 15(7): 2031
17. Royal College of Physicians, Royal College of Psychiatrists. 2013. *Smoking and mental health.* London: Royal College of Physicians
18. Tzu-Hsuan Chen D, Hirst J, Coupland CAC, *et al.* 2025. Ethnic disparities in lung cancer incidence and differences in diagnostic characteristics: a population-based cohort study in England. *Lancet Reg Health Eur* 48: 101124
19. Adjei AA. 2020. A Call to Arms: Reducing Disparities in Lung Cancer Care Worldwide. *J Thorac Oncol* 15(11): 1700-02
20. Aapro M, Lievens Y, Baird A M, *et al.* 2021. *Leave No One Behind – Delivering Innovation in Lung Cancer Care.* Brussels: European Cancer Organisation
21. Lung Cancer Europe. 2020. *Disparities and challenges in access to lung cancer diagnostics and treatment across Europe.* Bern: Lung Cancer Europe
22. Smeltzer MP, King JC, Connolly C, *et al.* 2025. The 2024 International Association for the Study of Lung Cancer (IASLC) Global Survey on Biomarker Testing. *J Thorac Oncol*: 10.1016/j.jtho.2025.07.114
23. Charpidou A, Hardavella G, Boutsikou E, *et al.* 2024. Unravelling the diagnostic pathology and molecular biomarkers in lung cancer. *Breathe (Sheff)* 20(2): 230192
24. National Cancer Institute. Pathological diagnosis. Available from: https://www.cancer.gov/publications/dictionaries/cancer-terms/def/pathologic-diagnosis [Accessed 03/08/25]
25. LUNGevity. Biomarker Testing. [Updated 09/02/24]. Available from: https://www.lungevity.org/patients-care-partners/navigating-your-diagnosis/biomarker-testing [Accessed 01/07/25]
26. National Cancer Institute. Molecular diagnosis. Available from: https://www.cancer.gov/publications/dictionaries/cancer-terms/def/molecular-diagnosis [Accessed 03/08/25]
27. Restrepo JC, Dueñas D, Corredor Z, *et al.* 2023. Advances in Genomic Data and Biomarkers: Revolutionizing NSCLC Diagnosis and Treatment. *Cancers (Basel)* 15(13): 3474
28. Batra U, Nathany S. 2024. Biomarker testing in lung cancer: from bench to bedside. *Oncol Rev* 18: 1445826
29. Keogh A, Finn S, Radonic T. 2022. Emerging Biomarkers and the Changing Landscape of Small Cell Lung Cancer. *Cancers (Basel)* 14(15): 3772
30. Romero Y, Tittenbrun Z, Trapani D, *et al.* 2025. The changing global landscape of national cancer control plans. *Lancet Oncol* 26(1): e46-e54
31. Wolfenden L, Bolsewicz K, Grady A, *et al.* 2019. Optimisation: defining and exploring a concept to enhance the impact of public health initiatives. *Health Res Policy Syst* 17(1): 108
32. Nuffield Department of Primary Care Health Sciences. Suspected CANcer (SCAN) Diagnostic Pathway. Available from: https://www.phc.ox.ac.uk/research/cancer-research-group/primary-care-cancer-diagnostics/suspected-cancer-scan [Accessed 14/10/25]

33. Chiew KL, Sundaresan P, Jalaludin B, *et al.* 2021. Quality indicators in lung cancer: a review and analysis. *BMJ Open Qual* 10(3): e001268

34. Brown B, Galpin K, Simes J, *et al.* 2024. Development of clinically meaningful quality indicators for contemporary lung cancer care, and piloting and evaluation in a retrospective cohort; experiences of the Embedding Research (and Evidence) in Cancer Healthcare (EnRICH) Program. *BMJ Open* 14(2): e074399

35. National Disease Registration Service. Routes to Diagnosis. [Updated 05/02/25]. Available from: https://digital.nhs.uk/ndrs/our-work/ncras-work-programme/routes-to-diagnosis [Accessed 30/06/25]

36. Cassim S, Chepulis L, Keenan R, *et al.* 2019. Patient and carer perceived barriers to early presentation and diagnosis of lung cancer: a systematic review. *BMC Cancer* 19(1): 25

37. Global Lung Cancer Coalition. 2024. *Global briefing: Symptom awareness, attitudes to lung cancer and views on screening, Findings from a global survey.* London: GLCC

38. de Koning HJ, van der Aalst CM, de Jong PA, *et al.* 2020. Reduced lung-cancer mortality with volume CT screening in a randomized trial. *New Engl J Med* 382(6): 503-13

39. Henschke CI, Yip R, Shaham D, *et al.* 2023. A 20-year Follow-up of the International Early Lung Cancer Action Program (I-ELCAP). *Radiology* 309(2): 1-8

40. Grover H, King W, Bhattarai N, *et al.* 2022. Systematic review of the cost-effectiveness of screening for lung cancer with low dose computed tomography. *Lung Cancer* 170: 20-33

41. Lung Cancer Policy Network. 2024. *Enhancing the earlier detection of lung cancer: effective management of incidental pulmonary nodules.* London: The Health Policy Partnership

42. The Lancet Respiratory Medicine. 2022. Feasibility of lung cancer screening in resource-poor areas. *Lancet Respir Med* 10(4): 313

43. Luo G, Zhang Y, Rumgay H, *et al.* 2025. Estimated worldwide variation and trends in incidence of lung cancer by histological subtype in 2022 and over time: a population-based study. *Lancet Respir Med* 13(4): 348-63

44. Kanwal M, Ding XJ, Cao Y. 2017. Familial risk for lung cancer. *Oncol Lett* 13(2): 535-42

45. Pelosof L, Ahn C, Gao A, *et al.* 2017. Proportion of Never-Smoker Non-Small Cell Lung Cancer Patients at Three Diverse Institutions. *J Natl Cancer Inst* 109(7): djw295

46. Zhou F, Zhou C. 2018. Lung cancer in never smokers-the East Asian experience. *Transl Lung Cancer Res* 7(4): 450-63

47. UK Lung Cancer Coalition. 2020. *Early diagnosis matters: making the case for the early and rapid diagnosis of lung cancer.* London: UKLCC

48. Habbous S, Khan Y, Langer DL, *et al.* 2021. The effect of diagnostic assessment programs on the diagnosis and treatment of patients with lung cancer in Ontario, Canada. *Ann Thorac Med* 16(1): 81-101

49. Evison M, Hewitt K, Lyons J, *et al.* 2020. Implementation and outcomes of the RAPID programme: Addressing the front end of the lung cancer pathway in Manchester. *Clin Med (Lond)* 20(4): 401-05

50. All.Can. Rapid referral pathways: reducing delays in the diagnosis of lung cancer. Available from: https://www.all-can.org/efficiency-hub/rapid-referral-pathways-reducing-delays-in-the-diagnosis-of-lung-cancer/ [Accessed 30/06/25]

51. Pradere P, Caramella C, Salem FB, *et al.* 2023. A Patient-Centered Model of Fast-Track Lung Cancer Diagnosis. *Clin Lung Cancer* 24(5): 453-58

52. Otty Z, Larkins S, Evans R, *et al.* 2025. Improving the timeliness of care for regional lung cancer patients through the implementation of a web-based lung cancer referral pathway. *Intern Med J* 55(9): 1474-82

53. Verma R, Pathmanathan S, Otty ZA, *et al.* 2018. Delays in lung cancer management pathways between rural and urban patients in North Queensland: a mixed methods study. *Intern Med J* 48(10): 1228-33

54. Otty Z. 2025. Interview with Jessica Hooper at The Health Policy Partnership [Videoconference]. 24/06/25

55. Otty Z, Larkins S, Evans R, *et al.* 2024. Clinicians' Experiences and Perspectives about a New Lung Cancer Referral Pathway in a Regional Health Service. *Int J Integr Care* 24(2): 3

56. National Disease Registration Service. Routes to Diagnosis: Incidence. [Updated 18/03/24]. Available from: https://nhsd-ndrs.shinyapps.io/routes_to_diagnosis/ [Accessed 30/06/25]

57. Newsom-Davis T. 2017. The route to diagnosis: emergency presentation of lung cancer. *Lung Cancer Manag* 6(2): 67-73

58. Pettit NR, Noriega A, Missen MRV. 2023. Retrospective review of patients with lung cancer presenting emergently. *Am J Emerg Med* 71: 129-33

59. Mitchell RJ, Delaney GP, Arnolda G, *et al.* 2024. Survival of patients who had cancer diagnosed through an emergency hospital admission: A retrospective matched case-comparison study in Australia. *Cancer Epidemiol* 91: 102584

60. Tsiligianni I, Christodoulakis A, Monastirioti A, *et al.* 2024. The journey of lung cancer patients from symptoms to diagnosis in Greece. A mixed methods approach. *NPJ Primary Care Respir Med* 34(1): 5

61. Howden Medical Centre. Lung Cancer. Available from: https://www.howdenmedicalcentre.nhs.uk/cancer-portal-lung-cancer-howden-medical-centre.html [Accessed 01/07/25]

62. Guldbrandt LM, Møller H, Jakobsen E, *et al.* 2017. General practice consultations, diagnostic investigations, and prescriptions in the year preceding a lung cancer diagnosis. *Cancer Medicine* 6(1): 79-88

63. Saab MM, Noonan B, Kilty C, *et al.* 2021. Awareness and help-seeking for early signs and symptoms of lung cancer: A qualitative study with high-risk individuals. *Eur J Oncol Nurs* 50: 101880

64. Cancer Research UK. Referral to a specialist for symptoms of lung cancer. [Updated 04/01/23]. Available from: https://www.cancerresearchuk.org/about-cancer/lung-cancer/getting-diagnosed/referral-specialist [Accessed 01/07/25]

65. Lung Foundation Australia. A systematic approach to investigating symptoms of lung cancer. Available from: https://lungfoundation.com.au/events/a-systematic-approach-to-investigating-symptoms-of-lung-cancer/ [Accessed 08/09/23]

66. Lung Cancer Europe. Get Checked. Available from: https://www.lungcancereurope.eu/get-checked/ [Accessed 01/07/25]

67. LUNGevity. Diagnosing Lung Cancer. Available from: https://www.lungevity.org/lung-cancer-basics/diagnosing-lung-cancer [Accessed 03/07/25]

68. Pei Q, Luo Y, Chen Y, *et al.* 2022. Artificial intelligence in clinical applications for lung cancer: diagnosis, treatment and prognosis. *Clin Chem Lab Med* 60(12): 1974-83

69. Feng J, Zhang P, Wang D, *et al.* 2024. New strategies for lung cancer diagnosis and treatment: applications and advances in nanotechnology. *Biomark Res* 12(1): 136

70. Ning J, Ge T, Jiang M, *et al.* 2021. Early diagnosis of lung cancer: which is the optimal choice? *Aging (Albany N Y)* 13(4): 6214-27

71. Kammer MN, Massion PP. 2020. Noninvasive biomarkers for lung cancer diagnosis, where do we stand? *J Thorac Dis* 12(6): 3317-30

72. Sharma M, Surani S. 2020. Exploring Novel Technologies in Lung Cancer Diagnosis: Do We Have Room for Improvement? *Cureus* 12(1): e6828

73. Helou MA, DiazGranados D, Ryan MS, *et al.* 2020. Uncertainty in Decision Making in Medicine: A Scoping Review and Thematic Analysis of Conceptual Models. *Acad Med* 95(1): 157-65

74. American Cancer Society. Tests for Lung Cancer. [Updated 29/01/24]. Available from: https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html [Accessed 03/07/25]

75. GO2 for Lung Cancer. Diagnosis. Available from: https://go2.org/what-is-lung-cancer/diagnosis/ [Accessed 03/07/25]

76. Roy Castle Lung Cancer Foundation. Lung Cancer tests. Available from: https://roycastle.org/learn-about-lung-cancer/getting-diagnosed/lung-cancer-tests/ [Accessed 03/07/25]

77. Gasparri R, Sabalic A, Spaggiari L. 2023. The Early Diagnosis of Lung Cancer: Critical Gaps in the Discovery of Biomarkers. *J Clin Med* 12(23): 7244

78. Zamay TN, Zamay GS, Kolovskaya OS, *et al.* 2017. Current and Prospective Protein Biomarkers of Lung Cancer. *Cancers (Basel)* 9(11): 155

79. Cainap C, Balacescu O, Cainap SS, *et al.* 2021. Next Generation Sequencing Technology in Lung Cancer Diagnosis. *Biology (Basel)* 10(9): 864

80. Lung Cancer Research Foundation. Why research? Available from: https://www.lungcancerresearchfoundation.org/research/why-research/ [Accessed 08/07/25]

81. Global Lung Cancer Coalition, Institute of Cancer Policy. 2020. *The state of global lung cancer research: 2004-2019.* London: Global Lung Cancer Coalition, Institute of Cancer Policy

82. Lung Cancer Research Foundation. Research funding opportunities. Available from: https://www.lungcancerresearchfoundation.org/research/funding-opportunities-late-2025/ [Accessed 14/07/25]

83. Roy Castle Lung Cancer Foundation. Research. Available from: https://roycastle.org/about-us/research/ [Accessed 14/07/25]

84. Wang L. 2017. Screening and Biosensor-Based Approaches for Lung Cancer Detection. *Sensors (Basel)* 17(10): 2420

85. Shende P, Augustine S, Prabhakar B, *et al.* 2019. Advanced multimodal diagnostic approaches for detection of lung cancer. *Expert Rev Mol Diagn* 19(5): 409-17

86. Huang D, Li Z, Jiang T, *et al.* 2024. Artificial intelligence in lung cancer: current applications, future perspectives, and challenges. *Front Oncol* 14: 1486310

87. Tunali I, Gillies RJ, Schabath MB. 2021. Application of Radiomics and Artificial Intelligence for Lung Cancer Precision Medicine. *Cold Spring Harb Perspect Med* 11(8): a039537

88. Vadala R, Pattnaik B, Bangaru S, *et al.* 2023. A review on electronic nose for diagnosis and monitoring treatment response in lung cancer. *J Breath Res*: 10.1088/1752-7163/acb791

89. Gasparri R, Santonico M, Valentini C, *et al.* 2016. Volatile signature for the early diagnosis of lung cancer. *JJ Breath Res* 10(1): 016007

90. Gasparri R, Capuano R, Guaglio A, *et al.* 2022. Volatolomic urinary profile analysis for diagnosis of the early stage of lung cancer. *J Breath Res*: 10.1088/1752-7163/ac88ec

91. Sabalic A, Gasparri R. Personal communication by email: 20/06/25

92. McLean AEB, Barnes DJ, Troy LK. 2018. Diagnosing Lung Cancer: The Complexities of Obtaining a Tissue Diagnosis in the Era of Minimally Invasive and Personalised Medicine. *J Clin Med* 7(7): 163

93. Roy-Chowdhuri S, Mani H, Fox AH, *et al.* 2024. The American Cancer Society National Lung Cancer Roundtable strategic plan: Methods for improving turnaround time of comprehensive biomarker testing in non-small cell lung cancer. *Cancer* 130(24): 4200-12

94. Brainard J, Farver C. 2019. The diagnosis of non-small cell lung cancer in the molecular era. *Mod Pathol* 32: 16-26

95. Kim SH, Kim MH, Lee MK, *et al.* 2023. Problems in the Pathologic Diagnosis of Suspected Lung Cancer. *Tuberc Respir Dis (Seoul)* 86(3): 176-82

96. Gregg JP, Li T, Yoneda KY. 2019. Molecular testing strategies in non-small cell lung cancer: optimizing the diagnostic journey. *Transl Lung Cancer Res* 8(3): 286-301

97. HaghighiKian SM, Shirinzadeh-Dastgiri A, Vakili-Ojarood M, *et al.* 2025. A Holistic Approach to Implementing Artificial Intelligence in Lung Cancer. *Indian J Surg Oncol* 16(1): 257-78

98. Zhao M, Xue G, He B, *et al.* 2025. Integrated multiomics signatures to optimize the accurate diagnosis of lung cancer. *Nat Commun* 16(1): 84

99. Seo D, Choi BH, La JA, *et al.* 2024. Multi-Biomarker Profiling for Precision Diagnosis of Lung Cancer. *Small* 20(47): e2402919

100. Ahamed MT, Forshed J, Levitsky A, *et al.* 2024. Multiplex plasma protein assays as a diagnostic tool for lung cancer. *Cancer Sci* 115(10): 3439-54

101. Bisson KR, Beharry A, Blais N, *et al.* 2025. Novel Approach to Proficiency Testing Reveals Significant Variations in Biomarker Practice Leading to Critical Differences in Lung Cancer Management. *JTO Clin Res Rep* 6(7): 100837

102. Pineault L, Valencia K, Buhay J, *et al.* 2025. ASCP explores the cancer biomarker testing navigator as a novel role to improve laboratory operations and workflows: A special report from the ASCP Biomarker Testing Navigator Project Team. *Am J Clin Pathol* 163(6): 926-35

103. van der Pol S, Rojas Garcia P, Antoñanzas Villar F, *et al.* 2021. Health-Economic Analyses of Diagnostics: Guidance on Design and Reporting. *Pharmacoeconomics* 39(12): 1355-63

104. Mirza M, Goerke L, Anderson A, *et al.* 2024. Assessing the Cost-Effectiveness of Next-Generation Sequencing as a Biomarker Testing Approach in Oncology and Policy Implications: A Literature Review. *Value Health* 27(9): 1300-09

105. UK Lung Cancer Coalition. 2025. *Faster Testing, Better Outcomes: Genomic Testing in Lung Cancer*. London: UKLCC

106. Dyer C. 2025. Interview with Jessica Hooper at The Health Policy Partnership [Videoconference]. 16/07/25

107. Lung Cancer Policy Network. 2025. *Patient navigation for lung cancer: an essential component of care*. London: The Health Policy Partnership

108. Roy Castle Lung Cancer Foundation. Your lung cancer team. Available from: https://roycastle.org/learn-about-lung-cancer/getting-diagnosed/your-lung-cancer-team/ [Accessed 12/07/25]

109. Kowalczyk A, Jassem J. 2020. Multidisciplinary team care in advanced lung cancer. *Transl Lung Cancer Res* 9(4): 1690-98

110. Common JL, Mariathas HH, Parsons K, *et al.* 2018. Reducing Wait Time for Lung Cancer Diagnosis and Treatment: Impact of a Multidisciplinary, Centralized Referral Program. *Can Assoc Radiol J* 69(3): 322-27

111. Albano D, Bilfinger T, Feraca M, *et al.* 2020. A Multidisciplinary Lung Cancer Program: Does It Reduce Delay Between Diagnosis and Treatment? *Lung* 198(6): 967-72

112. International Association for the Study of Lung Cancer. Global Multidisciplinary Practice Standards Committee (GMPSC). Available from: https://www.iaslc.org/global-multidisciplinary-practice-standards-committee-gmpsc [Accessed 12/07/25]

113. Postmus PE, Kerr KM, Oudkerk M, *et al.* 2017. Early and locally advanced non-small-cell lung cancer (NSCLC): ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 28: iv1-iv21

114. Institut National du Cancer. 2021. *2021-2030 France Ten-Year Cancer-Control Strategy: 2021-2025 Roadmap*. Boulogne-Billancourt: Institut National du Cancer

115. Canadian Partnership Against Cancer. 2019. *Canadian Strategy for Cancer Control 2019-2029.* Toronto: Canadian Partnership Against Cancer

116. Aldea M, Rotow JK, Arcila M, *et al.* 2025. Molecular Tumor Boards: A consensus statement from the International Association for the Study of Lung Cancer. *J Thorac Oncol*: 10.1016/j.jtho.2025.07.009

117. Travis WD, Dacic S, Wistuba I, *et al.* 2020. IASLC Multidisciplinary Recommendations for Pathologic Assessment of Lung Cancer Resection Specimens After Neoadjuvant Therapy. *J Thorac Oncol* 15(5): 709-40

118. International Association for the Study of Lung Cancer. 2023. *IASLC Atlas of Molecular Testing For Targeting Therapy in Lung Cancer*. Denver: IASLC

119. European Society for Medical Oncology. ESMO Clinical Practice Guidelines: Lung and Chest Tumours. Available from: https://www.esmo.org/guidelines/esmo-clinical-practice-guidelines-lung-and-chest-tumours [Accessed 11/07/25]

120. National Institute for Health and Care Excellence. 2024. *Lung cancer: diagnosis and management*. London: NICE

121. ASCO Publications. ASCO Guidelines: Thoracic Cancer. Available from: https://ascopubs.org/topics/asco-guidelines/thoracic-cancer [Accessed 21/08/25]

122. Ismail RK, Schramel FMNH, van Dartel M, *et al.* 2020. The Dutch Lung Cancer Audit: Nationwide quality of care evaluation of lung cancer patients. *Lung Cancer* 149: 68-77

123. NHS England. 2024. *National Optimal Lung Cancer Pathway (NOLCP) for suspected and confirmed lung cancer: Referral to treatment*. London: NHS England

124. Zhang J, Ijzerman MJ, Oberoi J, *et al.* 2022. Time to diagnosis and treatment of lung cancer: A systematic overview of risk factors, interventions and impact on patient outcomes. *Lung Cancer* 166: 27-39

125. Ezer N, Navasakulpong A, Schwartzman K, *et al.* 2017. Impact of rapid investigation clinic on timeliness of lung cancer diagnosis and treatment. *BMC Pulm Med* 17(1): 178

126. Lung Foundation Australia. Lung Cancer Nurse Training Package. Available from: https://lungfoundation.com.au/training/lung-cancer-nurse-training-package/ [Accessed 11/07/25]

127. Lung Foundation Australia. Lung Cancer Training Package for Aboriginal and Torres Strait Islander Health Workers and Practitioners. Available from: https://lungfoundation.com.au/training/lung-cancer-training-package-for-aboriginal-and-torres-strait-islander-health-workers-and-practitioners/ [Accessed 11/07/25]

128. British Thoracic Society. BTS Short courses. Available from: https://www.brit-thoracic.org.uk/education-and-events/bts-short-courses/ [Accessed 11/07/25]

129. GO2 for Lung Cancer. Global Knowledge Center for Lung Cancer. Available from: https://gkc.go2.org/ [Accessed 11/07/25]

130. OncologyPRO. OncologyPRO Resource Feed. Available from: https://oncologypro.esmo.org/oncologypro-resource-feed?topics=Cancer+Diagnostics [Accessed 21/08/25]

131. OncologyPRO. Welcome to the home of ESMO's educational and scientific resources. Available from: https://oncologypro.esmo.org/ [Accessed 21/08/25]

132. International Association for the Study of Lung Cancer. IASLC Academy. Available from: https://www.iaslc.org/science-research/iaslc-academy [Accessed 11/07/25]

133. Cooper WA, Amanuel B, Cooper C, *et al.* 2025. Molecular testing of lung cancer in Australia: consensus best practice recommendations from the Royal College of Pathologists of Australasia in collaboration with the Thoracic Oncology Group of Australasia. *Pathology* 57(4): 425-36

134. Fox AH, Alexander M, Forcucci JA, *et al.* 2024. Biomarker Testing for Guiding Precision Medicine for Patients With Non-Small Cell Lung Cancer. *Chest* 166(5): 1239-49

135. Fox AH, Nishino M, Osarogiagbon RU, *et al.* 2023. Acquiring tissue for advanced lung cancer diagnosis and comprehensive biomarker testing: A National Lung Cancer Roundtable best-practice guide. *CA Cancer J Clin* 73(4): 358-75

136. UK Lung Cancer Coalition. 2019. *Molecules Matter*. London: UKLCC

137. Penault-Llorca F, Socinski MA. 2025. Emerging molecular testing paradigms in non-small cell lung cancer management—current perspectives and recommendations. *Oncologist* 30(3): oyae357

138. Cima G. As Molecular Testing Expands, Labs Find Reimbursement Process Becoming a Herculean Task. [Updated 22/04/24]. Available from: https://www.360dx.com/business-news/molecular-testing-expands-labs-find-reimbursement-process-becoming-herculean-task [Accessed 11/07/25]

139. IDERHA. IDERHA overview. Available from: https://www.iderha.org/about [Accessed 11/07/25]

140. Nellesen D, Dea K, Guerin A, *et al.* 2018. Reimbursement landscape for molecular testing in non-small cell lung cancer (NSCLC). *Am J Manag Care* 24(2 Spec No.): SP37-SP42

141. Fox AH, Osarogiagbon RU, Farjah F, *et al.* 2024. The American Cancer Society National Lung Cancer Roundtable strategic plan: Advancing comprehensive biomarker testing in non-small cell lung cancer. *Cancer* 130(24): 4188-99

142. Fortune EE, Zaleta AK, Saxton MC. 2023. Biomarker testing communication, familiarity, and informational needs among people living with breast, colorectal, and lung cancer. *Patient Educ Couns* 112: 107720

143. National Comprehensive Cancer Network. 2025. *NCCN Guidelines for Patients: Early and Locally Advanced Non-Small Cell Lung Cancer*. Pennsylvania: NCCN

144. Global Lung Cancer Coalition. Biomarker-driven lung cancer organisations. Available from: https://www.lungcancercoalition.org/resources/organisations-dedicated-to-specific-biomarker-driven-lung-cancers/ [Accessed 11/07/25]

145. Masood L, Martins RS, Saqib S, *et al.* 2024. From hashtags to hope: TikTok's role in spreading lung cancer awareness. *Chest* 166(4): A121

146. GO2 for Lung Cancer. Lung cancer staging. Available from: https://go2.org/what-is-lung-cancer/lung-cancer-staging/ [Accessed 12/07/25]

147. International Association for the Study of Lung Cancer. IASLC Staging Project: Lung Cancer, Thymic Tumors, and Mesothelioma. Available from: https://www.iaslc.org/science-research/scientific-projects/iaslc-staging-project-lung-cancer-thymic-tumors-and [Accessed 12/07/25]

148. Parker MA, Moolla MS, Paris GE, *et al.* 2022. Staging and operability of primary lung cancer in Western Cape Province, South Africa. *Afr J Thorac Crit Care Med*: 10.7196/AJTCCM.2022.v28i1.151

149. Philip B, Jain A, Wojtowicz M, *et al.* 2023. Current investigative modalities for detecting and staging lung cancers: a comprehensive summary. *Indian J Thorac Cardiovasc Surg* 39(1): 42-52

150. Gandhi Z, Gurram P, Amgai B, *et al.* 2023. Artificial Intelligence and Lung Cancer: Impact on Improving Patient Outcomes. *Cancers (Basel)* 15(21): 5236

151. Guirado M, Fernández Martín E, Fernández Villar A, *et al.* 2022. Clinical impact of delays in the management of lung cancer patients in the last decade: systematic review. *Clin Transl Oncol* 24(8): 1549-68

152. Nadjafi M, Sung MR, Santos GDC, *et al.* 2020. Diagnostic patterns of non-small-cell lung cancer at Princess Margaret Cancer Centre. *Curr Oncol* 27(5): 244-49

153. Chiu C-H, Yang P-C. 2024. Challenges of lung cancer control in Asia. *eClinicalMedicine*: 10.1016/j.eclinm.2024.102706

154. Yang SC, Yeh YC, Chen YL, *et al.* 2022. Economic Analysis of Exclusionary EGFR Test Versus Up-Front NGS for Lung Adenocarcinoma in High EGFR Mutation Prevalence Areas. *J Natl Compr Canc Netw* 20(7): 774-82.e4

Appendix. Lung Cancer Policy Network members

Mariusz Adamek, Medical University of Silesia

Ogechukwu Akabuike, Move Against Cancer Africa

Humaid Al Shamsi, Burjeel Cancer Institute

Zhandos Amankulov, Kazakh Institute of Oncology and Radiology

Aziz Ayed, Massachusetts Institute of Technology Jameel Clinic

Chunxue Bai, Zhongshan Hospital, Fudan University

Anne-Marie Baird, Lung Cancer Europe

David Baldwin, Nottingham University Hospitals NHS Trust

Angela Barry, GO2 for Lung Cancer

Joanna Bidzińska, Medical University of Gdańsk

Torsten Gerriet Blum, Lungenklinik Heckeshorn

Andrea Borondy Kitts, Rescue Lung Society

Mark Brooke, Lung Foundation Australia

William Brown, ASPIRE (Asia Pacific Policy Review and Engagement) for Lung Cancer

Joanna Chorostowska-Wynimko, National Institute of Tuberculosis and Lung Diseases

Anne Clement, GE HealthCare

Lynsey Conway, UK Lung Cancer Coalition; ALK Positive Lung Cancer UK

Sébastien Couraud, Lyon Sud Hospital

Sue Crengle, University of Otago

Péter Czanyo, Fundación Pacientes de Cancer de Pulmon

Caleb Egwuenu, Move Against Cancer Africa

Helena Esteves, Oncoguia

Joelle Fathi, GO2 for Lung Cancer

Andrea Ferris, LUNGevity

John Field, University of Liverpool

Jesme Fox, Roy Castle Lung Cancer Foundation

Michelle Futrell, LUNGevity

Benjamin Gannon, Guardant Health

Pilar Garrido, University of Alcalá

David Gilligan, UK Lung Cancer Coalition

Ilya Gipp, GE HealthCare

Peter Glazier, Lung Cancer Canada

Tiffany Gowen, American College of Radiology

Derek Griffith, Global Action on Men's Health

Catharine Grimes, Bristol Myers Squibb Foundation

Vitali Grozman, Karolinska Institutet

Maria Isabelle Grueso, Pfizer

Helen Haggart, Johnson & Johnson

Ebba Hallersjö Hult, Vision Zero Cancer

Michael Hartevelt, MSD

Merel Hennink, Global Lung Cancer Coalition

Claudia Henschke, Mount Sinai Hospital

Jennifer Higgins, Guardant Health

Fred Hirsch, Mount Sinai Hospital

Luciana Holtz, Oncoguia

Hidehito Horinouchi, National Cancer Center Hospital

Gopal Iyer, University of Wisconsin

Hans-Ulrich Kauczor, University Hospital Heidelberg

Ella Kazerooni, University of Michigan

Karen Kelly, International Association for the Study of Lung Cancer

Anna Kerpel-Fronius, Országos Korányi Pulmonológiai Intézet

Yeon Wook Kim, Seoul National University

Jennifer King, International Association for the Study of Lung Cancer

Vladimír Koblížek, Charles University

Gilianne Lai, National Cancer Centre Singapore

David CL Lam, University of Hong Kong

Stephen Lam, University of British Columbia

David LeDuc, AstraZeneca

Olivier Leleu, Centre Hospitalier d'Abbeville

Judy Li, ASPIRE for Lung Cancer

Sewanti Limaye, Sir H. N. Reliance Foundation Hospital & Research Centre

Herbert Loong, Chinese University of Hong Kong

Ante Marušić, University Hospital Centre Zagreb

Olivia McDermid, Amgen

Allona McCloy, MSD

Christopher McPherson, AstraZeneca

Swasti Mishra, Lung Cancer Europe

Jessica Moffatt, Lung Health Foundation

Debra Montague, ALK Positive Lung Cancer UK; Lung Cancer Europe

Luis Montuenga, University of Navarra

Linda Murakami, Amgen

Andrea Nurko, American Lung Cancer Screening Initiative

Gbemi Ojole, Move Against Cancer Africa

Zulfiquer Otty, Townsville University Hospital; James Cook University

Matthijs Oudkerk, University of Groningen

Ugo Pastorino, Istituto Nazionale dei Tumori

Korina Pateli-Bell, FairLife Lung Cancer Care

Merilyn Penn, Cancer Australia

Pham Cam Phuong, Bach Mai Hospital; Vietnam National University

Lauren Pretorius, Campaigning for Cancer

Morten Quist, University Hospital of Copenhagen

Luis Raez, Memorial Cancer Institute

Nicole Rankin, University of Melbourne

Jacqui Real, Cancer Australia

Hilary Robbins, International Agency for Research on Cancer

Witold Rzyman, Medical University of Gdańsk

Oluf Dimitri Røe, Aalborg University Hospital

Anand Sachithanandan, Lung Cancer Network Malaysia

Ricardo Sales dos Santos, Hospital Israelita Albert Einstein

Miroslav Samaržija, University of Zagreb

Giorgio Scagliotti, University of Turin

Sebastian Schmidt, Siemens Healthineers

Victoria Schneider, Siemens Healthineers

Luis Seijo, University of Navarra

Dorith Shaham, Hadassah Medical Center

Sanjeev Sharma, Lung Connect India Foundation

Shani Shilo, The Israeli Lung Cancer Foundation

Ambar Shrivastava, Lung Connect India Foundation

Annemiek Snoeckx, Antwerp University Hospital

Yuanlin Song, Zhongshan Hospital; Fudan University

Kostas Syrigos, Hellenic Association of Lung Cancer

Edyta Szurowska, Medical University of Gdańsk

Katy Tong, Cancerinformation.com.hk

Maëlle-Marie Troadec, Massachusetts Institute of Technology Jameel Clinic

Sonia Upujan, Lilly

Stefania Vallone, Women Against Lung Cancer in Europe

Jan van Meerbeeck, Antwerp University and University Hospital

Giulia Veronesi, Vita-Salute San Raffaele University

Lucia Viola, Fundación Neumológica Colombiana; Luis Carlos Sarmiento Angulo Cancer Treatment and Research Center

Murry Wynes, International Association for the Study of Lung Cancer

Dawei Yang, Zhongshan Hospital; Fudan University

Pan-Chyr Yang, National Taiwan University

David Yankelevitz, Mount Sinai Hospital

Ignacio Zervino, Fundación Pacientes de Cancer de Pulmon

Please cite as: Lung Cancer Policy Network. 2025. *Harnessing innovation to optimise lung cancer diagnosis for better equity, access and outcomes*. London: The Health Policy Partnership.

© 2025 The Health Policy Partnership Ltd. This report may be used for personal, research or educational use only, and may not be used for commercial purposes. Any adaptation or modification of the content of this report is prohibited, unless permission has been granted by The Health Policy Partnership.