Learn more about the Who, What, When, Where, Why, and How of comprehensive biomarker testing[a] in early-stage NSCLC by exploring below.

Who nee… in the biomark…

…tions are there, and what …ered when selecting one?

When in the … biomarker t…

…n biomarker testing …performed?

Why should comprehensive biomarker testing be performed?

How can samples be used for biomarker testing?

To get started, click on any of the key questions, or use the navigation bar!

[a]Comprehensive biomarker testing includes CGP and IHC to evaluate PD-L1 levels and to identify all actionable and emerging biomarkers.[1-5]
CGP=comprehensive genomic profiling; IHC=immunohistochemistry; NSCLC=non–small cell lung cancer.

1. Rolfo C, et al. *J Thorac Oncol.* 2023;18(6):674-677. 2. Aggarwal C, et al. *Lung Cancer.* 2021;162:42-53. 3. Aggarwal C, et al. *JAMA Oncol*. 2023;9(6):758-760. 4. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 5. Kidane B, et al. *J Thorac Cardiovasc Surg.* 2023;166(3):637-654.

Learn more about the Who, What, When, Where, Why, and How of comprehensive biomarker testing[a] in early-stage NSCLC by exploring below.

Who needs to be involved in the biomarker testing workflow?

What testing options are there, and what should be considered when selecting one?

When in the patient journey can biomarker testing be ordered?

Where can biomarker testing be performed?

Why should comprehensive biomarker testing be performed?

How can samples be used for biomarker testing?

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Who needs to be involved in the biomarker testing workflow?

Multidisciplinary Team Members[1-6]

- Thoracic surgeons
- Medical and radiation oncologists
- Pathologists
- Interventionalists
  - Radiologists
  - Pulmonologists
- Advanced practice providers
- Nurse navigators
- Pharmacists
- May include other HCPs

The Value of the Multidisciplinary Team

- **Diagnosis:** The MDT coordinates timely diagnostic measures, such as bronchoscopies and biopsies by pulmonologists or other interventionalists.[2] MDTs reduce up/downstaging and improve staging alignment[7]
- **Testing:** The MDT determines which tests are appropriate for the patient while working to spare tissue.[3] They can also determine who orders tests (eg, interventionalist, surgeon, pathologist, oncologist) and when in the patient journey testing should be ordered[4,8]
- **Results:** The MDT can convene to interpret molecular findings in the clinical context of the patient, especially those with increased complexity, and help ensure treatment options are appropriately tailored to each patient for optimal care[2]
- **Treatment:** MDTs reduce delays to treatment initiation and increase patients' receipt of the appropriate treatment strategy[7,8]

HCP=healthcare provider; MDT=multidisciplinary team.

1. Mano MS, et al. *Future Oncol*. 2022;18(3):375-384. 2. Saeteng S, et al. *J Clin Med*. 2024;13(17):5276. 3. Popat S, et al. *Oncologist*. 2021;26(2):e306-e315. 4. Gosney JR, et al. *ESMO Open*. 2023;8(4):101587. 5. https://www.jons-online.com/images/JONS/downloads/Lung-Cancer-Navigator-Patient-Roadmap.pdf (Accessed November 11, 2024). 6. Pickard T, Williams S, Tetzlaff E, Petraitis C, Hylton H. *Am Soc Clin Oncol Educ Book*. 2023:43:e390572. 7. de Castro G Jr, et al. *JTO Clin Res Rep*. 2023;4(12):100580. 8. Spicer JD, et al. *J Thorac Oncol*. 2024;19(10):1373-1414.

What testing options are there, and what should be considered when selecting one?

Options for Genomic Testing

Upfront CGP

Single gene test or small panel, followed by CGP

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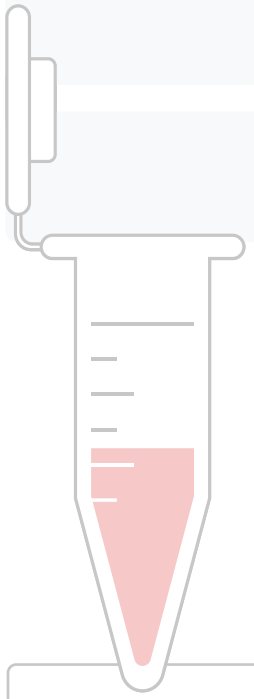

Click on each of the 4 testing options to learn more

For more information, scan a QR code:

Reducing QNS

Minimizing TAT

Comprehensive biomarker testing includes CGP and IHC to evaluate PD-L1 levels and to identify all actionable and emerging biomarkers.[1-5]
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What testing options are there, and what should be considered when selecting one?

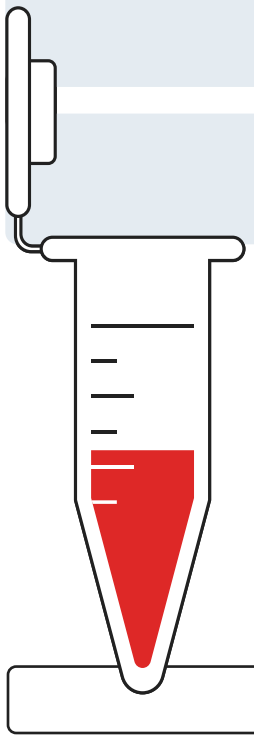
Options for Genomic Testing

Upfront CGP

Single gene test or small panel, followed by CGP

Single gene test or small panel

Liquid biopsy (to complement tissue testing)



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What testing options are there, and what should be considered when selecting one?

Testing Options

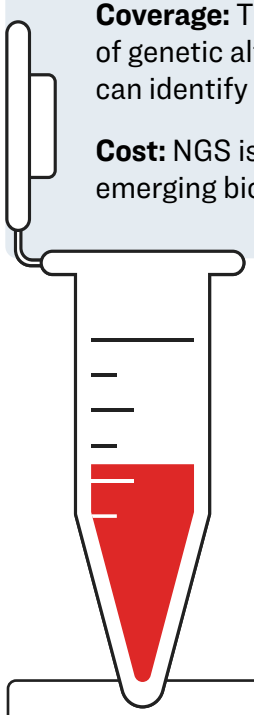
Upfront CGP

Tissue use: This a tissue-efficient testing option.[1] It often requires ≥25 mm^2 tissue with ≥20% tumor content; however, it provides results for several hundred genes from this tissue and does not require the use of multiple labs.[2-8]

Turnaround time: This offers the fastest route for multiple gene results, with a turnaround time of ~2 weeks.[9] However, this testing is not available at all facilities and may require shipping to another lab for testing, which adds time to the process.[1,10]

Coverage: These NGS-based tests provide broad coverage across genes of interest and can detect multiple types of genetic alterations, including mutations, comutations, rearrangements, and amplifications.[10-12] In addition, NGS can identify very rare or novel alterations that are not captured in PCR-based assays.[12]

Cost: NGS is cost-efficient for screening multiple biomarkers simultaneously (ie, to cover the actionable and emerging biomarkers in esNSCLC).[12]



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CGP=comprehensive genomic profiling; esNSCLC=early-stage non–small cell lung cancer; NGS=next-generation sequencing; PCR=polymerase chain reaction; QNS=quantity/quality not sufficient; TAT=turnaround time.

1. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 2. Tomlins SA, et al. *JCO Precis Oncol*. 2021;5:1312-1324. 3. Smits AJJ, et al. *Mod Pathol*. 2014;27(2):168-174. 4. https://www.foundationmedicine.com/test/foundationone-cdx (Accessed December 17, 2025). 5. https://www.thermofisher.com/us/en/home/clinical/preclinical-companion-diagnostic-development/oncomine-oncology/oncomine-cancer-research-panel-workflow/oncomine-comprehensive-assay-plus (Accessed December 17, 2025). 6. Press release. Guardant. Accessed December 17, 2025. 7. https://www.illumina.com/products/by-type/clinical-research-products/trusight-oncology-500.html (Accessed December 17, 2025). 8. Nesline MK, et al. *Oncol Ther*. 2024;12(2):329-343. 9. Zheng Y, et al. *Future Oncol*. 2022;18(4):505-518. 10. Fox AH, et al. *Chest*. 2024;166(5):1239-1249. 11. Gobbini E, et al. *Cancers (Basel)*. 2020;12(11):3112. 12. Rolfo C, et al. *J Thorac Oncol*. 2023;18(6):674-677.

What testing options are there, and what should be considered when selecting one?

Testing Options

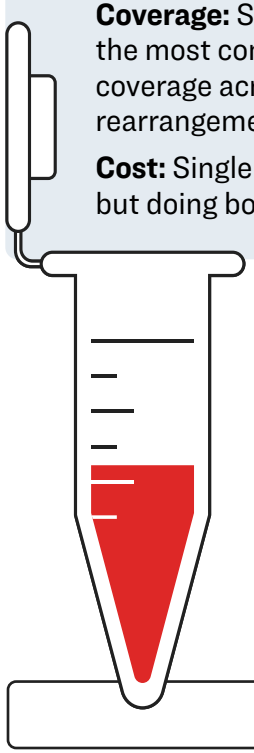
Single gene test or small panel, followed by CGP

Tissue use: This option risks tissue exhaustion and insufficient yield for the CGP with a tissue requirement for both the initially selected single gene or small panel tests and the subsequent CGP if the initial results are negative or uninformative.[1,2]

Turnaround time: This offers fast results for the initially selected genes; however, there is a slower time to comprehensive results.[3] There is a turnaround time of ≤1 week for the single gene or small panel, which may or may not provide actionable results, followed by the ~2 weeks for CGP if the initial results are negative.[3,4]

Coverage: Single gene tests and PCR-based panels may miss some gene alterations due to their coverage of the most common alterations and may also lead to false negatives for some patients.[4] CGP tests provide broad coverage across genes of interest and can detect multiple types of genetic alterations, including mutations, rearrangements, and amplifications.[4]

Cost: Single gene tests such as PCR-based tests may seem cost-effective upfront while NGS is more expensive, but doing both increases overall costs.[4]



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CGP=comprehensive genomic profiling; PCR=polymerase chain reaction; QNS=quality/quantity not sufficient; TAT=turnaround time.

1. Zameer U, et al. *Cancer Inform*. 2024;23:11769351241243243. 2. Nesline MK, et al. *Oncol Ther*. 2024;12(2):329-343. 3. Zheng Y, et al. *Future Oncol*. 2022;18(4):505-518. 4. Rolfo C, et al. *J Thorac Oncol*. 2023;18(6):674-677.

What testing options are there, and what should be considered when selecting one?

Testing Options

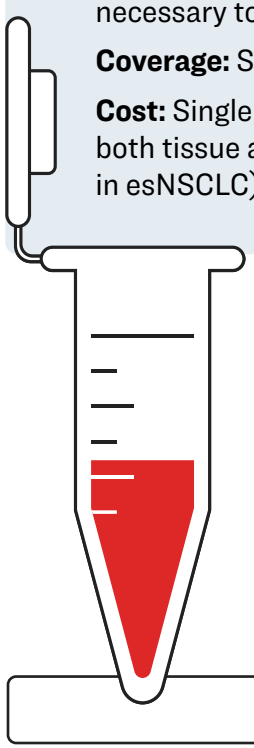
Single gene test or small panel

Tissue use: Using multiple single gene tests is not as tissue efficient as CGP, requiring individual tests to assay the most common actionable biomarkers; however, it can be useful in cases where tissue is not sufficient for the NGS methods to query.[1,2] Panel testing requires less tissue than CGP but provides results for a more limited number of biomarkers.[3] For immunohistochemistry, the efficiency varies depending on approach, with multiplex methods allowing more than 1 test on the same tissue.[4]

Turnaround time: Single gene tests often have fast turnaround times of ≤1 week, but prioritization may be necessary to ensure the more common biomarker is tested first.[4,5]

Coverage: Single gene tests and PCR-based panels may miss gene alterations due to their coverage limitations.[6]

Cost: Single gene tests such as PCR-based tests are cost-effective on a limited number of targets but lose both tissue and cost efficiency as more genes are tested (ie, to cover the actionable and emerging biomarkers in esNSCLC).[6]



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CGP=comprehensive genomic profiling; esNSCLC=early-stage non–small cell lung cancer; NGS=next-generation sequencing; PCR=polymerase chain reaction; QNS=quality/quantity not sufficient; TAT=turnaround time.

1. Herdt LR, et al. *Diagnostics (Basel)*. 2024;14(3):243. 2. Nesline MK, et al. *Oncol Ther*. 2024;12(2):329-343. 3. Fox AH, et al. *Chest*. 2024;166(5):1239-1249. 4. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 5. Zheng Y, et al. *Future Oncol*. 2022;18(4):505-518. 6. Rolfo C, et al. *J Thorac Oncol*. 2023;18(6):674-677.

What testing options are there, and what should be considered when selecting one?

Testing Options

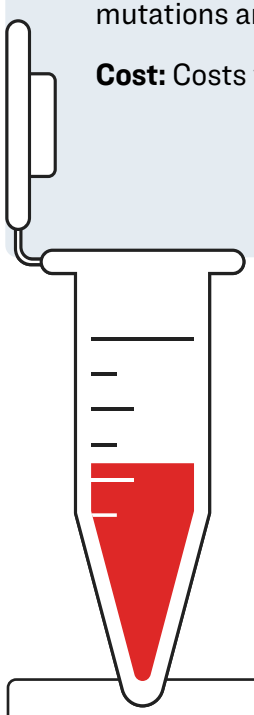
Liquid biopsy

Tissue use: Liquid biopsy does not require tumor tissue and may complement tissue testing but is not viable as a standalone option in esNSCLC unless no tissue can be obtained for testing.[1-6]

Turnaround time: Approximately 1 week for CGP of liquid biopsy samples[2]

Coverage: Liquid biopsy is limited by the level of ctDNA.[2] For Stage I-IIIA NSCLC, tissue-based testing is preferred because these tumors do not reliably shed ctDNA; therefore, liquid biopsy can often miss actionable mutations and is not a recommended option in esNSCLC.[2-6]

Cost: Costs vary compared to tissue testing depending on methods used but are generally lower.[2]



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CGP=comprehensive genomic profiling; ctDNA=circulating tumor DNA; esNSCLC=early-stage NSCLC; NSCLC=non–small cell lung cancer; QNS=quality/quantity not sufficient; TAT=turnaround time.

1. Bertoli E, et al. *Int J Mol Sci*. 2023;24(13):10803. 2. Gobbini E, et al. *Cancers (Basel)*. 2020;12(11):3112. 3. Guibert N, et al. *Eur Respir Rev*. 2020;29(155):190052. 4. Peng M, et al. *Front Oncol*. 2020;10:561598. 5. Adashek JJ, et al. *Cancers (Basel)*. 2021;13(14):3600. 6. Hofman P, et al. *Lung Cancer*. 2025;201:108107.

When in the patient journey can biomarker testing be ordered?

Your MDT can help make these decisions[1,4]

Click to learn more about **how** to test a biopsy sample

Click to learn more about **how** to test a surgical sample

Diagnosis

Testing at diagnosis informs (neo)adjuvant therapy decisions.[1]

Adding neoadjuvant therapy to a surgical treatment plan has potential benefits that make it worth consideration.[1-3] Having results upfront can also inform adjuvant treatment and avoid undue delays in treatment decisions.[4,5]

Click to see pros and cons of testing at diagnosis

Surgery

Testing at the time of surgery informs adjuvant therapy decisions and may save time if disease recurs.[3]

Adjuvant therapy can improve survival outcomes and should be considered.[1,4]

Click to see pros and cons of testing at surgical resection

Progression or Recurrence

Testing at progression or recurrence may reveal actionable biomarkers or resistance mechanisms.[3,4]

Click to see pros and cons of testing at progression or recurrence

Available treatment options

For more information on biomarker testing in advanced or metastatic NSCLC, visit here:

MDT=multidisciplinary team; NSCLC=non–small cell lung cancer.

1. Kidane B, et al. *J Thorac Cardiovasc Surg*. 2023;166(3):637-654. 2. Deem JD. *Curr Oncol*. 2025;32(4):239. 3. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 4. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 5. Fox AH, et al. *Chest*. 2024;166(5):1239-1249.

When in the patient journey can biomarker testing be ordered?

Your MDT can help make these decisions[1,5]

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Testing at diagnosis informs (neo)adjuvant therapy decisions.[1]

Adding neoadjuvant therapy to a surgical treatment plan has potential benefits that make it worth consideration.[1-3] Having results upfront can also inform adjuvant treatment and avoid undue delays in treatment decisions.[4,5]

- Comprehensive testing at diagnosis allows tailored (neo)adjuvant immunotherapy or targeted treatment with or without chemotherapy.[1] Tailoring may also exclude neoadjuvant immunotherapy in cases with certain genomic drivers.[6] Testing at this time also enables consideration of an increasing number of trial targets in the (neo)adjuvant setting, including PD-L1, EGFR, ALK, ROS1, NTRK1/2/3, BRAF, RET, and KRAS.[3,7,8]
- CGP at diagnosis allows for proper assessment of all treatment options, including (neo)adjuvant therapy options that may increase resection and treatment completion rates and improve survival outcomes.[1,3,8] The MDT can decide what treatments are appropriate to offer the patient.[9]
- Waiting for results could cause a delay for some surgical candidates.[3,5] However, as time from diagnosis to surgery scheduling can be over 2 weeks, there is often time for several testing options, including sending out samples for CGP.[10,11]

CGP=comprehensive genomic profiling; MDT=multidisciplinary team.

1. Kidane B, et al. *J Thorac Cardiovasc Surg*. 2023;166(3):637-654. 2. Deem JD. *Curr Oncol*. 2025;32(4):239. 3. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 4. Fox AH, et al. *Chest*. 2024;166(5):1239-1249. 5. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 6. Pierret T, et al. Presented at: European Society of Medical Oncology. October 17-21, 2025. Abstract 2007P. 7. Frisch A, et al. *Oncologist*. 2025;30(6):oyaf153. 8. Jeon H, et al. *Lung*. 2025;203(1):53. 9. Popat S, et al. *Oncologist*. 2021;26(2):e306-e315. 10. Saeteng S, et al. *J Clin Med*. 2024;13(17):5276. 11. Huang H, et al. *J Mol Diagn*. 2019;21(5):862-872.

When in the patient journey can biomarker testing be ordered?

Your MDT can help make these decisions[2,3]

Surgery

Testing at the time of surgery informs adjuvant therapy decisions and may save time if disease recurs.[1]

Adjuvant therapy can improve survival outcomes and should be considered.[2,3]

- Testing at surgery allows tailored adjuvant immunotherapy or targeted treatment with or without chemotherapy.[1] It also informs trial opportunities in the adjuvant setting, such as trials targeting EGFR, ALK, ROS1, NTRK1/2/3, BRAF, RET, and KRAS.[1,4]
- Adjuvant treatment options informed by biomarker testing on surgical specimens may reduce risk of recurrence and improve survival.[2,3] The MDT can decide what treatments are appropriate to offer the patient based on the characteristics of the patient, the characteristics of the tumor, and other risks or benefits.[5,6]
- Testing at surgery is too late to inform neoadjuvant treatments.

MDT=multidisciplinary team.

1. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 2. Kidane B, et al. *J Thorac Cardiovasc Surg*. 2023;166(3):637-654. 3. Hofman P, et al. *Lung Cancer*. 2025;201:108107. 4. Frisch A, et al. *Oncologist*. 2025;30(6):oyaf153. 5. Popat S, et al. *Oncologist*. 2021;26(2):e306-e315. 6. Deem JD. *Curr Oncol*. 2025;32(4):239.

When in the patient journey can biomarker testing be ordered?

Your MDT can help make these decisions[1,8]

Progression or Recurrence

Testing at progression or recurrence may reveal actionable biomarkers or resistance mechanisms.[1,2]

- Testing at progression or recurrence may provide insight into resistance mechanisms or reveal actionable biomarkers to pursue further treatment.[1-3] Several targeted treatment trials and other treatments have shown improvement in outcomes for patients with advanced/metastatic or recurrent NSCLC.[4-6]
- Waiting until progression or recurrence to test means the patient was not offered the best possible treatment while they still had early-stage disease. However, in cases where the patient presents as advanced/metastatic, testing is still critical to inform first-line treatment decisions.[7]

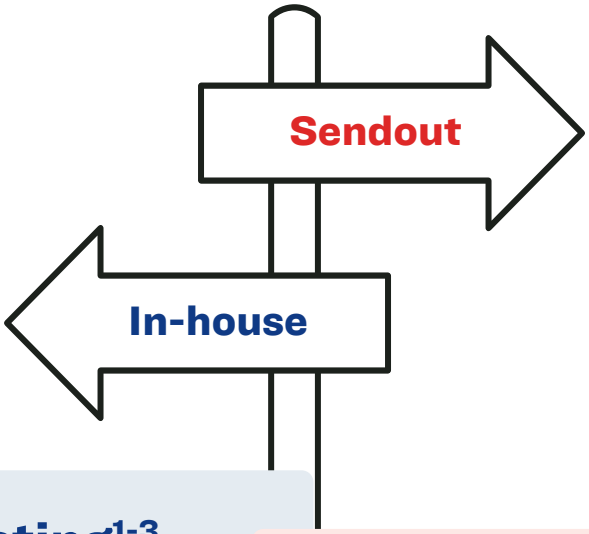
For more information on biomarker testing in advanced or metastatic NSCLC, visit here:

MDT=multidisciplinary team; NSCLC=non–small cell lung cancer.

1. Hofman P, et al. *Lung Cancer.* 2025;201:108107. 2. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 3. Evangelist M, et al. *J Clin Oncol*. 2023;41(16_suppl):9109. 4. Jeon H, et al. *Lung*. 2025;203(1):53. 5. Sonoda D, et al. *Cancers (Basel)*. 2025;17(14):2293. 6. Yano T, et al. *World J Clin Oncol*. 2014;5(5):1048-1054. 7. Fox AH, et al. *Chest*. 2024;166(5):1239-1249. 8. Kidane B, et al. *J Thorac Cardiovasc Surg*. 2023;166(3):637-654.

Where can biomarker testing be performed?

Molecular testing performed at either a local institution or an external reference lab can identify druggable targets that may guide patient treatment options if sufficient testing coverage is available.[1,2]



Local in-house testing[1-3]

- **Time:** Testing in-house or locally can avoid shipping time.
- **Test availability:** Individual institutions may not offer NGS-based testing.
- **Sample distribution:** Some tests, such as IHC or other SGTs (eg, PCR, FISH), may be performed locally while others are sent to a reference lab afterward. It is preferable to use a single assay for comprehensive biomarker assessment rather than a piecemeal approach.

Reference lab testing[1,2]

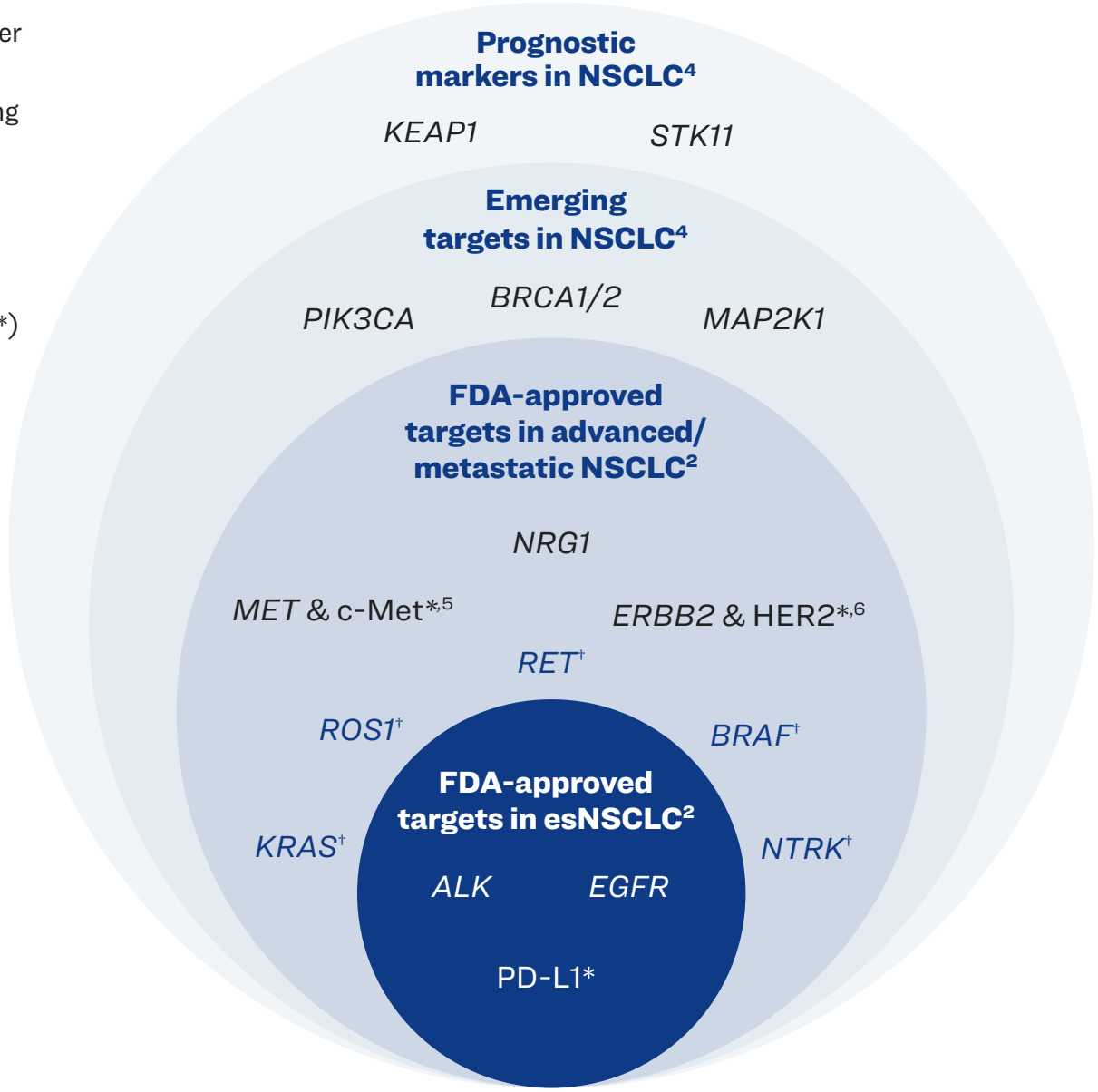
- **Time:** Shipping samples to reference labs takes time, which can be compounded by logistical complications, such as sending the incorrect or an inadequate sample.
- **Test availability:** Reference labs with NGS testing available should be selected based on their assays' coverage of actionable and emerging biomarkers.
- **Sample distribution:** Limited tissue samples do not need to be further distributed if all recommended testing can be performed at a reference lab.

FISH=fluorescence in situ hybridization; IHC=immunohistochemistry; NGS=next-generation sequencing; PCR=polymerase chain reaction; SGT=single gene test.

1. de Jager VD, et al. *Lancet Reg Health Eur*. 2024;38:100839. 2. Serna-Blasco R, et al. *Lung Cancer*. 2025;204:108550. 3. Nesline MK, et al. *Oncol Ther*. 2024;12(2):329-343.

Why should comprehensive biomarker testing be performed?

- Patients treated without biomarker testing have decreased survival[1]
- New targeted treatments are being approved rapidly, and testing can present driver-based options[2]
  - Currently approved therapies inhibit 10 different oncogenic driver genes, as well as 3 protein targets (marked with *)
- Although immunotherapy is becoming more common, it is less effective in the presence of some oncogenic drivers and may increase the risk of adverse events if used prior to targeted therapies[1,3]



*Protein-based biomarker expression measured by IHC. †Under investigation in Stage I-IIIA resectable or Stage III resectable NSCLC.[7]
esNSCLC=early-stage NSCLC; FDA=US Food and Drug Administration; IHC=immunohistochemistry; NSCLC=non–small cell lung cancer.

1. Fox AH, et al. *Chest*. 2024;166(5):1239-1249. 2. Jeon H, et al. *Lung*. 2025;203(1):53. 3. Pierret T, et al. Presented at: European Society of Medical Oncology. October 17-21, 2025. Abstract 2007P. 4. de Jager VD, et al. *Lancet Reg Health Eur*. 2024;38:100839. 5. Tsao MS, et al. *NPJ Precis Oncol*. 2025;9(1):369. 6. Ismail A, et al. *Front Oncol*. 2025;15:1624124. 7. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53.

How can samples be used for biomarker testing?

There are multiple potential biomarker testing workflows in esNSCLC[1]:

- Pathologist-driven testing where molecular testing orders are placed by the pathologist as soon as the histological diagnosis of NSCLC is available, avoiding additional characterization of the tumor by IHC
- Oncologist-driven testing where molecular testing orders are placed by oncologists once they receive the pathology report

While biomarker testing is beneficial regardless of the workflow, pathologist-driven and stage-agnostic testing workflows are associated with higher testing rates, faster results, and improved tissue management.[2-5] The best [illegible] the MDT.[1]

Click on each of the options below to learn more

What sample is being used?

- Diagnostic biopsy
- Surgical specimen

Is the staging information available when the specimen is received?

- No
- Yes

esNSCLC=early-stage NSCLC; IHC=immunohistochemistry; MDT=multidisciplinary team; NSCLC=non–small cell lung cancer.

1. Gosney JR, et al. *ESMO Open*. 2023;8(4):101587. 2. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 3. Braxton DR, et al. *J Clin Oncol*. 2021;39(15_suppl):e13507. 4. Hooper K, et al. *J Clin Oncol*. 2022;40(16_suppl):3127. 5. Fox AH, et al. *Chest*. 2024;166(5):1239-1249.

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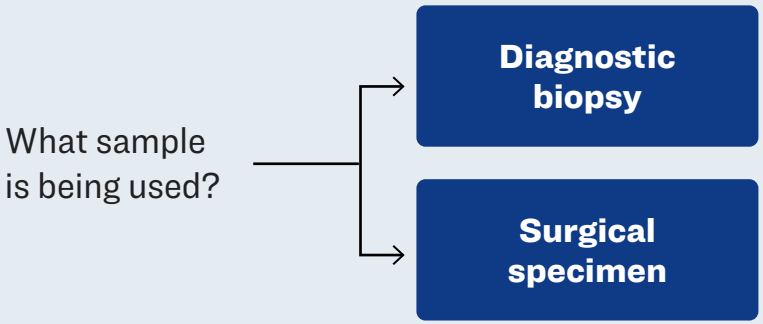

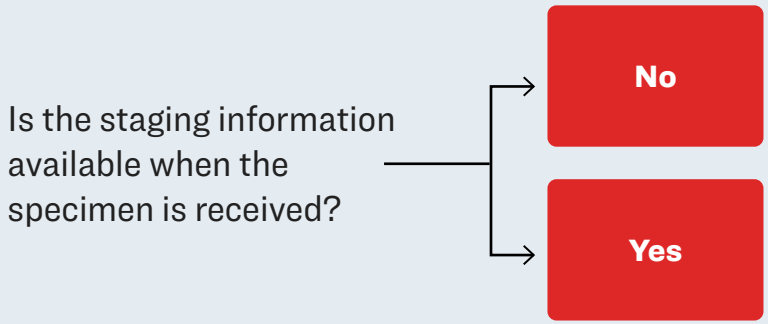

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1. Gosney JR, et al. *ESMO Open*. 2023;8(4):101587. 2. Aggarwal C, et al. *Lung Cancer*. 2021;162:42-53. 3. Braxton DR, et al. *J Clin Oncol*. 2021;39(15_suppl):e13507. 4. Hooper K, et al. *J Clin Oncol*. 2022;40(16_suppl):3127. 5. Fox AH, et al. *Chest*. 2024;166(5):1239-1249.

How can samples be used for biomarker testing?

There are multiple potential biomarker testing workflows in esNSCLC[1]:

- Pathologist-driven testing where molecular testing orders are placed by the pathologist as soon as the histological diagnosis of NSCLC is available, avoiding additional characterization of the tumor by IHC
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While biomarker testing is beneficial regardless of the workflow, pathologist-driven and stage-agnostic testing workflows are associated with higher testing rates, faster results, and improved tissue management.[2-5] The best approach should be determined in consult with the MDT.[1]

What sample is being used?

Diagnostic biopsy[2,6,7]

Diagnostic biopsy specimens can be used for biomarker testing to inform (neo)adjuvant therapies but may be limited by available tissue quantity. In cases of limited tissue, cytology samples may be used. If no additional samples are available for testing, rebiopsy should be considered.

Molecular testing of diagnostic tissue samples can help maximize the number of available treatment options for patients and inform the use of neoadjuvant I/O or targeted therapy (± chemotherapy).

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What sample is being used?

Surgical specimen[2,6-8]

Surgical specimens, such as those from resections (eg, wedge resections, segmentectomies, lobectomies), can be used for biomarker testing to inform adjuvant treatment if comprehensive biomarker testing was not performed at biopsy or if tissue was insufficient for such testing. Waiting for the surgical specimen to perform molecular testing informs opportunities for adjuvant I/O or targeted therapy (± chemotherapy) but is too late in the patient journey for neoadjuvant treatment to be considered.

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Has staging been completed?

Stage-agnostic testing: before staging is available

This approach provides the shortest time to genomic results and may provide results sooner to inform treatment opportunities.[2,6] However, there is a risk for unnecessarily increased cost for some patients with small tumors eligible for curative-intent resection or who are otherwise not candidates for systemic therapy.[2,7]

When used algorithmically, stage-agnostic testing increases overall testing rates and improves tissue triage.[3,4]

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Has staging been completed?

Stage-dependent testing[a]: once staging is available

This option provides slower time to genomic testing results but may avoid incurring costs for patients who may only need/opt for surgery.[2,6]

[a]Stage IA NSCLC cases are exempt from broad, NGS-based molecular testing.[5]

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