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NCCN GUIDELINES FOR PATIENTS®

2018

Lung Cancer

NON-SMALL CELL LUNG CANCER

Presented with support from:

NCCN National Comprehensive Cancer Network FOUNDATION® Guiding Treatment, Changing Lives.

LUNG CANCER RESEARCH COUNCIL

Available online at NCCN.org/patients

LEARNING that you have cancer can be overwhelming.

The goal of this book is to help you get the best care. It presents which cancer tests and treatments are recommended by experts in non-small cell lung cancer.

The National Comprehensive Cancer Network® (NCCN®) is a not-for-profit alliance of 27 leading cancer centers. Experts from NCCN have written treatment guidelines for doctors who treat lung cancer. These treatment guidelines suggest what the best practice is for cancer care. The information in this patient book is based on the guidelines written for doctors.

This book focuses on the treatment of lung cancer. Key points of the book are summarized in the NCCN Quick Guide™. NCCN also offers patient resources on lung cancer screening as well as other cancer types. Visit NCCN.org/patients for the full library of patient books, summaries, and other resources.

About

National Comprehensive Cancer Network®

These patient guidelines for cancer care are produced by the National Comprehensive Cancer Network® (NCCN®).

The mission of NCCN is to improve cancer care so people can live better lives. At the core of NCCN are the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®). NCCN Guidelines® contain information to help health care workers plan the best cancer care. They list options for cancer care that are most likely to have the best results. The NCCN Guidelines for Patients® present the information from the NCCN Guidelines in an easy-to-learn format.

Panels of experts create the NCCN Guidelines. Most of the experts are from NCCN Member Institutions. Their areas of expertise are diverse. Many panels also include a patient advocate. Recommendations in the NCCN Guidelines are based on clinical trials and the experience of the panelists. The NCCN Guidelines are updated at least once a year. When funded, the patient books are updated to reflect the most recent version of the NCCN Guidelines for doctors.

For more information about the NCCN Guidelines, visit NCCN.org/clinical.asp.

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NCCN FOUNDATION®
Guiding Treatment, Changing Lives.

NCCN Foundation was founded by NCCN to raise funds for patient education based on the NCCN Guidelines. NCCN Foundation offers guidance to people with cancer and their caregivers at every step of their cancer journey. This is done by sharing key information from leading cancer experts. This information can be found in a library of NCCN Guidelines for Patients® and other patient education resources. NCCN Foundation is also committed to advancing cancer treatment by funding the nation's promising doctors at the center of cancer research, education, and progress of cancer therapies.

For more information about NCCN Foundation, visit NCCNFoundation.org.

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Endorsed and sponsored in part by

Lung Cancer Research Council

As an organization that seeks to increase public awareness and understanding about lung cancer and support programs for screening and early detection, the Lung Cancer Research Council strongly supports and endorses these NCCN Guidelines for Patients. lungcancerresearchcouncil.org

Endorsed by

American Lung Association

The American Lung Association strongly supports efforts to help ensure all patients facing lung cancer get the highest standard of treatment and care. Helping patients understand treatment guidelines is one important step in empowering them to get the care they want and need. That is why we are pleased to endorse NCCN'S efforts to provide accessible treatment guidelines and information to patients through the NCCN Guidelines for Patients. Lung.org

Bonnie J. Addario Lung Cancer Foundation

The Bonnie J. Addario Lung Cancer Foundation is proud to endorse these NCCN Guidelines for Patients. We believe that educated and empowered patients do better and live longer. This book should be in the hands of every patient diagnosed with lung cancer. lungcancerfoundation.org

Caring Ambassadors

The Caring Ambassador Lung Cancer Program is pleased to endorse these NCCN Guidelines for Patients: Non-Small Cell Lung Cancer. Patients and their loved ones need reliable resources to achieve the best possible outcomes for their disease. lungcancercap.org.

Dusty Joy Foundation (LiveLung)

With patients' best interest at heart, NCCN defines the standard of care for patients and physicians through proven scientific methods and expectations for new discoveries leading to improved patient outcomes. As a lung cancer advocacy nonprofit, our organization wholeheartedly supports the NCCN Guidelines for Patients. LiveLung.org

Free ME from Lung Cancer

As a lung cancer survivor and President and CEO of Free ME from Lung Cancer, I am pleased to endorse this vitally important resource so that lung cancer patients can have the information needed to make informed decisions about their treatment. freeMEfromLungCancer.org

Lung Cancer Alliance

Lung Cancer Alliance is proud to collaborate with the National Comprehensive Cancer Network to endorse these NCCN Guidelines for Patients®: Non-Small Cell Lung Cancer. lungcanceralliance.org

Lung Cancer Initiative of North Carolina

As an organization specializing in connecting patients, survivors and loved ones with the medical research community, the Lung Cancer Initiative of NC fully supports these NCCN Guidelines for Patients. These guidelines set the standard for patient education and access to care. lungcancerinitiativenc.org

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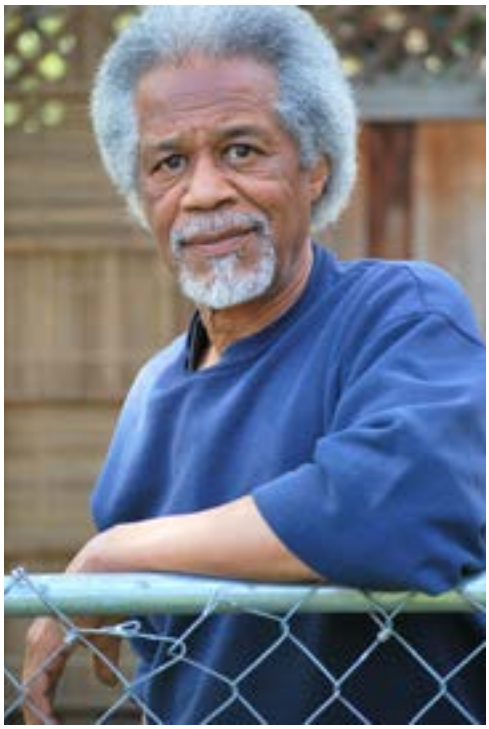
The William and Susan Federici Charitable Fund for their gift in loving memory of their fathers – Richard P. Federici and Gerard R. Flaherty.

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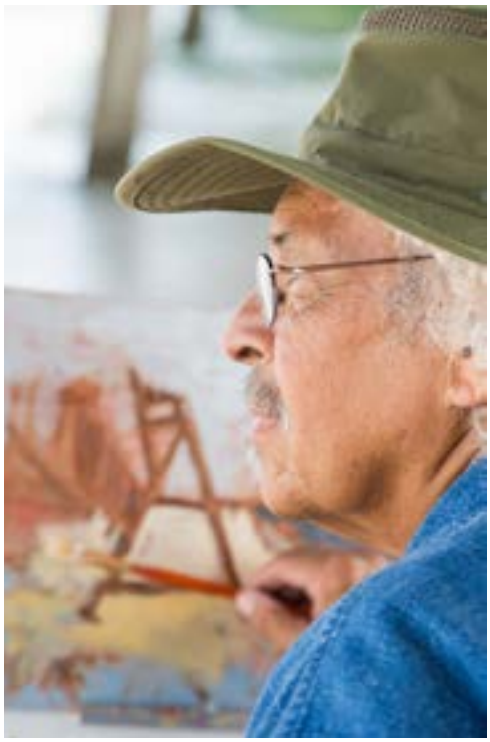


Contents

How to use this book

Who should read this book?

The information in this book is about cancer of the non-small cells of the lung. About 85 out of 100 patients with lung cancer have non-small cell lung cancer. Patients and those who support them—caregivers, family, and friends—may find this book helpful. It is a good starting point to learn what your options may be.

Are the book chapters in a certain order?

Early chapters explain concepts that are repeated in later chapters. **Part 1** explains the parts of the lungs and what lung cancer is. Knowing more about this cancer may help you better understand its treatment. **Part 2** addresses the process of assessing a lung mass for cancer.

If you have lung cancer, your doctors will assess how far it's grown and spread. This is called cancer staging. Treatment options in this book are based on cancer staging. Read **Part 3** for detailed information. Knowing the stage of the cancer will help you use Parts 4, 6, and 7.

Part 4 lists the tests needed to plan treatment. Some tests are used to stage the cancer. Others reveal the features of the cancer and if you can have surgery.

Parts 5 through 8 address treatment. **Part 5** briefly describes the main types of treatments so you can understand your options that are listed in **Part 6** or **7**. Tips for making treatment decisions are presented in **Part 8**.

Does this book include all options?

This book includes information for many people. Your treatment team can point out what applies to you. They can also give you more information. While reading, make a list of questions to ask your doctors.

The treatment options are based on science and the experience of NCCN experts. However, their recommendations may not be right for you. Your doctors may suggest other options based on your health and other factors. If other options are given, ask your treatment team questions.

Help! What do the words mean?

In this book, many medical words are included. These are words that your treatment team may say to you. Most of these words may be new to you. It may be a lot to learn.

Don't be discouraged as you read. Keep reading and review the information. Ask your treatment team to explain a word or phrase that you do not understand.

Words that you may not know are defined in the text or in the *Dictionary*. Acronyms are also defined when first used and in the *Glossary*. Acronyms are short words formed from the first letters of several words. One example is DNA for **d**eoxyribo**n**ucleic **a**cid.

1
Lung cancer basics

You've learned that you have lung cancer. It's common to feel shocked and confused. Part 1 reviews some basics that may help you learn about lung cancer.

Lungs

To learn about lung cancer, you first must know about the lungs. The lungs are the main organs of the respiratory system. They are involved in the exchange of gases in and out of the body.

Airways

Your lungs transfer oxygen—a gas that cells need to live—from the air into the blood. The blood then carries oxygen to all the cells in the body. The lungs also remove carbon dioxide—a gas made by cells—from the blood. Carbon dioxide is then exhaled from the lungs into the air. The transfer of these gases in and out of the body is called respiration.

When you inhale, air travels down your throat into your windpipe (trachea). **See Figure 1**. Air then enters your lungs through the bronchi. The bronchi branch off into each part (lobe) of your lung. Your right lung has three lobes and your left lung has only two lobes to make space for your heart.

Within the lobes, the bronchi divide into smaller airways called bronchioli. At the end of each bronchioli are bunches of alveoli wrapped in blood vessels. The transfer of gases in and out of the blood occurs in the alveoli.

Lymph

Throughout your body—including in your lungs—is a clear fluid called lymph. Lymph gives cells food and water. It also contains germ-fighting blood cells. Lymph drains from tissue into vessels that transport it to the bloodstream. **See Figure 2**. As lymph travels, it passes through small structures called lymph nodes. Lymph nodes remove germs from lymph.

Pleura

Your lungs are protected by tissue called the pleura. Pleura covers each lung and helps the lungs safely rub against other organs. Pleura is made of two layers. The outer layer is known as the parietal pleura. The inner layer is called the visceral pleura. The space in between the two layers is called the pleural cavity. It is filled with a small amount of fluid called pleural fluid.

A disease of cells

Your body is made of trillions of cells. Cancer is a disease of cells. Each type of cancer is named after the cell from which it derived.

Lung cancer

Lung cancer starts in cells of the lung. Cancers of cells from elsewhere that spread to the lung are not lung cancers. Almost all lung cancers are carcinomas. Carcinomas are cancers of cells that line the inner or outer surfaces of the body. Lung carcinomas start in cells that line the airways of the lungs.

NSCLC

Lung carcinomas are divided into two groups based on how the cells look. One group is called small cell lung cancer and the other group is called NSCLC (**n**on-**s**mall **c**ell **l**ung **c**ancer). The second group is much more common and is the focus of this book.

There are two major types of NSCLC. The first type is non-squamous carcinoma. It includes adenocarcinomas, large-cell carcinomas, and rare cell types. The second type of NSCLC is squamous cell carcinoma. It is also called epidermoid carcinoma.

Figure 1
The airways and lungs

Oxygen enters your body though a series of airways that include the windpipe (trachea), bronchi, and bronchioli. Inside your lungs, oxygen is transferred into the bloodstream in the alveoli. Carbon dioxide is transferred out of the bloodstream in the alveoli and exits your body through your airways.

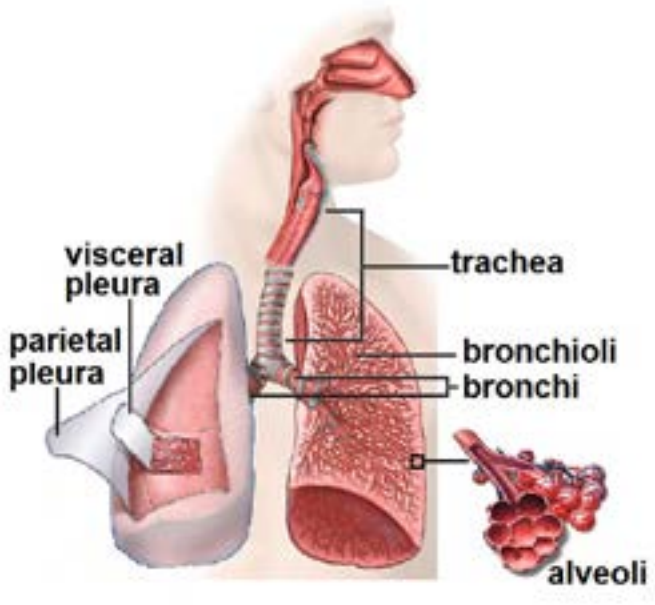
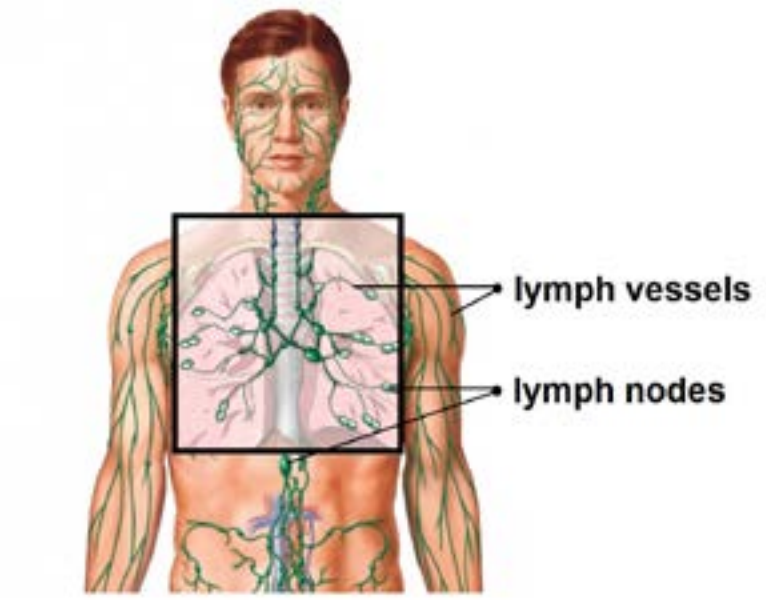


Figure 2
Lymph vessels and nodes

Throughout your body, including your lungs, is a network of vessels that transport lymph to the bloodstream. Lymph is a clear fluid that contains germ-fighting blood cells. As lymph travels in vessels, it passes through lymph nodes, which remove germs from lymph.



Mutations

Cells have a control center called the nucleus. The nucleus contains chromosomes, which are long strands of DNA (**d**eoxyribo**n**ucleic **a**cid) tightly wrapped around proteins. **See Figure 3**. Within DNA are coded instructions for building new cells and controlling how cells behave. These instructions are called genes.

There can be abnormal changes in genes called mutations. Some types of mutations that are linked to cancer are present in all cells. Other mutations are present only in cancer cells. Mutations cause cancer cells to not behave like normal cells and, sometimes, to look very different from normal cells.

Cancer's threat

When needed, normal cells grow and then divide to form new cells. When old or damaged, they die as shown in **Figure 4**. Normal cells also stay in place. Cancer cells don't behave like normal cells. Cancer cells differ from normal cells in three key ways.

Mass of cells

Cancer cells make new cells that aren't needed. They don't die quickly when old or damaged. Over time, cancer cells form a mass called the primary tumor.

Invasion

The second way cancer cells differ from normal cells is that they can grow into surrounding tissues. If not treated, the primary tumor can grow through an airway. It can even grow into nearby structures. This is called invasion. Lung cancer can invade another bronchus or the pleura. Cancer cells can replace so many normal cells that is it hard to breathe.

Metastasis

Third, unlike normal cells, cancer cells can leave the lungs. This process is called metastasis. In this process, cancer cells break away from the tumor and merge with blood or lymph. Then, the cancer cells travel in blood or lymph through vessels to other sites. Once in other sites, cancer cells may form secondary tumors and cause major health problems. The sites to which lung cancer travels are listed in Part 3.

Review

- The lungs help the body get the air it needs to live.
- The lungs are made of many small airways and sacs.
- Lung cancer often starts in the cells that line the airways.
- Cancer cells form a tumor since they don't grow and die as normal cells do.
- Cancer cells can spread to other body parts through lymph or blood.

Figure 3
Genetic material in cells

Most human cells contain the "blueprint of life"—the plan by which our bodies are made and work. The plan is found inside of chromosomes, which are long strands of DNA that are tightly wrapped around proteins. Genes are small pieces of DNA that contain instructions for building new cells and controlling how cells behave. Humans have an estimated 20,000 to 25,000 genes.

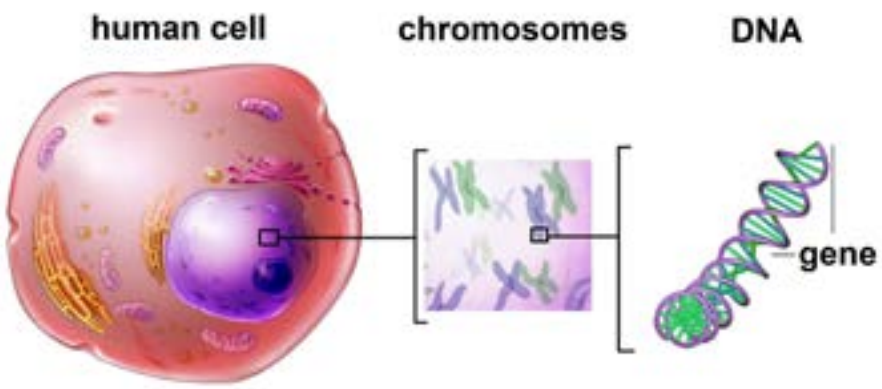
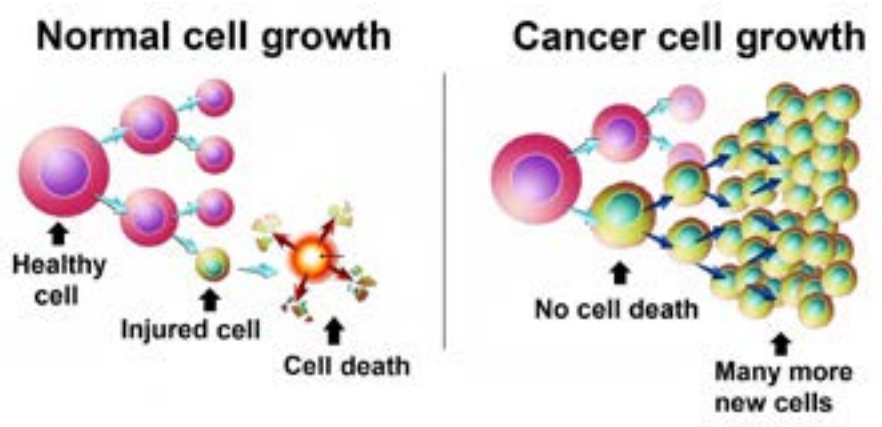
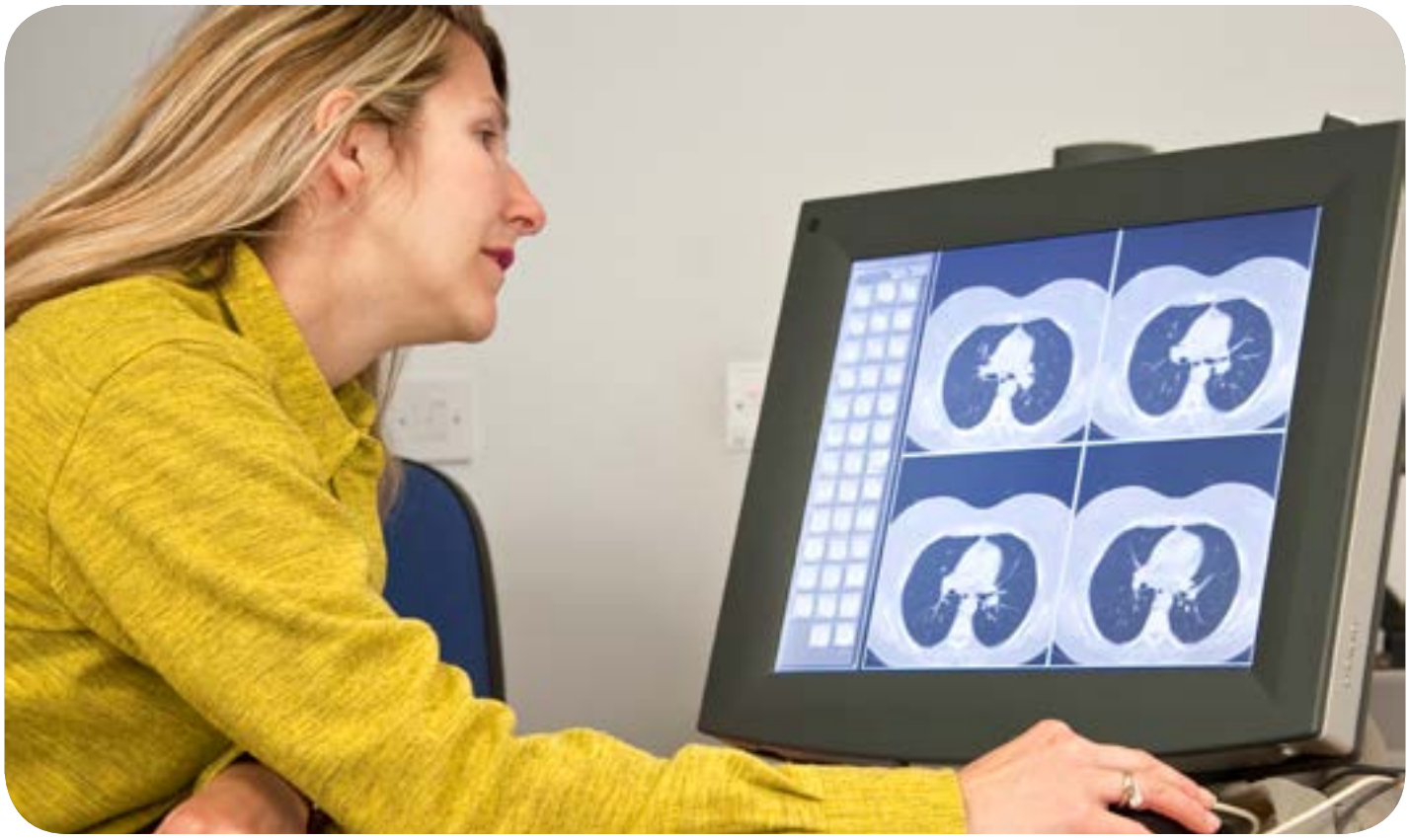


Figure 4
Normal cell growth vs. cancer cell growth

Normal cells increase in number when they are needed and die when old or damaged. In contrast, cancer cells quickly make new cells and live longer because of abnormal changes in genes.



2
Assessing lung nodules



Many people have small masses of tissue in their lungs. These small masses are called nodules. A nodule may have been found in your lung by chance. Part 2 discusses how doctors decide if this nodule is likely cancer.

Team work

Nodules can be caused by cancer, infections, scar tissue, and other conditions. Most nodules are not cancer. It takes a team of experts to decide if a nodule is cancer.

Team members

Your treatment team should include a pulmonologist, thoracic radiologist, and thoracic surgeon. A pulmonologist is a doctor who's an expert of lung diseases. A thoracic radiologist is a doctor who's an expert of imaging tests of the chest. A thoracic surgeon is a doctor who's an expert in operations within the chest.

Methods

Your team will assess if a lung nodule is cancer by three or four methods. One method is to assess your risk for lung cancer. Another method is to review test results for signs of cancer. A third method is to repeat tests to see if there are changes that suggest cancer is present. When doctors suspect cancer, a fourth method is used. Tissue is removed from your body and tested to confirm if cancer is present.

Your cancer risk

Guide 1 lists the risk factors that doctors use to assess if a nodule may be cancer. A risk factor is anything that increases your chance of lung cancer. Risk factors can be activities that people do, things in the environment, or personal data like age and health. If one or more risk factors applies to you, it doesn't mean you have lung cancer. Likewise, lung cancer occurs in some people who have no known risk factors.

Tobacco smoke

Smoking tobacco is the biggest risk factor for lung cancer. There are more than 50 compounds in tobacco smoke known to cause cancer. Any smoking increases your risk for lung cancer. However, the more you smoke, the higher your risk.

If you quit smoking, your risk will decrease. However, the risk for lung cancer is higher for former smokers than for people who never smoked. Thus, current or past tobacco smoking is a risk factor for lung cancer.

Guide 1. Risk factors for lung cancer

You are more likely to get lung cancer if you:
• Smoke or have smoked
• Have had major exposure to second-hand smoke
• Are older in age
• Have had certain other cancers
• Have a parent, sibling, or child who has had lung cancer
• Have had exposure to cancer-causing agents
• Have had certain other lung diseases

In 1981, a link between second-hand smoke and lung cancer was first suggested. Since then, other studies have found the risk for lung cancer is greater for people exposed to second-hand smoke. However, the risk may depend on how much contact a person has had.

If you smoke, ask your treatment team for help to quit.

Older age

As you get older, you are more likely to get cancer. Half of the people who were diagnosed with lung cancer in recent years were 70 years old or older. Only 12 out of 100 people with lung cancer were younger than age 55.

Having had cancer

Your risk for lung cancer may be increased if you've had certain types of cancer. Having had any type of lung cancer increases your risk for other types of lung cancer. Likewise, if you've had a smoking-related cancer, like head and neck cancer, your risk for lung cancer is increased.

Some cancer treatments also increase risk. The risk for lung cancer increases after receiving radiation therapy in the chest, especially if you smoke. Treatment of Hodgkin's lymphoma with an alkylating agent—a type of cancer drug—increases the risk for lung cancer too.

Family who've had lung cancer

If your parent, sibling, or child has had lung cancer, your risk for lung cancer is higher than a person with no family history. Your risk is even higher if your relative had cancer at a young age. Your risk is also higher if more than one relative has had lung cancer.

Cancer-causing agents

There are 11 known agents to cause lung cancer. You are more likely to have lung cancer after having major contact with these agents. The risk after exposure is higher for those who smoke than for those who don't smoke.

Asbestos

Exposure to asbestos can cause lung cancer especially if you smoke. Asbestos is a group of minerals made of tiny fibers. It has been used in housing and commercial products, such as roofing and brake pads. Asbestos can break into tiny pieces that may be breathed in or swallowed. The pieces can then get trapped in the lungs and remain there for years.

Uranium and radon

Uranium is a cancer-causing agent. It is a substance found in rocks and soil. As it decays, a gas called radon is made and gets into air and water.

Miners of uranium have a high risk of developing lung cancer. Some studies of radon found in the home have linked radon to lung cancer, while other studies have not. The risk for lung cancer may depend on how much radon is in the home.

Other agents

Five metallic metals known to cause lung cancer are arsenic, beryllium, cadmium, chromium, and nickel. Other cancer-causing agents include coal smoke, soot, silica, and diesel fumes.

Other lung diseases

Two lung diseases have been linked to lung cancer. A history of COPD (**c**hronic **o**bstructive **p**ulmonary **d**isease) increases your risk for lung cancer. COPD makes breathing hard because the lung tissue is damaged or there's too much mucus. The second disease linked to lung cancer is pulmonary fibrosis. Pulmonary fibrosis is major scarring of lung tissue that makes it hard to breathe.

Signs of cancer

Imaging tests make pictures of the insides of the body. CT (**c**omputed **t**omography) and PET (**p**ositron **e**mission **t**omography) are types of imaging tests. A CT machine is shown in **Figure 5**.

Sometimes, a lung nodule is found by chance with an imaging test. Your doctors will review images to decide if the nodule may be cancer. Important test results are the features of the nodule, abnormal lung tissue, and PET hot spots.

Features of the nodule

Nodules caused by cancer have specific traits. First, they aren't likely to have calcium buildup. Second, they often have rough edges and odd shapes. Other very important features are the nodule size and density.

Size

Nodules with cancer often grow faster and are larger than ones without cancer. Thus, nodules that are large are more likely to be cancer than small nodules.

Density

The density of the nodule is also assessed to decide if the nodule may be cancer. Non-solid nodules have low density. Solid nodules have high density. Part-solid nodules have both high and low areas of density. Part-solid nodules are found less often than solid nodules, but more of them are caused by cancer. On the other hand, solid nodules that are cancer grow faster than part-solid nodules that are cancer.

Abnormal lung tissue

Besides nodules, your doctors will look at your imaging results for other abnormal findings. The imaging tests may show tissue inflammation, tissue scarring, or both. The nodule is more likely to be cancer if there's inflammation or scarring than if neither is present.

PET hot spots

PET shows how your cells are using a simple form of sugar. To create the pictures, a sugar radiotracer is put into your body. The radiotracer emits a small amount of energy that is detected by the imaging machine. Cancer appears brighter ("hotter") in the pictures, because cancer cells use sugar more quickly than normal cells. Hot spots suggest that cancer is present. To confirm that cancer is present, a biopsy is needed.

Figure 5
CT machine

Pictures of the insides of your body can be made with an imaging test. During the scan, you will lie on a table that will move into the tunnel of the imaging machine. The pictures will be viewed by a doctor who will look for signs of cancer.

Repeat testing

This section is for lung nodules found by chance with CT. If a nodule is found during routine lung cancer screening, read the *NCCN Guidelines for Patients®: Lung Cancer Screening*. The next steps of care for cancer screening are covered in these guidelines.

Nodules found by chance

Nodules found by chance with CT include solid and subsolid nodules. Subsolid nodules include both non-solid and part-solid nodules. Non-solid nodules are also called GGOs (**g**round-**g**lass **o**pacities) or GGNs (**g**round-**g**lass **n**odules). Options for follow-up care are grouped by whether a nodule is solid or subsolid.

LDCT vs. diagnostic CT

Often, the use of one imaging test doesn't clearly reveal whether the nodule is cancer. Thus, tests need to be repeated to look for increases in nodule size or density over time. Such changes are likely signs of cancer.

Most often, CT is used for follow-up imaging. It may be an LDCT (**l**ow-**d**ose **CT**) or a diagnostic CT. LDCT uses much less radiation than a standard scan. It also does not require contrast. Contrast is a dye that is injected into the body to make clearer pictures. It is used for a diagnostic CT. LDCT is preferred by NCCN experts for cancer screening unless a clearer picture is needed.

Solid nodules

Guide 2 lists the options for follow-up care for solid nodules. Options are partly based on whether you are at low or high risk for lung cancer. They are also based on the nodule size at baseline. If you get a second CT, your doctor will look for increases in nodule size and density.

Low risk for lung cancer

Your risk is low if you have none or minor risk factors. You must not have smoked or smoked very little. Other risk factors are absent or minor.

<6 mm. Routine follow-up care is not needed for nodules smaller than 6 mm. They are likely not cancer among people at low risk.

6–8 mm. Between 6 and 12 months, re-assess nodules between 6 mm and 8 mm in size. If there's no increase, think about getting CT between 18 and 24 months.

>8 mm. There are three options for nodules larger than 8 mm. One option is CT at 3 months. If cancer is present, an increase in size or density may be seen by this point.

A second option is to think about getting PET with CT. When used together, they are called a PET/CT scan. Your whole body or from the base of your skull to your knees can be scanned.

PET/CT may detect cancer quicker than CTs repeated over a period of time. It may also show signs of cancer spreading in the body. The presence of cancer needs to be confirmed before starting treatment. Read the next section, *Confirming cancer*.

A third option is to think about getting a biopsy. Instead of waiting for a scan, you could be tested for cancer now. However, sometimes a biopsy is not possible. Also, your doctor may think it's better

to wait. More information on biopsy is in the next section, *Confirming cancer*.

High risk for lung cancer
Your risk for lung cancer is high if you are or have been a smoker. If your parents or siblings have had lung cancer, your risk is high. Exposure to asbestos, radon, or uranium also puts you at high risk.

<6 mm. CT at 12 months is an option for nodules smaller than 6 mm. If the nodule isn't bigger or denser, it's likely not cancer. No more follow-up care is needed.

6–8 mm. Between 6 and 12 months, re-assess nodules between 6 mm and 8 mm in size. If there's no increase, re-assess between 18 and 24 months.

>8 mm. There are three options for nodules larger than 8 mm. One option is CT at 3 months. If cancer is present, an increase in size or density may be seen by this point.

A second option is to think about getting PET with CT. When used together, they are called a PET/CT scan. Your whole body or from the base of your skull to your knees can be scanned.

Guide 2. Follow-up care for solid nodules

Low risk for lung cancer

Baseline nodule size	What are the options for follow-up care?
<6 mm	• No routine follow-up care is needed
6–8 mm	• CT at 6–12 months ◦ If no increase, think about getting CT at 18–24 months
>8 mm	• Think about getting CT at 3 months
	• Think about getting PET/CT instead of CT
	• Think about getting a biopsy instead of CT

High risk for lung cancer

Baseline nodule size	What are the options for follow-up care?
<6 mm	• CT at 12 months is an option ◦ If no increase, no further routine follow-up
6–8 mm	• CT at 6–12 months ◦ If no increase, CT at 18–24 months
>8 mm	• Think about getting CT at 3 months
	• Think about getting PET/CT instead of CT
	• Think about getting a biopsy instead of CT

PET/CT may detect cancer quicker than CTs repeated over a period of time. It may also show signs of cancer spreading in the body. The presence of cancer needs to be confirmed before starting treatment. Read the next section, *Confirming cancer*.

A third option is to think about getting a biopsy. Instead of waiting for a scan, you could be tested for cancer now. However, sometimes a biopsy is not possible. Also, your doctor may think it's better to wait. More information on biopsy is in the next section, *Confirming cancer*.

Guide 3. Follow-up care for subsolid nodules

One non-solid nodule (no solid parts)

Baseline nodule size	What are the options for follow-up care?
<6 mm	• No routine follow-up care is needed
≥6 mm	• CT at 6–12 months ◦ If no increase, CT every 2 years until 5 years

One part-solid tumor

Baseline nodule size	What are the options for follow-up care?
<6 mm	• No routine follow-up care is needed
≥6 mm	• CT at 3–6 monthss ◦ If no increase, CT every year for 5 years

Multiple subsolid nodule

Baseline nodule size	What are the options for follow-up care?
<6 mm	• CT at 3–6 months ◦ If no increase, think about getting CT in 2 and 4 years
≥6 mm	• CT at 3–6 monthss ◦ Next steps depend on the nodule that is the most likely to be cancer

Subsolid nodules

Guide 3 lists the options for follow-up care for subsolid nodules. Options are partly based on density and number of nodules. They are also based on the nodule size at baseline. If you get a second CT, your doctor will look for increases in nodule size and density.

One non-solid nodule (no solid parts)
Many of these nodules will go away in time. Those that remain are likely not to become a problem. As such, a nodule smaller than 6 mm does not need routine follow-up care. Re-assess a nodule 6 mm or larger between 6 and 12 months. If there is no increase, re-assess every 2 years until 5 years.

One part-solid nodule
A nodule smaller than 6 mm does not need routine follow-up care. Re-assess a nodule larger than 6 mm between 3 and 6 months. If there is no increase, re-assess every year for 5 years.

Multiple subsolid nodules
Re-assess a nodule smaller than 6 mm between 3 and 6 months. If there is no increase, think about getting CT in 2 and 4 years. Re-assess a nodule larger than 6 mm between 3 and 6 months. The next steps of care will be based on the nodule that is the most likely to be cancer.

Confirming cancer

Tissue or fluid must be removed from your body and be tested to confirm (diagnose) cancer. There is no single plan for diagnosis that is best for all people. Your plan will depend on the tumor's size, where cancer might be in your body, your health, and the experience of your doctors.

Choice of method

For lung cancers, biopsy and surgery are two methods that doctors use to remove tissue or fluid. Some people have a choice between the two methods. When deciding between methods, doctors should think about 1) how strongly they think there's cancer; 2) where the cancer is in your body; and 3) what method you prefer.

There is more than one type of biopsy and surgery to diagnose lung cancer. They are briefly described next by broad groups. Read Part 4 for more details. Which type you will have depends partly on where the cancer is.

- **External needle biopsies** involve inserting a needle through your chest wall. The needle is guided to the site with an imaging test like CT. These biopsies include TTNA (**t**rans**t**horacic **n**eedle **a**spiration), core needle biopsies, and thoracentesis.

- **Down-the-throat biopsies** involve guiding tools down your throat into your windpipe or esophagus. Samples may be removed by needle, brush, tongs, or liquid. These biopsies include bronchoscopy and EUS (**e**ndoscopic **u**ltra**s**ound)-guided biopsies.

- **Phlegm biopsy** requires that you cough up some mucus (phlegm). The phlegm will be tested for cancer cells. This may be the easiest way to test for cancer, but you'll likely have another biopsy or surgery. More tissue is needed for the cancer tests discussed in Part 4.

- **Portal surgeries** involve cutting small holes (ports) into your chest. Small tools are inserted through the ports to remove tissue. Compared to open surgery, this technique is "minimally invasive." These surgeries include thoracoscopy and mediastinoscopy.

- **Open surgery** involves making a large cut between your ribs to spread them farther apart. The whole nodule is removed by your doctor with a surgical knife. You may have open surgery when other methods won't work or a larger piece of tissue is needed.

Choice of timing

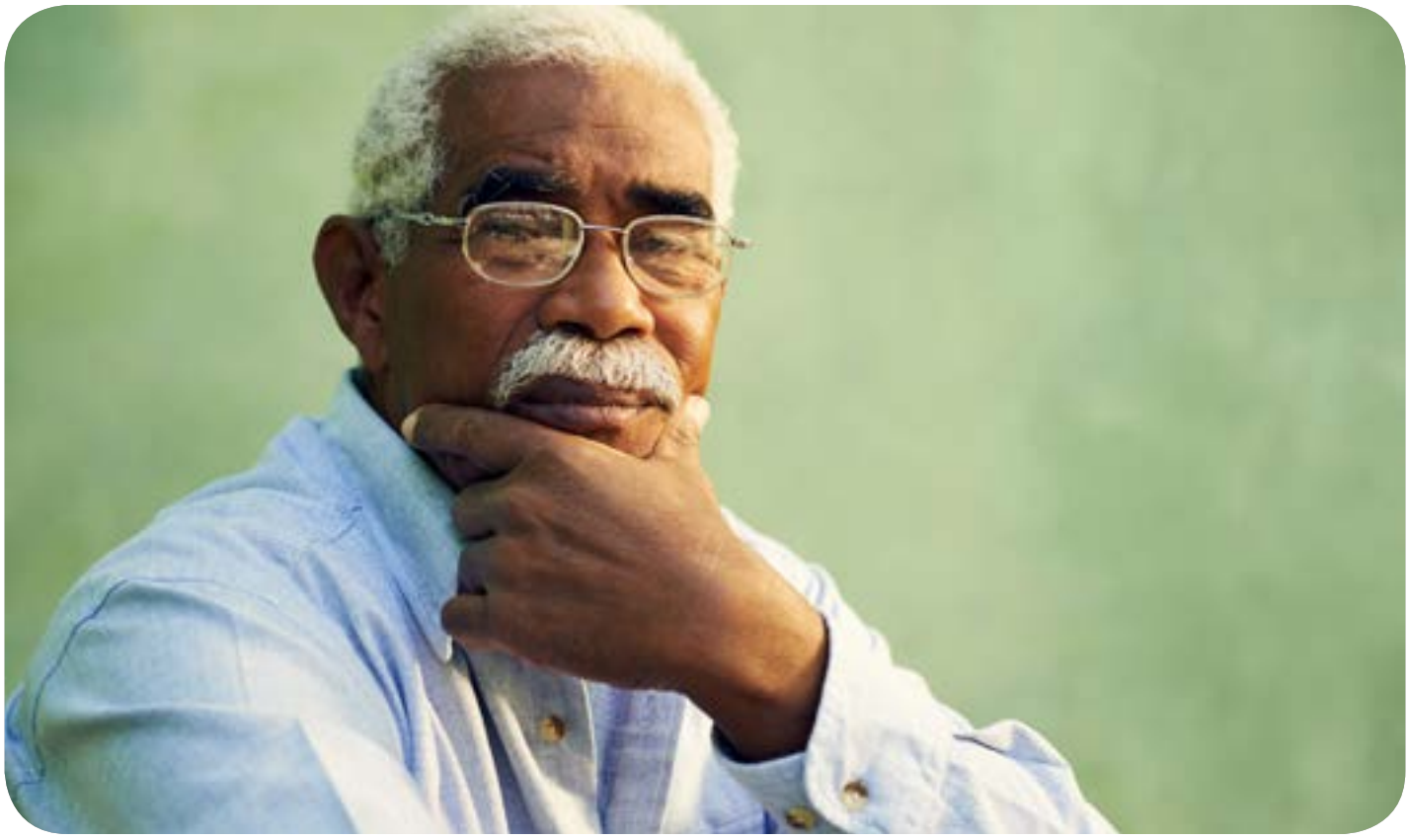
Another choice you may have is when to confirm whether there's cancer. Diagnosis may occur before or at the time of surgical treatment. There may be no need to have a biopsy before treatment if your doctors strongly think a nodule is cancer. A biopsy done beforehand would increase health risks, time spent, and costs. If confirmed at the time of surgery, tissue can be removed by biopsy or excision. More lung tissue may be removed if cancer is present.

A biopsy before treatment may be done if diagnosis during surgery would be hard or risky. Likewise, FNA (**f**ine-**n**eedle **a**spiration) or core needle biopsy before treatment may be done if the cancer may not be lung cancer. An FNA removes a small group of cells with a thin needle and a core needle biopsy removes a solid tissue sample with a needle. A biopsy before treatment is also needed if you will receive treatment other than surgery.

Review

- It takes a team of experts to assess lung nodules for cancer.
- Tobacco smoking is the biggest risk factor for lung cancer.
- Signs of cancer can be found with imaging tests. For lung cancer, doctors assess a nodule's features, the condition of the lung tissue, and for PET hot spots.
- Doctors assess changes in a nodule's size and density with repeat testing. Nodules that increase fast in size or density are more likely to be cancer.
- Testing of tissue that is removed by biopsy or surgery is needed for diagnosis.

3
Cancer staging



Cancer staging is a rating by your doctors of how far the cancer has grown and spread. Doctors plan additional tests and treatment based on how much the cancer has grown. In Part 3, the scoring system used for cancer staging is explained.

Staging plan

Staging is very important for treatment planning. Like diagnosis, there is no single plan for staging that is best for all people. Your plan will depend on the cancer site, your health, and the experience of your doctors.

Lung cancer is often staged twice. The first staging is done before treatment and is called the clinical stage. Imaging tests, like CT and PET/CT, may show where the cancer has grown and spread. Blood tests should also be done. Read Part 4 to learn about the procedures used for staging.

Your doctors may try to diagnose and stage the cancer at the same time. This can be done by testing the furthest site from the nodule that likely has cancer. Examples of such sites are lymph nodes and adrenal glands. By doing this, you'll likely have fewer procedures.

Some cancers may not be correctly staged until after surgical treatment. For example, all the lymph nodes with cancer might not be found until surgery. On the other hand, some nodes thought to have cancer may be cancer-free. This second staging is called the pathologic stage. It is based on tests of tissue removed during surgery. For some people, lung cancer is diagnosed, staged, and treated during one operation.

TNM scores

The AJCC (**A**merican **J**oint **C**ommittee on **C**ancer) staging system is used to stage lung cancer. In this system, the letters T, N, and M describe different areas of cancer growth. Your doctors will assign a score to each letter. These scores will be combined to assign the cancer a stage.

T = Tumor

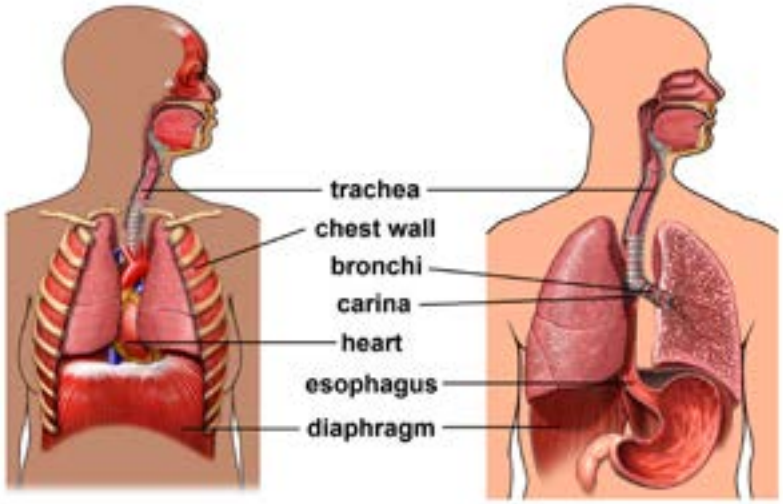
The T score tells how large or where the primary tumor has grown. In medicine, tumors are measured in cm (**c**enti**m**eters). About 0.4 inch equals 1 cm. **Figure 6** shows some sites where the tumor might grow. Your doctors will assess the size and growth of tumors. T scores for lung cancer include:

- **TX** tumors are too small for testing or can't be found with tests.
- **T0** means no primary tumor has been found.
- **Tis** means there are abnormal or cancer cells in airways that haven't invaded lung tissue.
- **T1** tumors are in the lungs only and are not larger than 3 cm.
  - **T1mi** tumors grow only along the surface of lung tissue. Areas of invasion are no deeper than 0.5 cm.
  - **T1a** tumors are 1 cm or smaller and have invaded at least 0.5 cm.
  - **T1b** tumors are larger than 1 cm but not larger than 2 cm. Areas of invasion are at least 0.5 cm.
  - **T1c** tumors are more than 2 cm but not larger than 3 cm. Areas of invasion are at least 0.5 cm.

- **T2** tumors: a) are larger than 3 cm but not larger than 5 cm; b) have grown into the main bronchus; c) have grown into the lung's inner lining (visceral pleura); or d) have caused lung collapse (atelectasis) or swelling (pneumonitis).
  - **T2a** tumors are 4 cm or smaller. Other features may or may not be present (ie, b–d). Smaller tumors with other features are also rated T2a.
  - **T2b** tumors are larger than 4 cm. Other features may or may not be present (ie, b–d).
- **T3** tumors: a) are larger than 5 cm but not larger than 7 cm; b) have grown into the lung's outer lining (parietal pleura) or nearby sites including chest wall, phrenic nerve, or the heart's lining (pericardium); or c) there are primary and secondary tumors in the same lobe.
- **T4** tumors a) are larger than 7 cm; b) have grown into the diaphragm, mediastinum, heart or its major blood vessels, windpipe (trachea), recurrent laryngeal nerve, carina, esophagus, or spine; or c) there are secondary tumors in the same lung but a different lobe than the primary tumor.

Figure 6
Areas to which lung tumors grow

Lung tumors may grow beyond the lobe in which it started to other parts of the lung and nearby organs.



N = Nodes

Cancer cells can spread throughout the body by traveling in lymph. Lymph in lung tissue first travels to the intrapulmonary and peribronchial lymph nodes inside the lungs. **See Figure 7**. From these nodes, lymph then travels to the hilar lymph nodes. Hilar lymph nodes are found right outside the lungs where the windpipe attaches to the large airway.

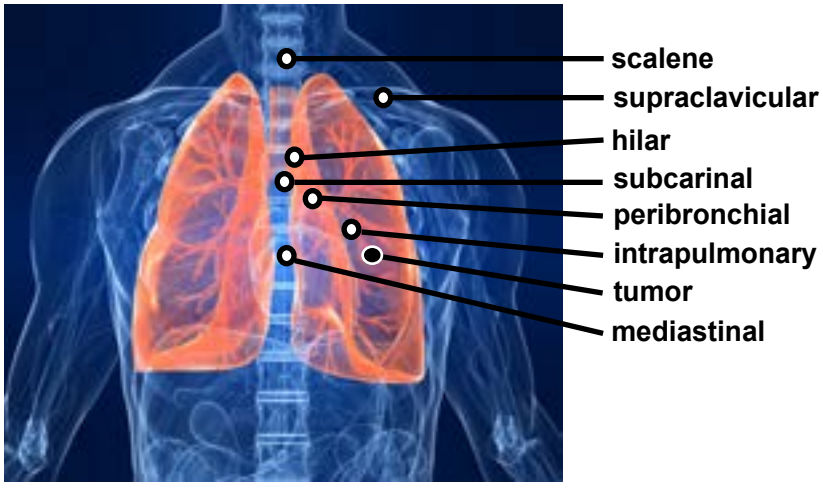
From the hilar lymph nodes, lymph travels to nodes in the mediastinum. The mediastinum is the center of the chest where the heart is. Subcarinal lymph nodes are located right below the windpipe. Lymph also travels to nodes above the collarbone (supraclavicular) and within the neck (scalene).

The N score reflects how far lung cancer has spread within the described lymph nodes. N scores for lung cancer include:

- **NX** means nearby lymph nodes have not been tested.
- **N0** means that there is no cancer in nearby lymph nodes.
- **N1** means that the cancer has spread to the peribronchial nodes and/or to the hilar and intrapulmonary nodes of the lung with the primary tumor.
- **N2** means that the cancer has spread to mediastinal lymph nodes, which include subcarinal nodes, near the lung with the primary tumor.
- **N3** means that the cancer has spread to the mediastinal or hilar nodes near the lung without the primary tumor, or to any supraclavicular or scalene lymph nodes.

Figure 7
Lymph nodes to which lung cancer spreads

Lung cancer can spread to lymph nodes inside the lung then to nodes in between the lungs, near the collarbone, and in the neck.



M = Metastasis

The M score tells you if there are metastases to distant sites. Lung cancer tends to spread to the brain, adrenal gland, and to the lung without the primary tumor. M scores for lung cancer include:

- **M0** means the cancer hasn't spread to distant sites.
- **M1** means the cancer has spread to distant sites.
  - **M1a** means the cancer has spread:
    a) from one lung into the other lung;
    b) into the lung's lining (pleura) and has formed secondary nodule(s);
    c) into the heart's lining (pericardium) and has formed secondary nodule(s), or
    d) into the fluid around the lungs or the heart.
  - **M1b** means the cancer has spread to one site outside the chest area.
  - **M1c** means the cancer has spread to multiple sites outside the chest area.

"A major mass in left lung was found but no tumors elsewhere. I was told it was stage 4 because the pleural effusion fluid tested positive for cancer cells. Then, I developed bilateral embolisms in my lungs.

– Fred
Lung cancer survivor

The 5 stages

Guide 4 shows the five cancer stages labeled by Roman numerals 0–IV. Occult carcinoma is also included. Occult carcinoma is the finding of cancer cells in the absence of a tumor.

The five stages are defined by TNM scores. The stages group tumors together that have a similar prognosis. A prognosis is the outlook (prediction) of the pattern and outcome of a disease.

In general, earlier cancer stages have better outcomes. However, doctors define cancer stages with information from thousands of patients, so a cancer stage gives an average outcome. It may not tell the outcome for one person. Some people will do better than expected. Others will do worse. Other factors not used for staging cancer are also very important. Such factors include your general health and the type of lung cancer.

Review

- Lung cancer is grouped into stages to help plan treatment.
- The timing of and methods used for staging are not the same for everyone.
- Doctors rate the extent of cancer with T, N, and M scores.
- There are five cancer stages for lung cancer. Earlier cancers often have better outcomes.

Guide 4. Lung cancer stages

AJCC Prognostic Stage Groups			
Occult carcinoma	TX	N0	M0
Stage 0	Tis	N0	M0
Stage IA1	T1mi	N0	M0
	T1a	N0	M0
Stage IA2	T1b	N0	M0
Stage IA3	T1c	N0	M0
Stage IB	T2a	N0	M0
Stage IIA	T2b	N0	M0
Stage IIB	T1a	N1	M0
	T1b	N1	M0
	T1c	N1	M0
	T2a	N1	M0
	T2b	N1	M0
	T3	N0	M0
Stage IIIA	T1a	N2	M0
	T1b	N2	M0
	T1c	N2	M0
	T2a	N2	M0
	T2b	N2	M0
	T3	N1	M0
	T4	N0	M0
	T4	N1	M0
Stage IIIB	T1a	N3	M0
	T1b	N3	M0
	T1c	N3	M0
	T2a	N3	M0
	T2b	N3	M0
	T3	N2	M0
	T4	N2	M0
Stage IIIC	T3	N3	M0
	T4	N3	M0
Stage IVA	Any T	Any N	M1a
	Any T	Any N	M1b
Stage IVB	Any T	Any N	M1c

The AJCC 8th Edition Cancer Staging System will be implemented on January 1, 2018. For the AJCC 7th Edition Staging Manual, visit www.springer.com. Used with the permission of the American Joint Committee on Cancer (AJCC), Chicago, Illinios. The original and primary source for this information is the AJCC Cancer Staging Manual, Eighth Edition (2016) published by Springer Science+Business Media, LLC (SBM).

4
Treatment planning

Doctors plan treatment with many sources of information. These sources include tests of your health and the cancer. Part 4 describes who should receive which tests before treatment. Some tests are used to confirm the clinical stage of the cancer. Others are used to know which treatments would work best.

Medical history

A medical history is needed to plan treatment for all stages of lung cancer. Your medical history includes any health events and medicines you've taken in your life. You will be asked about illnesses, injuries, health conditions, and more. It may help to make a list of old and new medications while at home to bring to your doctor's office.

Your doctor will ask about symptoms that may be related to lung cancer. Such symptoms include cough, trouble breathing, chest pain, and weight loss. Knowing which symptoms you have can help your doctors stage the cancer.

Some cancers and other health conditions can run in families. Thus, your doctor will ask about the medical history of your blood relatives. You doctor may ask about the health of your siblings, your parents and their siblings, and your grandparents and their siblings. Be prepared to tell who in your family has had what diseases and at what ages.

Physical exam

Doctors often perform a physical exam along with taking a medical history. A physical exam is a study of your body for signs of disease. To start, your basic body functions will be measured. These functions include your temperature, blood pressure, and pulse and breathing (respiration) rate. Your weight will also be checked.

During the exam, your doctor will listen to your lungs, heart, and gut. Your doctor will also look at and feel parts of your body. This is done to see if organs are of normal size, are soft or hard, or cause pain when touched. Cancer and other health conditions can cause organs to become enlarged and hard.

Your doctor will also rate your performance status. Performance status is your ability to do daily activities. It is used by doctors to assess if you can undergo certain treatments. Read Part 7 for more information.

Blood tests

Blood tests are needed to plan treatment for all stages of lung cancer. They are used to look for signs of disease. For a blood test, a needle will be inserted into your vein to remove a sample of blood. The needle may bruise your skin and you may feel dizzy from the blood draw. Your blood sample will then be sent to a lab where a pathologist will test it.

Complete blood count

A CBC (**c**omplete **b**lood **c**ount) measures the number of blood cells in a blood sample. It includes numbers of white blood cells, red blood cells, and platelets. Cancer and other health problems can cause low or high counts.

Chemistry profile

Another blood test is a chemistry profile. Chemicals in your blood come from your liver, bone, and other organs. A blood chemistry test assesses if the chemicals in your blood are too low or high. Abnormal levels can be caused by spread of cancer or by other health problems.

Imaging tests

Imaging tests make pictures (images) of the insides of your body. They can show which sites have cancer. This information helps your doctors stage the cancer and plan treatment.

Your treatment team will tell you how to prepare for these tests. You may need to stop taking some medicines and stop eating and drinking for a few hours before the scan. Tell your doctors if you get nervous when in small spaces. You may be given a sedative to help you relax.

Diagnostic CT

Diagnostic CT of your chest and belly area (upper abdomen) is needed for clinical staging. Higher doses of radiation are used than for low-dose CT. As a result, the images show more details. Imaging of your chest and upper abdomen may show if the cancer has spread to your lymph nodes, adrenal glands, liver, or other sites.

CT should be one of the first tests done in the treatment planning process. Your doctors will be better able to plan which sites to biopsy and which treatment is best. The CT scan used to assess if you can have surgery should not be older than 60 days.

FDG PET/CT

PET/CT is a common test used for planning treatment. Usually, the area between the base of the skull and the knees is scanned. Sometimes, the whole body is scanned.

FDG (**f**luoro**d**eoxy**g**lucose) is a radiotracer used for lung cancer. It is made of fluoride and a simple form of sugar called glucose. You must fast for 4 hours or more before the scan.

If you haven't had PET/CT, it is advised for clinical stages I, II, III, and sometimes IV. PET/CT may detect cancer in the lymph nodes or other sites that wasn't found by CT. Thus, PET/CT results may change the clinical stage of the cancer and your treatment options. The PET/CT scan should not be older than 60 days when used to assess if you can have surgery.

Cancer detected by PET/CT often needs to be confirmed. A biopsy and, in some cases, another imaging test can be done. For example, brain MRI (**m**agnetic **r**esonance **i**maging) may be needed. A biopsy of the most distant site may help with diagnosis and staging.

Brain MRI

MRI is an imaging test that uses a magnetic field and radio waves to make pictures. It may show small tumors in the brain that aren't causing symptoms. It is not needed for clinical stage IA but is an option for stage IB. It is advised for clinical stages II, III, and IV.

If you have stage IV cancer, brain MRI is very important. Cancer in the brain may or may not cause symptoms. In either case, brain MRI will show if cancer is present.

For brain MRI, a device will be placed around your head that sends and receives radio waves. **See Figure 8**. You may also be given a contrast dye to make the pictures clearer. It's important to lie still during the test, so straps may be used to help you stay in place. You may be given a sedative beforehand if you feel nervous.

During MRI, you will be inside the MRI machine. The machine makes loud noises but you can wear earplugs. After MRI, you will be able to resume your activities right away unless you took a sedative. A brain MRI may cause your head to feel a bit warm.

MRI of spine and thoracic inlet

Some stage IIB and III lung cancers are superior sulcus tumors. This type of tumor starts at the top of the lung. It easily grows into the chest wall. This tumor may have grown next to your spine or nearby blood vessels. In this case, MRI of your spine and thoracic inlet may be advised. The thoracic inlet is the center of a ring of bones at the top of the ribcage.

Figure 8
Brain MRI

MRI may show small tumors in the brain that aren't causing symptoms. It is not needed for clinical stage IA but is an option for stage IB. It is advised for clinical stages II and III. If you have stage IV cancer, brain MRI is very important.

Airway tests

To assess your airways, your doctor will perform a bronchoscopy. It is very important for diagnosis and cancer staging. A tool, called a bronchoscope, will be used to see inside your lungs. It is also used to collect samples from lung tumors and lymph nodes. Common types of bronchoscopy are described below.

Bronchoscopy is advised for clinical stages I, II, IIIA, and IIIB before treatment is started. A bronchoscopy is sometimes done for stage IIIC or IV disease. If your doctors strongly think a nodule is cancer, you might not need a bronchoscopy until the day of your surgery. It should be done right before the surgery as one procedure. Doing so reduces health risks and saves time and money.

Standard bronchoscopy

To perform this test, part of the bronchoscope will be inserted into your body. This part looks like a thin, long tube about as thick as a pencil. **See Figure 9**. It has a light, camera, and open channel. The light and camera allow your doctor to guide the tube down your nose or mouth and into your lungs. A small brush, needle, or tongs can be inserted into the open channel to collect samples. Also, liquid may be sprayed into the airway and then sucked back up.

There are two types of standard bronchoscopes. A rigid bronchoscope is straight and doesn't bend. A flexible bronchoscope is thinner and longer and can bend. It can reach the smaller airways of the lung. General anesthesia is needed for a rigid bronchoscopy. Local anesthesia is used for a flexible bronchoscopy. After the biopsy, you may feel some swelling and sound hoarse.

Radial EBUS bronchoscopy

Radial EBUS (**e**ndo**b**ronchial **u**ltra**s**ound) bronchoscopy uses a flexible bronchoscope that is fitted with an ultrasound device. Ultrasound uses high-frequency sound waves to make pictures of the insides of the body. Your doctor will move the device back and forth to see a 360-degree view of the area on a screen. The ultrasound device will then be removed so that the sampling tool can be inserted.

Navigational bronchoscopy

The airways of the lungs get smaller as they extend toward the sides of the body. Flexible bronchoscopes are often too large to travel through these small airways. A navigational bronchoscopy uses a flexible

Figure 9
Bronchoscope

A bronchoscope is a tool doctors use to see inside your lungs. Part of it looks like a thin tube. This part will be inserted down your nose or mouth into your airways.

bronchoscope that is fitted with a second open channel that is thinner and longer.

For this test, your doctor will first plan how to reach the cancer site using CT. Your doctor will then guide the bronchoscope to the site with a sensor that will be inserted through an open channel. When the site is in reach, the sensor will be removed and the sampling tool will be inserted.

Lung function tests

Surgery and radiation therapy are treatment options for stage I and II, and some stage III and IV tumors. To assess if you can have these treatments, your doctors will need to know how well your lungs work. There are three lung tests that are called pulmonary function tests. A common side effect of these tests is shortness of breath.

- **Spirometry** involves blowing into a tube to measure how much air and how fast you breathe. **See Figure 10**.
- A **gas diffusion test** involves breathing in a harmless gas and measuring how much you breathe out. It tells how much oxygen travels from your lungs into your blood.
- **Body plethysmograph** involves sitting in a small room and breathing into a tube. This test measures how much air your lungs can hold and how much air is left in your lungs after you exhale.

Biopsy

Most people with lung cancer will have a biopsy of their lymph nodes or other sites. The clinical stage will be used to decide which sites to biopsy. Biopsy results may change the clinical stage.

Biopsy by cancer stage

The area between your two lungs is called the mediastinum. This area has lymph nodes. These nodes are more likely to have cancer when the lung tumor is larger and closer to this area. As such, a biopsy of mediastinal nodes may not be needed for

Figure 10
Spirometry

Spirometry is a procedure that measures how well your lungs work. You may receive this test to assess if lung surgery and radiation therapy are treatment options.

stage IA. A mediastinal biopsy is advised for clinical stage IB, II, and IIIA.

For stages IIIB and IIIC, the type of biopsy depends on which nodes may have cancer. For some people, a mediastinal biopsy may be best. For others, a biopsy of supraclavicular or scalene nodes might be better to confirm N3 disease.

The timing of a mediastinal biopsy can differ across stages. For stages I and II, a mediastinal biopsy may not be needed until the day of surgery. It should be done right before surgery as one procedure. Doing so saves money and time, and reduces health risks. For some stage III (N2 or N3) cancers, a mediastinal biopsy may be done before the day of surgery. It may also be done beforehand if lab tests for cancer can't be done during the operation.

If tests suggest stage IV, a biopsy is needed before treatment. Your doctor will use imaging results to select the biopsy sites. This site is often the adrenal gland, liver, and bone. A mediastinal biopsy is very rarely done for stage IV cancers. Some lung cancers spread into the fluid around the lungs or heart. If this has likely happened, some fluid may need to be removed.

There are many ways to biopsy lymph nodes and other sites. Navigational bronchoscopy, described in the prior section, is one way to access mediastinal nodes. Other common types of biopsies are described next.

TTNA

TTNA (**t**rans**t**horacic **n**eedle **a**spiration) can be used to biopsy certain lung nodules and also some lymph nodes. This test is also called a percutaneous needle biopsy. A very thin needle will be inserted through your chest wall to get a tissue sample.

Before inserting the needle, your skin will be cleaned and numbed with local anesthesia. Next, a small cut will be made into your skin. The needle will be inserted through the cut and into the nodule by your doctor. An imaging test should be used to help guide the needle to the right spot. This test may be a CT or ultrasound.

During the biopsy, you may be asked to stay still and hold your breath at times. After the biopsy, the cut will be bandaged and you will be given a chest x-ray to check the results. After TTNA, you may feel sore and have some redness at the needle site.

Mediastinoscopy

This biopsy accesses lymph nodes in the middle of the chest with a mediastinoscope. A mediastinoscope is very much like a bronchoscope. A cut right above your breastbone will be made to insert the mediastinoscope into your body. When a cut alongside the breastbone is made, the biopsy is called a Chamberlain mediastinoscopy. This method allows access to lymph nodes on the left side of your chest. General anesthesia will be used for these biopsies. You may have some pain and swelling and a small scar afterward.

EBUS-TBNA

EBUS-TBNA (**e**ndo**b**ronchial **u**ltra**s**ound-guided **t**rans**b**ronchial **n**eedle **a**spiration) can access mediastinal lymph nodes. A flexible bronchoscope fitted with an ultrasound device will be guided down your trachea. For this biopsy, the device doesn't need to be removed in order to insert the sampling tool. Once the bronchoscope is in place, a needle will be inserted through the bronchus and into a lymph node to obtain a sample. EBUS-TBNA requires local anesthesia.

EUS-FNA

Food passes from the throat into the stomach through the esophagus. The esophagus extends lower into the body than the bronchi. Thus, lymph nodes below the bronchi can be accessed through the esophagus. For EUS-FNA (**e**ndoscopic

ultra**s**ound-guided **f**ine-**n**eedle **a**spiration), a bronchoscope will be guided down your esophagus. Ultrasound is used to help find the right spot. A needle will then be inserted through your esophagus and into a lymph node to obtain a sample. Local anesthesia is used to prevent pain.

Thoracentesis

When cancer spreads into the fluid around the lungs, it can cause a buildup of fluid. This excess fluid is called pleural effusion. Fluid samples can be removed with thoracentesis. First, anesthesia will be injected into your skin. Then, a needle will be inserted between your ribs and into your chest cavity to remove fluid. The fluid will be assessed with a microscope to see if there are cancer cells. If cancer isn't found by thoracentesis, a thoracoscopy may be done. **See Figure 11**.

Pericardiocentesis

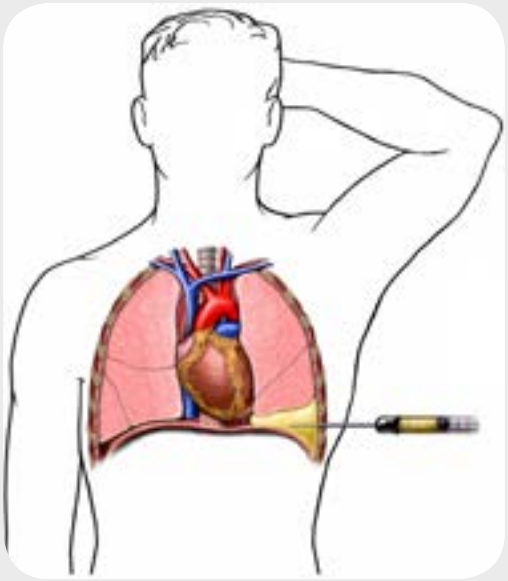
Pericardiocentesis is much like thoracentesis. Like the lungs, there is fluid around the heart. Excess fluid may build up if cancer invades it. This excess fluid is called pericardial effusion. Pericardiocentesis removes the excess fluid with a needle inserted through your chest wall. You will receive local anesthesia beforehand.

Thoracoscopy

This procedure can obtain samples of N2 and N3 lymph nodes as well as fluid from around the lungs and heart. It requires general anesthesia. A thoracoscope will be inserted through a cut between your ribs. Thoracoscopes work much like bronchoscopes allowing doctors to see any abnormal tissue. Samples can be collected with different types of tools. This surgery may cause some pain and swelling and will leave a small scar. This test is also called a VATS (**v**ideo-**a**ssisted **t**horacoscopic **s**urgery).

Figure 11
Thoracentesis

Pleural effusion is the buildup of fluid around your lung. A thoracentesis is a procedure that removes some of the fluid. A needle will be inserted through your skin and into your lung.



Cancer lab tests

Samples from the biopsy or surgery will be sent to a pathologist. A pathologist is a doctor who's an expert in testing cells to find disease. He or she will examine the samples using a microscope. All lab results are recorded in a pathology report. It's a good idea to get a copy of your pathology report. It's used to plan treatment.

Histologic typing

The pathologist will study the parts of the cancer cells to classify the disease. This is called histologic typing. The pathology report will state if the cancer started in the lung or elsewhere. If the cancer started in the lung, the report will also list the type of lung cancer.

Histologic subtypes of NSCLC include squamous cell carcinoma, adenocarcinoma, large-cell lung carcinoma, and other rare types. Squamous cells are thin and flat and line the airways of the lung. Adenocarcinoma is a cancer of epithelial cells that make fluids to keep the lungs moist. Large-cell lung carcinomas lack features to classify them as any other carcinoma.

The pathologist will also help with assessing how far the cancer has grown and spread. He or she will measure the size of the primary tumor. Lymph nodes and other removed tissue will be studied for cancer cells. If the cancer appears to have spread to a distant site, the pathologist will assess if the tumor cells from the distant site are from your lung.

Biomarker testing

Another task of pathologists is to do biomarker (or molecular) testing. Biomarker testing includes tests of genes or their products (proteins) within cancer cells. It is done because not all lung cancers are alike. Lung cancer can differ between people by which genes are present. Biomarker testing is used to plan treatment for metastatic lung cancers.

Overactive *EGFR* mutations

EGFR (**e**pidermal **g**rowth **f**actor **r**eceptor) is a surface receptor. A surface receptor is a protein in the outer membrane of cells that starts changes within a cell when turned on. **See Figure 12**. Mutations in the gene that controls EGFR cause the receptors to be overactive. EGFR overactivity causes new cancer cells to form quickly.

EGFR mutation testing is advised for metastatic lung adenocarcinomas, large-cell lung carcinomas, and unknown subtypes. Very few squamous cell carcinomas have overactive EGFR mutations. However, EGFR mutation testing of metastatic squamous cell carcinomas may be considered. It may be done for people who never smoked and for mixed histology. Testing for EGFR is approved both from a tissue sample or blood sample.

ALK gene rearrangement

For some lung cancers, the growth of the cancer cells is caused in part by an *ALK* (**a**naplastic **l**ymphoma **k**inase) gene rearrangement. A gene rearrangement is the fusion of one gene with another gene to create a new gene. In some lung cancers, *ALK* fuses with *EML4*. The *ALK-EML4* fusion gene makes an overactive ALK surface receptor that helps lung cancer cells grow.

ALK testing is advised for metastatic lung adenocarcinomas, large-cell lung carcinomas, and unknown subtypes. Very few squamous cell carcinomas have an *ALK* gene rearrangement. However, *ALK* testing of metastatic squamous cell carcinomas may be considered. It may be done for people who never smoked and for mixed histology. An *ALK* rearrangement does not usually occur with *EGFR*, *ROS1*, and *KRAS* mutations.

ROS1 gene rearrangement

About 2 out of every 100 lung adenocarcinomas (2%) consist of cells with a *ROS1* gene rearrangement. Several genes have been found to fuse with

ROS1. Like *ALK*, the *ROS1* fusion gene makes an overactive ROS1 surface receptor that helps lung cancer cells grow.

ROS1 testing is advised for metastatic lung adenocarcinomas, large-cell lung carcinomas, and unknown subtypes. It may be considered for people with squamous cell carcinoma. An *ROS1* rearrangement does not usually occur with *EGFR*, *ALK*, and *KRAS* mutations.

BRAF V600E mutation

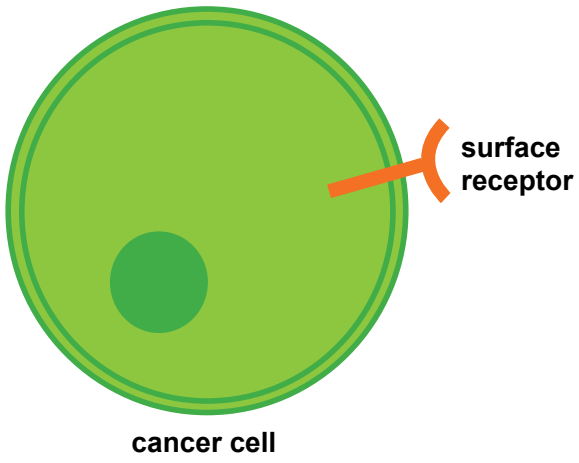
A *BRAF V600E* mutation occurs in 1 to 2 out of every 100 lung adenocarcinomas (1%–2%). Commonly, people with this mutation smoke or have smoked. Mutations in the *BRAF* gene causes the BRAF protein (kinase) to be overactive. BRAF overactivity causes new cancer cells to form quickly.

BRAF testing is advised for metastatic lung adenocarcinomas, large-cell lung carcinomas, and unknown subtypes. It may be considered for people with squamous cell carcinoma. *BRAF* mutations typically do not occur with *EGFR* and *ALK* mutations.

> When my biopsy was performed, the tissue was sent off for testing. I have a mutation that allows for targeted therapy. My treatment team is superb!
>
> – Shirley
> Lung cancer survivor

Figure 12
Surface receptor

Some lung cancers consist of cells with abnormal surface receptors. A surface receptor is a protein in the outer membrane of cells that starts changes within a cell when turned on. Receptors that may be abnormal and help lung cancer grow include EGFR, ALK, and ROS1.



PD-L1 expression
T cells are part of your body's disease-fighting (immune) system. One job of T cells is to attack cancer cells. Some lung cancers consist of cells that make (express) molecules called PD-L1. PD-L1 attaches to PD-1 on T cells and stops them from attacking cancer cells. **See Figure 13**. Pembrolizumab, nivolumab, durvalumab, and atezolizumab are medicines that block PD-L1 from attaching to T cells.

Testing for PD-L1 expression is advised for all types of metastatic lung cancer. Results may be used to decide which treatment is best. It is required before use of pembrolizumab.

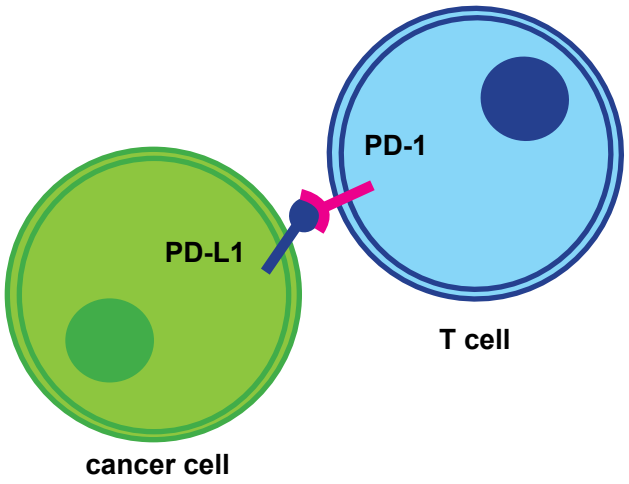
Other biomarkers
There are other known biomarkers linked with NSCLC. However, they are rare and related treatments are still being tested in clinical trials. Testing for these biomarkers should be done along with *EGFR*, *ALK*, and *ROS1* testing. There may be treatments available or a clinical trial you could join.

Read Part 5 for more information on clinical trials.
Other gene changes linked with lung cancer include:

- High-level *MET* amplification,
- *MET* exon 14 skipping mutation,
- *RET* gene rearrangements, and
- *HER2* mutations.

Figure 13
PD-L1 expression

Some lung cancers consist of cells with PD-L1. PD-L1 attaches to a receptor on a T cell called PD-1. When attached, PD-L1 stops the T cell from attacking the cancer cell.



Review

- A medical history is a report of all health events in your lifetime.
- Your doctor will examine your body for signs of disease. He or she will touch parts of your body to see if anything feels abnormal.
- Blood tests may be done to look for signs of cancer.
- Diagnostic CT shows more details in pictures than LDCT and may show where the cancer has spread in your body. PET/CT may detect cancer that CT did not.
- MRI can be used to see if the cancer has spread to your brain. You may also have an MRI of your spine and thoracic inlet if you have a superior sulcus tumor.
- Pulmonary function tests help doctors assess if surgery or radiation therapy is a treatment option.
- A bronchoscopy involves a tool that is guided into your airways to find and collect samples for cancer testing.
- There are many ways to biopsy lymph nodes and other sites to which lung cancer might have spread. Which biopsy you will receive partly depends on where the imaging tests show the cancer to be.
- Pathologists are doctors who conduct lab tests on body tissue or fluid to find disease. Lab tests can reveal if you have cancer, the type of cancer, and the cancer stage. Pathologists also do biomarker testing. These tests look for cancer-related changes in genes for which there may be treatment.

5
Overview of cancer treatments

In Part 5, the main treatment types for lung cancer are briefly described. Knowing what a treatment is will help you understand your treatment options listed in Parts 6 and 7. Not every person will receive every treatment described in this chapter.

Surgery

Removal of the tumor by surgery is the time-honored way to try to cure lung cancer. It is preferred over other local treatments. It is commonly used to treat stages I, II, and some III cancers. It is rarely used for stage IV. If you will have surgery, a board-certified thoracic surgeon who treats lung cancer often should be on your treatment team.

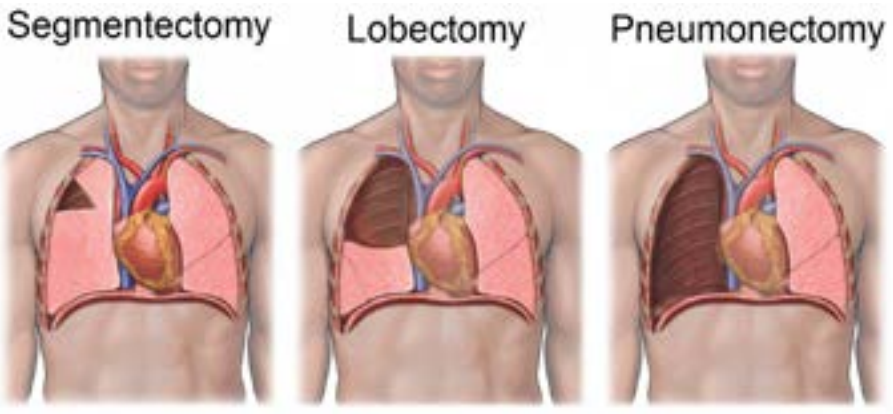
Lung tumor surgery

As shown in **Figure 14**, how much lung tissue is removed during surgery can differ. Some surgeries for lung cancer remove only part of, rather than the whole lung. Common lung surgeries are:

- **Wedge resection** – A small part of a lobe is removed,
- **Segmentectomy** – A large part of a lobe is removed,
- **Lobectomy** – An entire lobe is removed,
- **Sleeve lobectomy** – An entire lobe and part of the bronchus is removed, and
- **Pneumonectomy** – The entire lung is removed.

Figure 14
Lung surgery

How much lung tissue will be removed during surgery partly depends on the size of the tumor. Part of a lobe, a whole lobe, or an entire lung may be removed.



The goal of surgery is to remove all the cancer from the body. To do so, the tumor is removed, along with some normal-looking tissue around its rim. The normal-looking tissue is called the surgical margin. Which surgery you will have depends on where the tumor has grown and how well your lungs work.

The preferred surgery for most lung cancers is a pneumonectomy or lobectomy. If a sleeve lobectomy and pneumonectomy are options, a sleeve lobectomy is preferred. It saves most of the lung.

A segmentectomy or wedge resection may be an option in two conditions. One condition is if a lobectomy would seriously threaten your health. The other condition is if you have a very small tumor that hasn't likely spread. If you can have either surgery, a segmentectomy is the preferred choice.

Classic and newer methods
Removal of a lung tumor can sometimes be done with one of two methods. The classic method is thoracotomy. Thoracoscopy, also called VATS, is a newer method. It is also used to do biopsies as described in Part 4. VATS can be done with or without help from a robot (robotic VATS versus conventional VATS). Not enough research has been done to know if the classic or newer methods are better than the other.

Before surgery, you will be asked to stop eating, drinking, and taking some medicines for a short period of time. If you smoke, it is important to stop. Smoking can limit treatment results. General anesthesia will be used.

With thoracotomy, a large cut is made from the front of the chest to the back passing under the armpit and shoulder blade. The cut is made between the ribs and through the chest wall. The ribs are spread apart with retractors to allow the surgeon to work. Sometimes, a part of the rib is removed. During surgery, the lung with the tumor is deflated and a breathing tube is inserted down the throat to assist the other lung. After surgery, the cut is sewn closed, but chest tubes are left in place for a few days to drain fluid and air. The surgery can take between 2 and 6 hours to complete. You may stay in the hospital for a few days to recover.

With thoracoscopy, 3 or 4 small cuts are made between the ribs on the side of the chest. A small camera and surgical tools are inserted through the cuts. Video from the camera is shown on a screen so that the surgeon can clearly see your organs. Tissue is removed through the small cuts rather than a large opening as done for thoracotomy.

During surgery, the lung with the tumor is deflated and a breathing tube is inserted down your throat to assist the other lung. After surgery, the cuts are sewn closed, but chest tubes are left in place for a few days to drain fluid and air. The surgery can take between 2 and 3 hours to complete. You may stay in the hospital for a few days to recover.

Lymph node surgery

During the surgery to remove the tumor, lymph nodes will be removed. These nodes include those that have or may have cancer. Lymph nodes will be removed by systematic lymph node sampling or lymph node dissection.

For sampling, some nodes in the lung and some mediastinal lymph nodes are removed. A lymph node dissection removes as many nodes as possible from the lung and mediastinum. To remove nodes, some organs may need to be moved or cut.

If the N stage is N0 or N1, both sampling and dissection are options. Lymph node dissection is advised for stage IIIA cancers with N2 lymph nodes.

Side effects

Side effects are unhealthy or unpleasant physical or emotional responses to treatment. You may experience side effects from the anesthesia or surgery. General anesthesia may cause a sore throat from the breathing tube, nausea with vomiting, confusion, muscle aches, and itching.

Common side effects of any surgery are pain, swelling, and scars. Pain can be intense after lung surgery. Pain and swelling often fade away in the weeks after surgery. Numbness near the surgical area may be long-lasting. There is a chance of infection, which may cause pneumonia. There's also a chance of a collapsed lung (pneumothorax).

Not all side effects of surgery are listed here. Please ask your treatment team for a complete list of common and rare side effects. If a side effect bothers you, tell your treatment team. There may be ways to help you feel better.

Ablation

Ablation destroys small tumors with little harm to nearby tissue. It isn't used often for lung cancer. It may be used for small tumors. Radiofrequency ablation kills cancer cells using heat from electrodes that are passed through a bronchoscope. This treatment is done by an interventional radiologist.

Radiation therapy

Radiation therapy most often uses high-energy x-rays to treat lung cancer. The x-rays damage DNA in cancer cells. This either kills the cancer cells or stops new cancer cells from being made.

Radiation therapy may be used for all stages of lung cancer. In some cases, it may be used to treat the cancer. In other cases, it is used to reduce symptoms. It may be used alone or with other types of cancer treatment. Read Parts 6 or 7 to learn when and which types of radiation therapy are an option.

Supportive care

Supportive care doesn't aim to treat cancer but aims to improve quality of life. It is also called palliative care. It can address many needs. One example is treatment for physical and emotional symptoms.

Supportive care can also help with treatment decisions as you may have more than one option. It can also help with coordination of care between health providers. Talk with your treatment team to plan the best supportive care for you.

A board-certified radiation oncologist who treats lung cancer often should oversee treatment. A radiation oncologist is a doctor who's an expert in treating cancer with radiation. He or she will design the treatment to meet your needs.

External radiation

For lung cancer, the most common radiation method is EBRT (**e**xternal **b**eam **r**adiation **t**herapy). A large machine makes high-energy x-rays used for treatment. This machine is called a LINAC (linear accelerator). **See Figure 15**.

The radiation beams will move through your body very quickly. There is no ongoing radiation inside of you after the treatment session. You will not have to avoid people.

It takes a team of people to perform the radiation therapy. The radiation team consists of doctors, medical physicists, dosimetrists, nurses, and radiation therapists. Your team will work together to design your treatment plan and provide treatment.

Planning session

A planning session is needed to map out your treatment. The planning process is called simulation. It involves getting an imaging scan. During the scan, your body will be in the position that is needed for treatment. The scan is only used for treatment planning.

At minimum, a CT scan should be used for simulation. 4D-CT (**four-d**imensional **c**omputed **t**omography) is ideal to account for tumor movement from breathing. Contrast may be used to improve scans of certain tumors. These tumors are in the inner two-thirds of the lung or are in lymph nodes.

A PET/CT scan can be useful. It can help to aim radiation beams when the lung has collapsed or contrast can't be used. PET/CT scans within 4 weeks of treatment are advised.

You will not have to do much to prepare. Think about wearing easy-to-remove clothes since you'll wear a hospital gown. The planning session takes about 1 hour.

During simulation, you will lie face up on a table. Your arms will be raised above your head. A body mold may be made. Colored laser lights will be used to help position you. If your breathing causes large movements, motion control methods may be used. Next, the scan will be done. The medical physicist or dosimetrist may take more measurements for treatment planning.

Figure 15
External radiation

Radiation therapy is often delivered from a large machine. The x-rays pass through skin and travel to the tumor. Healthy tissue is protected using modern types of treatment.

The images will be transferred to a treatment planning computer. Your lung and other organs will be seen on the scan. This information will show your radiation oncologist where to direct the radiation.

After the treatment sites are set, your skin will be marked for treatment sessions. Your skin will be marked with a felt pen. Sometimes, set-up marks are made with tiny permanent tattoos. Photos of your set up will be taken. The marks and photos will be used to position you for daily treatments.

After simulation, your radiation team will further plan your treatment. Plans will be made by viewing your scans on the treatment planning computer. Your radiation oncologist will work closely with a dosimetrist. They will plan the best dose, number and shape of radiation beams, and number of treatments. Your plan will be designed to treat the cancer while sparing normal tissue.

Set-up session

Once your treatment plan is made, a set-up session will be needed. This session is sometimes called "port film" day or dress rehearsal. The set-up session occurs in the treatment room.

The radiation therapists will help place you in position on the treatment table. The set-up marks will be used for positioning. X-rays of the treatment fields will be taken and viewed by your doctor. These x-rays (or port films) are not for treatment. Your doctor will approve treatment when your set-up is correct.

Treatment sessions

Before treatment, your hospital gown will be lowered off your chest. You will then be placed into position. If a body mold was made, you will lie on it on top of the treatment table. You must be in the same position that was approved at the set-up session. X-rays of your chest will be taken to assure this.

Conformal techniques are used for treating lung cancer. These techniques shape the radiation dose to the cancer site to spare healthy tissue. Which technique you receive depends on multiple factors. These factors include where the cancer is in your body. Another factor is what techniques your cancer center has to offer. The types of conformal radiation include:

- **3D-CRT** (**three-d**imensional **c**onformal **r**adiation **t**herapy) delivers a photon beam that matches the shape of the target. The machine will move around you to target the tumor. Treatment is completed in about 6 weeks.
- **IMRT** (**i**ntensity-**m**odulated **r**adiation **t**herapy) is a form of 3D-CRT. It further modifies the beam's intensity during treatment.
- **SABR** (**s**tereotactic **ab**lative **r**adiotherapy) treats cancer with very precise, high-dose photon beams. Receiving SABR is much like other conformal techniques except treatment is finished in about 1 to 2 weeks.
- **SRS** (**s**tereotactic **r**adio**s**urgery) treats cancer in the brain with precise, high-dose photon beams. This treatment is known by CyberKnife and Gamma Knife. Treatment is completed in 1 to 2 weeks.
- **WBRT** (**w**hole **b**rain **r**adiation **t**herapy) uses small amounts of radiation to treat the entire brain. Treatment is completed in 2 weeks.
- **Proton therapy** treats cancer with proton beams that deliver radiation mostly within the tumor. Treatment is completed in about 6 weeks.

A lung tumor is harder to target than some other tumors in the body. This is because breathing causes the tumor to move. IGRT (**i**mage-**g**uided

radiation **t**herapy) can improve how well the radiation beam targets the tumor. IGRT uses a machine that delivers radiation and also takes pictures of the tumor. Pictures can be taken right before or during treatment. These pictures are compared to the ones taken during simulation. If needed, changes will be made to your body position or the radiation beams. During treatment, you will be alone in the room. A therapist will operate the machine from a nearby room. He or she will be able to see, hear, and speak with you at all times. As treatment is given, you may hear noises. You will not see or feel the radiation.

Treatment is given once a day on Monday through Friday. Each session can last between 10 to 30 minutes. In general, treatment is received at the same time each day.

Internal radiation

The less common radiation method is internal radiation therapy. This method is also called brachytherapy. It involves placing a radioactive object in or near the tumor. For lung cancer, internal radiation can shrink a tumor blocking an airway. Radiation is given through a plastic tube that is inserted into the airway. The tube is removed after the treatment session.

Side effects

Side effects from radiation therapy differ among people. Factors like radiation dose and length of treatment play a role. Side effects are cumulative. This means they build up slowly and are worse at the end of treatment. Your doctor will check on you every week during treatment. He or she will review skin care, medicines, and other options to help you feel better.

Acute effects

Acute effects are those that happen during treatment or shortly after the last session. Acute effects will generally improve after treatment. Fatigue is an acute effect. It may be painful to swallow. Skin changes and hair loss at the treatment site are expected.

Often, people describe skin changes as like a sunburn. Unlike a sunburn, skin changes build up slowly during treatment. Your skin may become red, irritated, and dry. It may also itch, darken, peel, and sometimes crack open.

Late effects

Late effects are those that happen after treatment. Some do not go away. Your lungs may become inflamed. If so, the inflammation often goes away in a few months. Scar tissue may form in the lungs. The scar tissue may cause shortness of breath and a cough. Radiation may damage the heart but this is rare.

Not all the side effects of radiation have been listed here. Please ask your treatment team for a complete list of side effects. If a side effect bothers you, tell your treatment team. There may be ways to help you feel better.

> “Learning to manage side effects is well worth the effort!
>
> – Jon
> Lung cancer survivor

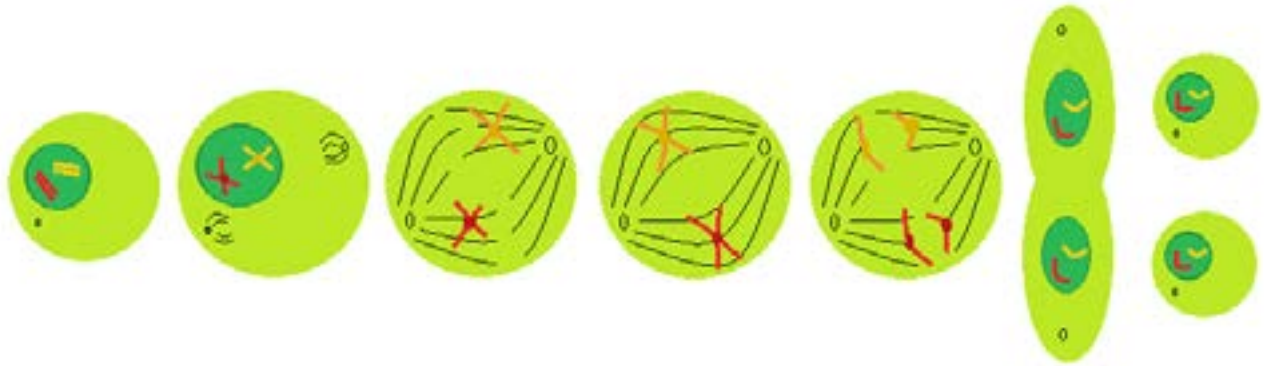
Chemotherapy

Chemotherapy, or “chemo,” includes drugs that disrupt the life cycle of cancer cells. The types of chemotherapy differ in the way they work. Some kill cancer cells by damaging their DNA or by disrupting the making of DNA. Others interfere with cell parts that are needed for making new cells. Thus, no new cells are made to replace dying cells. Chemotherapy can affect both cancer and normal cells.

Some chemotherapy drugs work when cells are in an active growth phase. **See Figure 16**. During the active growth phase, cells grow and divide to form a new cell. Chemotherapy that disrupts the growth phase works well for cancer cells that are growing and dividing quickly. Other chemotherapy drugs work in any growth or resting phase.

Figure 16
Chemotherapy and the cell cycle

A cell goes through many changes to divide into two cells. Science has grouped these changes into 7 main phases. There may be another phase of rest, too. Some chemotherapy drugs work in any phase. Other chemotherapy drugs work in one or two growth phases. In growth phases, DNA is copied and two full sets of chromosomes are made. A full set of chromosomes is pulled into each end of the cell. The cell then divides into two cells each with their own set of chromosomes.



Chemotherapy may work in some or all phases of cell division.

Regimens

Chemotherapy drugs used for lung cancer are listed in Guide 5. Sometimes, only one drug is used. Other times, more than one drug is used because drugs differ in the way they work.. Often, cisplatin or carboplatin—drugs made with platinum—is used with another drug. These regimens are called platinum-doublet chemotherapy. Parts 6 and 7 are guides that explain who should receive which treatments.

What to expect

A member of your treatment team will likely review what to expect with you. Drugs can differ in terms of how they are given. Ask your treatment team how you should prepare for treatment.

Most chemotherapy drugs for lung cancer are liquids that are slowly injected into a vein. Some are a pill that is swallowed. By any method, the drugs travel in your bloodstream to treat cancer throughout your body. Doctors use the term “systemic” when talking about a cancer treatment for the whole body.

Chemotherapy is given in cycles of treatment days followed by days of rest. The cycles vary in length depending on which drugs are used. Common cycles are 14, 21, or 28 days long. Giving chemotherapy in cycles gives your body a chance to recover after receiving chemotherapy. If you will have chemotherapy, ask your doctor how many cycles and days of treatment there are within a cycle.

Side effects

Side effects from chemotherapy differ among people. Some people have many side effects. Other people have few. Some side effects can be very serious. Others can be unpleasant but not serious.

Side effects of chemotherapy depend on multiple factors. These factors include the drug type, amount taken, length of treatment, and the person. In general, side effects are caused by the death of fast-growing cells.

Fast-growing cells are found in the hair follicles, gut, mouth, and blood. Death of these cells can cause

Guide 5. Chemotherapy

Generic (chemical) name	Brand name (sold as)
Carboplatin	–
Cisplatin	Platinol®
Docetaxel	Taxotere®
Etoposide; Etoposide phosphate	Etopophos®
Gemcitabine hydrochloride	Gemzar®
Paclitaxel	Taxol®
Paclitaxel, albumin bound	Abraxane®
Pemetrexed	Alimta®
Vinblastine sulfate	–
Vinorelbine tartrate	Navelbine®

low blood cell counts, not feeling hungry, nausea, vomiting, diarrhea, hair loss, and mouth sores. Lung damage may also occur at the time of treatment.

Most side effects appear shortly after treatment starts and will stop after treatment. However, other side effects are long-term or may appear years later. Late side effects include another type of cancer, heart disease, low levels of thyroid hormones (hypothyroidism), and problems having babies (infertility).

Not all side effects of chemotherapy are listed here. Please ask your treatment team for a complete list of common and rare side effects. If a side effect bothers you, tell your treatment team. There may be ways to help you feel better. There are also ways to prevent some side effects.

Targeted therapy

Targeted therapy is a class of drugs. It works by stopping key molecules that help cancer cells grow. It is less likely to harm normal cells than chemotherapy. Targeted therapies for lung cancer are listed in Guide 6.

These treatments are briefly described next. Some side effects are listed. Ask your treatment team for a full list of common and rare side effects. In Part 7,

Guide 6. Targeted therapy

Generic (chemical) name	Brand name (sold as)	Target molecule(s)
Ado-trastuzumab	Kadcyla®	HER2
Afatinib	Gilotrif®	EGFR and HER2
Alectinib	Alecensa®	ALK
Bevacizumab	Avastin®	VEGF
Brigatinib	Alunbrig™	ALK
Ceritinib	Zykadia®	ALK
Cetuximab	Erbitux®	EGFR
Crizotinib	Xalkori®	ALK, ROS1, and MET
Dabrafenib	Tafinlar®	BRAF V600E
Erlotinib hydrochloride	Tarceva®	EGFR
Gefitinib	Iressa®	EGFR
Osimertinib	Tagrisso™	EGFR
Ramucirumab	Cyramza®	VEGF
Trametinib	Mekinist®	MEK1 and MEK2 (for *BRAF* mutation)
Vandetanib	Caprelsa®	RET
Vemurafenib	Zelboraf®	BRAF V600E

information on who should receive these drugs is provided. Targeted therapy is often given when certain mutations are present.

EGFR mutation

Cell growth is started by growth signals. EGFR is one of the surface receptors in lung cancer cells that can trigger growth signals. Some people with lung cancer have gene mutations that cause EGFR to be overactive. With overactive EGFRs, new cancer cells form quickly. There are five medicines used to stop EGFRs from triggering growth signals. **See Figure 17**.

Erlotinib

Erlotinib attaches to a part of EGFR that is within cells. This part of EGFR is a tyrosine kinase. It is a docking site for phosphate as it is moved from one molecule to another. Erlotinib blocks phosphate and stops EGFRs from completing their job. Thus, growth signals aren't triggered by EGFRs.

Erlotinib is made as a pill. It should be taken on an empty stomach. The dose given differs among people. Your doctor will decide the dose you need.

Common side effects of erlotinib are rash; diarrhea; not feeling hungry; weakness; trouble breathing; and cough. You may have severe eye, skin, lung, kidney, or liver problems, but these are rare. Other rare events include tears in your gut and bleeding. Don't take erlotinib if you are pregnant, trying to get pregnant, or breastfeeding.

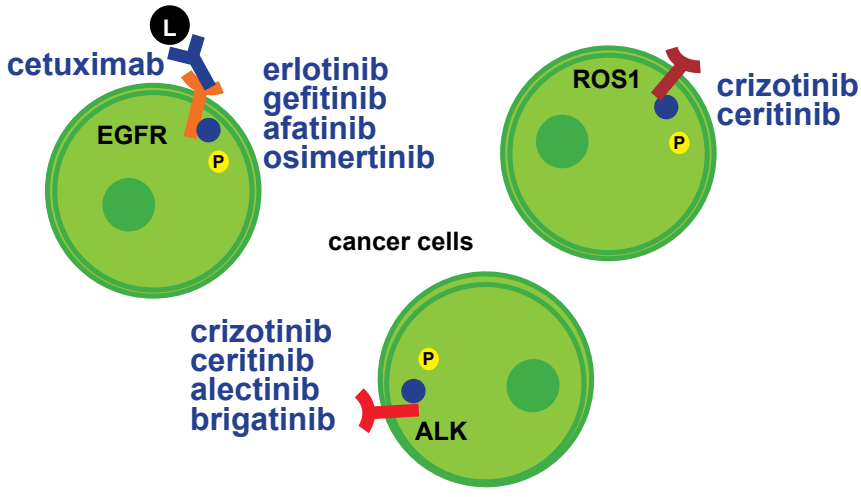
Gefitinib

Gefitinib is the same type of drug as erlotinib. Gefitinib is made as a pill. It can be taken with or without food. It is usually taken once a day.

The most common side effects of gefitinib are skin reactions and diarrhea. Serious side effects include a tear in your gut and eye problems.

Figure 17
EGFR, ALK, ROS1 targets

Some lung cancers have overactive surface receptors. These receptors help the cancer cells grow by triggering cell growth signals. Targeted therapy stops growth signals from these receptors.



Very rarely, severe lung and liver problems occur. Don't take gefitinib if pregnant, trying to get pregnant, or breastfeeding.

Afatinib
Afatinib is the same type of drug as erlotinib. However, it also stops another surface receptor called HER2. Unlike erlotinib and gefitinib, afatinib doesn't detach from EGFR and HER2. Its effect on cells doesn't stop.

Afatinib is made as a pill. It should be taken on an empty stomach. The dose given differs among people. Your doctor will decide the dose you need.

Common side effects of afatinib include diarrhea, nausea, vomiting, skin rash or dryness, acne, nail infection, mouth sores, itching, and not feeling hungry. Diarrhea and skin problems may be severe. Likewise, you may also have lung, liver, heart, and eye problems. Don't take afatinib if you are pregnant, trying to get pregnant, or breastfeeding.

Osimertinib
Osimertinib is the same type of drug as erlotinib. It is made as a pill. It can be taken with or without food. The dose given differs among people. Your doctor will decide the dose you need.

The most common side effects of osimertinib are tiredness, diarrhea, skin rash, dry skin, and nail changes. Nail changes include redness, swelling, pain, and nails breaking and detaching from the finger. Osimertinib may also cause severe eye, lung, or heart problems, but these problems are rare. Osimertinib may harm your baby if you're pregnant or breastfeeding.

Cetuximab
Cetuximab attaches to the ends of EGFRs that are outside of the cell. Thus, molecules (ligands) are blocked from attaching to and turning on EGFRs. No growth signals are started. Cetuximab also attracts immune cells that help to kill the cancer cells.

Cetuximab with afatinib may be received if the cancer worsens while taking another EGFR-targeted therapy. It is given by infusion. It is usually received once a week or every other week. It may take 2 hours to receive the first dose. Later doses will take only 1 hour.

Common side effects of cetuximab are skin problems. These problems include acne-like rash, dry skin, eye inflammation, and skin infections. Other common side effects are diarrhea and loss of appetite. Blood magnesium levels may drop. Rare but serious side effects include a severe reaction to the infusion and lung damage. Cetuximab may harm your baby if you're pregnant or breastfeeding.

ALK rearrangement
ALK is a surface receptor that can trigger growth signals in lung cancer cells. In lung cancers with an ALK rearrangement, ALK is overactive. With overactive ALK, new cancer cells form quickly. There are four medicines used to stop ALK from triggering growth signals.

Crizotinib
Crizotinib attaches to a part of ALK that is within cells. This part of ALK is a tyrosine kinase. It is a docking site for phosphate as it is moved from one molecule to another. Crizotinib blocks the phosphate and stops ALK signaling.

Crizotinib is made as a pill. It is taken twice a day. It can be taken with or without food.

Common side effects of crizotinib include vision problems; stomach problems (nausea, vomiting, diarrhea, constipation); not feeling hungry; fluid buildup; and feeling tired despite sleep. It can cause dizziness, lung infections, and nerve damage. Severe problems may include lung, liver, and heart

problems. Crizotinib may harm your baby if you're pregnant or breastfeeding.

Ceritinib
Ceritinib is the same type of drug as crizotinib. However, the structure of ceritinib differs from crizotinib. Thus, it is able to block phosphate when crizotinib can't.

Ceritinib is made as a pill. It should be taken on an empty stomach. However, your doctor may suggest a different dose with food. It is taken once a day.

Common side effects of ceritinib are diarrhea, nausea, vomiting, abdominal pain, tiredness, not feeling hungry, and weight loss. It rarely causes severe lung, heart, and liver problems. Ceritinib may harm your baby if you're pregnant or breastfeeding.

Alectinib
Alectinib is the same type of drug as crizotinib and ceritinib. However, its structure differs. Thus, it is able to block phosphate when other medicines do not.

Alectinib is made as a pill. It is taken twice a day with food. Common side effects of alectinib are tiredness, constipation, swelling, and muscle pain. It rarely causes severe lung, heart, kidney, and liver problems. Alectinib may harm your baby if you're pregnant or breastfeeding.

Brigatinib
Brigatinib works much like the other medicines but its structure differs. Thus, it is able to block phosphate when other medicines do not.

Brigatinib is made as a pill. It can be taken with or without food. It is taken once a day. It is given at half dose for the first week of treatment.

Common side effects include nausea, diarrhea, headache, cough, and tiredness. It may cause severe lung, heart, vision, and muscle problems. Brigatinib may harm your baby if you're pregnant or breastfeeding.

ROS1 rearrangement
ROS1 is surface receptor that can trigger growth signals in lung cancer cells. In lung cancers with a *ROS1* rearrangement, ROS1 is overactive. With overactive ROS1, new cancer cells form quickly. There are two medicines used to stop ROS1 from triggering growth signals.

Ceritinib
Besides ALK, ceritinib also stops growth signals from ROS1. It works by blocking the transfer of phosphate by the tyrosine kinase. Read the section, *ALK rearrangement*, to learn more about ceritinib.

Crizotinib
Besides ALK, crizotinib also stops growth signals from ROS1. It works by blocking the transfer of phosphate by the tyrosine kinase. Read the section, *ALK rearrangement*, to learn more about crizotinib.

BRAF V600E mutation
BRAF is a kinase inside of cells. It transfers phosphates from one molecule to another. The phosphate "turns on" the next growth signal in the pathway. In lung cancers with a *BRAF V600E* mutation, BRAF is overactive. With overactive BRAF, new cancer cells form quickly. There are three medicines to treat overactive BRAF signals. **See Figure 18**.

Dabrafenib + trametinib
Dabrafenib and trametinib are most often used together for treatment. Dabrafenib attaches to BRAF and blocks the transfer of phosphate. Trametinib blocks the transfer of phosphate by another kinase called MEK. BRAF and MEK are within the same growth signal pathway. MEK is further down in the pathway.

Dabrafenib and trametinib are made as pills. Both should be taken on an empty stomach. Dabrafenib is taken twice a day. Trametinib is taken once a day at the same time each day.

Common side effects of dabrafenib with trametinib include fever, chills, and fatigue. You may feel nauseated, vomit, have diarrhea, or not feel hungry. Your skin may become dry or get a rash. You face, arms, or legs may swell. Bleeding, cough, and shortness of breath are also common.

There are rare but serious side effects. These include tears in your gut, blood clots, and heart, eye, or lung problems. Fever, rash, or bleeding may be severe. Blood sugar may become very high. Other types of cancer may develop.

If you want to have a baby, tell your doctor. Sperm counts can drop in men. Women may have trouble getting pregnant. Don't use dabrafenib and trametinib if you're pregnant or breastfeeding. These medicines may harm your baby.

Dabrafenib only

Dabrafenib and trametinib may be too hard on your body. In this case, dabrafenib used alone may be an option. Common side effects include changes in your skin. Your skin may become thick or get warts. Your hands or feet may become red, swell, peel, or feel tender. Other common side effects are fever, joint aches, and hair loss.

Vemurafenib

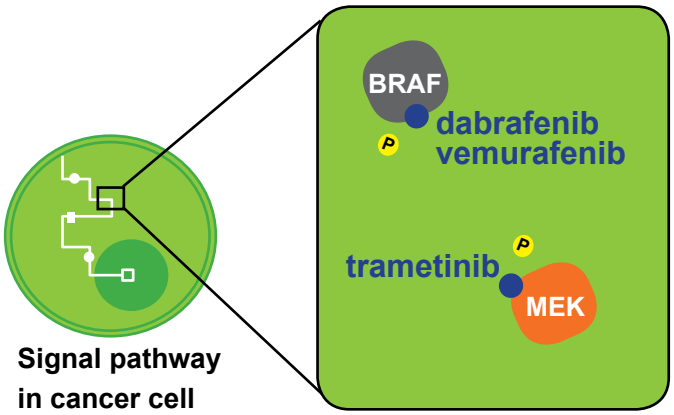
Vemurafenib may also be an option if dabrafenib with trametinib can't be taken. It works like dabrafenib and stops BRAF signals. It is used to treat melanoma. More research is needed on lung cancer.

Vemurafenib is made as a pill. It is taken twice a day. It can be taken with or without food.

Side effects may be alike for melanoma and lung cancer. Common side effects for melanoma treatment include joint pain, tiredness, and nausea. Your skin may get a rash or warts. You may have hair loss or easily get a sunburn. You may feel itchy.

Figure 18
BRAF and MEK targets

Some lung cancers have overactive BRAF proteins. These proteins send too many growth signals. Targeted therapy stops the signal from BRAF or the next protein (MEK) in the signal pathway.



Serious side effects include allergic or skin reactions, heart problems, liver or kidney damage, and eye problems.

VEGF pathway

Cancer cells need the food and oxygen in blood to grow. Cancer cells get blood from blood vessels that have grown into the tumor. VEGF (**v**ascular **e**ndothelial **g**rowth **f**actor) is one of the molecules that triggers the growth of these blood vessels.

Unlike other biomarkers, VEGF is not mutated. However, it plays a role in most lung cancers. VEGF is made by cancer cells. It travels from cancer cells to endothelial cells. Endothelial cells form blood vessels.

VEGF attaches to surface receptors on the outside of endothelial cells. Attachment of VEGF to surface receptors triggers growth signals. There are two medicines used to stop the growth signals caused by VEGF.

Bevacizumab

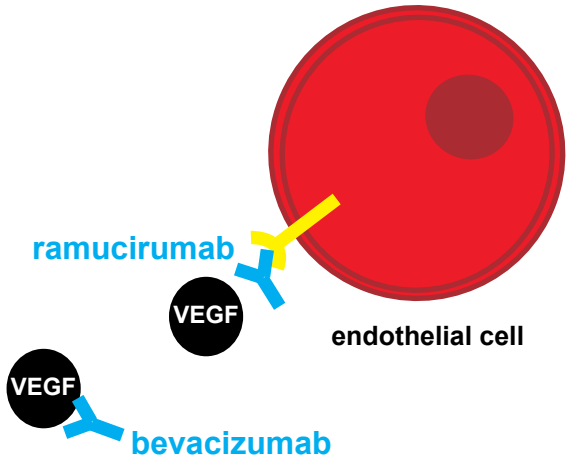
Bevacizumab attaches to VEGF before it attaches to receptors on endothelial cells. **See Figure 19**. As a result, VEGF can't attach to receptors. No growth signals caused by VEGF are started.

Bevacizumab is given by infusion. It takes about 90 minutes to get the first dose and 30 minutes for later doses. Bevacizumab is always first given with chemotherapy and after 4 to 6 treatments, may be given alone to maintain good results. It is given every 2 or 3 weeks depending on the chemotherapy.

Common side effects of bevacizumab are high blood pressure, nosebleeds, and headache. You might also have a runny nose, protein in the urine, and rectal bleeding. Rare but serious side effects include stroke, heart attack, blood clots, kidney damage, a tear in your gut, abnormal passage between body parts, and bleeding. Very rarely, brain damage occurs. Don't take bevacizumab if you are pregnant, trying to get pregnant, or breastfeeding.

Figure 19
VEGF target

Cancer cells need blood to grow. They send VEGF to endothelial cells to start the growth of blood vessels. Ramucirumab blocks VEGF from attaching to receptors. Bevacizumab disables VEGF from attaching to receptors.



Ramucirumab
Ramucirumab attaches to VEGF receptors on the outside of endothelial cells. This blocks VEGF from attaching. No growth signals caused by VEGF are started.

Ramucirumab is given by infusion. It takes 60 minutes to receive the full dose. Ramucirumab is always given with chemotherapy. It is given every two weeks on the first day of chemotherapy.

Common side effects of ramucirumab are high blood pressure and diarrhea. Serious side effects include bleeding, blood clots, tears in your gut, abnormal passage between body parts, and slow wound healing. Very rarely, brain damage occurs. Don't take bevacizumab if pregnant, trying to get pregnant, or breastfeeding.

Other targets

Although rare, there are other biomarkers of lung cancer for which there are treatments. These treatments are approved for lung or other cancers but still need more research. Such treatments include ado-trastuzumab for HER2. Cabozantinib and vandetanib target RET. In addition to targeting ALK and ROS1, crizotinib targets MET.

Complementary and alternative medicine

CAM (**c**omplementary and **a**lternative **m**edicine) is a group of treatments that aren't often given by doctors. There is much interest today in CAM for cancer. Many CAMs are being studied to see if they are truly helpful.

Complementary medicines are treatments given along with usual medical treatments. While CAMs aren't known to kill cancer cells, they may improve your comfort and well-being. Two examples are acupuncture for pain management and yoga for relaxation.

Alternative medicine is used in place of usual medicine. Some alternative medicines are sold as cures even though they haven't been proven to work in clinical trials. If there was good proof that CAMs or other treatments cured cancer, they would be included in this book.

It is important to tell your treatment team if you are using any CAMs. They can tell you which CAMs may be helpful and which CAMs may limit how well medical treatments work.

Immunotherapy

The immune system is the body's natural defense against disease. It includes many chemicals and proteins made by your body. Immunotherapy increases the activity of your immune system. Your body can better find and destroy cancer cells.

PD-1 and PD-L1 inhibitors

PD-L1 is found on some normal cells. It attaches PD-1 on T cells to turn off an immune response. This is a normal when a response is no longer needed.

Cancer cells with PD-L1 can also turn off the immune response. This prevents the immune system from attacking the tumor. The PD-L1 and PD-1 inhibitors listed in Guide 7 are used to stop cancer cells with PD-L1.

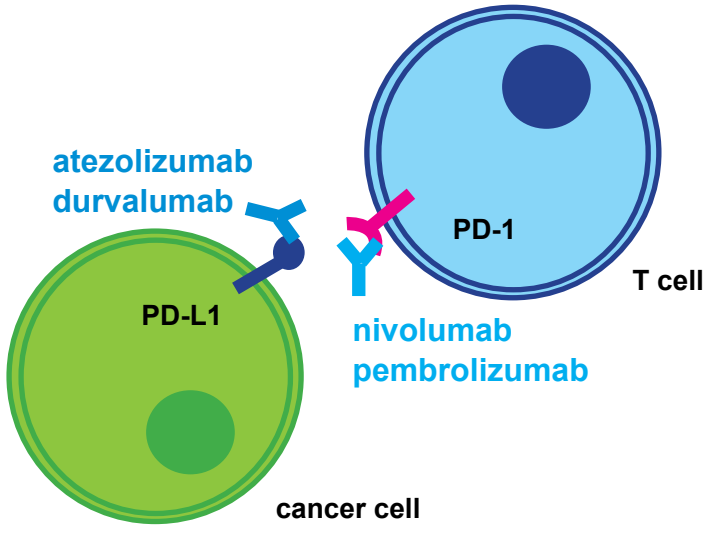
PD-L1 inhibitors attach to PD-1 on T cells. PD-1 inhibitors attach to PD-1 on cancer cells. Both types of inhibitors stop cancer cells with PD-L1 from attaching to T cells. Thus, T cells are able to attack cancer cells. **See Figure 20**.

Guide 7. Immunotherapy

Generic (chemical) name	Brand name (sold as)	Type
Atezolizumab	Tecentriq®	PD-L1 inhibitor
Durvalumab	Imfinzi™	PD-L1 inhibitor
Nivolumab	Opdivo®	PD-1 inhibitor
Pembrolizumab	Keytruda®	PD-1 inhibitor

Figure 20
Immunotherapy

Some lung cancers consist of cells that have PD-L1 on their surface. PD-L1 can attach to T cells and stop them from attacking cancer cells. Immunotherapy for lung cancer stops PD-L1 from attaching. As a result, T cells are able to attack cancer cells.



What to expect

PD-1 and PD-L1 inhibitors are given by infusion. Durvalumab and nivolumab are given every 2 weeks for 60 minutes. Pembrolizumab is given every 3 weeks for 30 minutes. Atezolizumab is given every 3 weeks for 60 minutes

Side effects

Most people have fewer side effects with immunotherapy than chemotherapy. Common side effects for immunotherapy include feeling tired despite sleep. It is also common to feel constipated, nauseated, and not hungry. You may have muscle or bone pain.

Any organ can become inflamed while taking immunotherapy. This is rare but can cause severe side effects involving the lung, gut, liver, kidney, hormones, or skin. Don't take immunotherapy if you are pregnant, trying to get pregnant, or breastfeeding. It may harm your baby.

Not all side effects of immunotherapy are listed here. Please ask your treatment team for a complete list of common and rare side effects. If a side effect bothers you, tell your treatment team. There may be ways to help you feel better. There are also ways to prevent some side effects.

Clinical trials

One of your treatment choices may be to join a clinical trial. Joining a clinical trial is strongly supported. NCCN believes that you will receive the best management in a clinical trial.

New tests and treatments aren't offered to the public as soon as they're made. They first need to be studied. A clinical trial is a type of research that studies a test or treatment in people.

Clinical trials study how safe and helpful tests and treatments are for people. When found to be safe and helpful, they may become tomorrow's standard treatment. Because of clinical trials, the tests and treatments in this book are now widely used to help people with lung cancer. Future tests and treatments that may have better results will depend on clinical trials.

New tests and treatments go through a series of clinical trials. These trials aim to ensure they're safe and work. Without clinical trials, there is no way to know if a test or treatment is safe or helpful. Clinical trials have four phases. Some examples of the four phases of treatment are:

- **Phase I trials** aim to find the safest and best dose of a new drug. Another aim is to find the best way to give the drug with the fewest side effects. These trials often involve about 20 people.
- **Phase II trials** assess if a drug works for a specific type of cancer. These trials often involve 20 to 100 people.
- **Phase III trials** compare a new drug to a standard treatment head-to-head. These trials often involve hundreds or thousands of people.
- **Phase IV trials** test drugs approved by the U.S. FDA (**F**ood and **D**rug **A**dministration) to learn more about side effects with long-term use.

Joining a clinical trial has benefits. First, you'll have access to the most current cancer care. However, please note that it is unknown how well new treatments will work, if at all. Second, you will receive the best management of care. Third, the results of your treatment—both good and bad—will be carefully tracked. Fourth, you may help other people who will have cancer in the future.

Clinical trials have risks, too. Like any test or treatment, there may be side effects. Also, new tests or treatments may or may not improve your health. In fact, your health may worsen during a trial. Other downsides may include more hospital trips, paperwork, and extra costs for you.

To join a clinical trial, you must meet the conditions of the study. Patients in a clinical trial are often alike in terms of their cancer and general health. Thus, if patients improve, it's because of the treatment and not because of differences between them.

To join, you'll need to review and sign an informed consent form. This form describes the study in detail. The study's risks and benefits should be described and may include others than those described above.

Ask your treatment team if there is an open clinical trial that you can join. There may be clinical trials where you're getting treatment or at other treatment centers nearby. You can also find clinical trials through the websites listed in Part 8.

I qualified for a clinical trial. Tumor has reduced in size by almost two-thirds and fluid cleared. Right now I'm doing great and my horizon has lengthened considerably. Grateful to be a "survivor."

– Fred
Lung cancer survivor

Review

- Lung surgery removes the tumor with some normal tissue around its edge. Lymph node surgery removes nodes with cancer and nodes that may have cancer.
- Radiofrequency ablation kills cancer cells using heat.
- Radiation therapy most often uses high-energy x-rays to treat lung cancer.
- Chemotherapy stops cancer cells from completing their life cycle so they can't increase in number.
- Targeted therapy drugs stop cancer cells from getting food or signals to grow.
- Immunotherapy activates your body's disease-fighting system to destroy cancer cells.
- Clinical trials give people access to new tests and treatments that otherwise can't usually be received. These new tests and treatments may in time be approved by the FDA.

6
Treatment guide: Non-metastatic cancer

Part 6 is a guide to the treatment options for cancer stages I, II and III. These cancers are called non-metastatic. Options are grouped by whether there is one or more unrelated tumors. Your doctor may suggest other options based on your health and wishes. Fully discuss your options with your doctor.

Overview

Primary tumors

A primary tumor is the first mass of cancer cells. Cancer cells may break away from the primary tumor and form other tumors. These are called secondary tumors.

A person can have more than one primary tumor. The histologic subtype may be the same or differ between the primary tumors.

Multiple primary tumors may occur at the same time. They may occur in the same lung but different lobes or occur in both lungs. Multiple tumors may occur at different times. You may have been treated for one primary tumor and now have a second primary tumor.

Treatment path

Lung cancer is very often treated with more than one type of treatment. Treatments may be received in a sequence or at the same time. Some of the terms used in this book or by doctors are:

- **Initial treatment** is the first treatment received. It is often based on the clinical stage of the cancer. The clinical stage is the rating of the extent of cancer before treatment.
- **Induction treatment** is the first treatment received for some higher-staged cancers. The goal is to greatly reduce the extent of cancer. It consists of chemotherapy with or without radiation. If it works well, sometimes surgery becomes an option.
- **Preoperative treatment** is received before surgery. It is often given to shrink the cancer to make surgery easier. It is sometimes called neoadjuvant treatment. It may consist of chemoradiation or chemotherapy.
- **Adjuvant treatment** is given after local treatments to treat any remaining cancer. It consists of chemotherapy, radiation therapy, or both. It is partly based on the pathologic stage of cancer. This stage is a rating of the cancer after treatment. Sometimes, more cancer is found than first thought.
- **Boost radiation** is an extra dose of radiation. It is used to improve the results of treatment.
- **Consolidation treatment** is given to prolong the good results of prior treatment. For lung cancer, up to 12 months of durvalumab is used.

Chemotherapy regimens

Chemotherapy is often used to treat lung cancer. However, the chemotherapy received differs among people. Regimens recommended by NCCN experts for lung cancer are listed next.

Chemoradiation (back-to-back) or chemotherapy

Chemotherapy may be received before or after radiation therapy. Doctors call this sequential chemoradiation. Chemotherapy alone or back-to-back with radiation may improve the results of surgery.

Cisplatin is most often used along with another drug. The other drug may be vinorelbine, etoposide, gemcitabine, docetaxel, or pemetrexed. If these regimens make you too sick, take carboplatin with either paclitaxel, gemcitabine, or pemetrexed.

Chemoradiation (at the same time)

Chemotherapy may be received at the same time as radiation therapy. Doctors call this concurrent chemoradiation. Cisplatin with either etoposide or vinblastine are options. Paclitaxel with carboplatin is another option. For non-squamous cell carcinoma, pemetrexed with either cisplatin or carboplatin may be used.

Chemoradiation (at the same time) is also used to try to cure the cancer. Doctors call this definitive chemoradiation. For a cure, more cycles may be received. Four more cycles of pemetrexed may follow cisplatin and pemetrexed. Two more cycles of paclitaxel may follow paclitaxel and carboplatin.

When you are diagnosed with cancer, the most important thing that you can arm yourself with is knowledge and education.

– Anonymous
Lung cancer survivor

One primary tumor

This section presents treatment options for one or more related masses of cancer cells. Treatment options are listed by cancer stage. Cancer is staged based on tests given before treatment. This is called the clinical stage.

To learn your options for initial treatment, read the section that is a match to the clinical stage. For example, if the cancer is stage II, read the section called *Stage II*.

Options for adjuvant treatment will depend on the results of surgery. During surgery, your doctors may find more cancer than first thought. This may change the stage of the cancer. If the cancer is upstaged, read the section that is a match to the pathologic stage. For example, if the cancer was upstaged from stage II to stage III, read the section *Stage III* for adjuvant treatment.

Stage I

Guide 8 lists the treatment options for stage I. In stage IA, the lung tumor is 3 cm or smaller. A stage IB tumor can be as large as 4 cm.

Initial treatment

Options for initial treatment depend on if you are able to have surgery. If lung surgery is an option, removal of the tumor and lymph nodes is advised. The goal of surgery is to cure the cancer.

You may be unable or refuse to have surgery. In this case, radiation therapy is an option. The goal of radiation therapy is to cure the cancer. You may receive conventional radiation therapy. Conventional radiation therapy gives radiation in small doses for weeks and targets both the tumor and some normal tissue. One example is 3D-CRT. A newer type of radiation therapy—SABR—is also advised. Ablation may be an option for some stage IA tumors in the outer third of the lung.

Adjuvant treatment

Adjuvant treatment is given to reduce the chances of the cancer returning. Options are grouped by type of initial treatment.

After surgery

Cancer-free surgical margins are often a sign that all the cancer was removed. In this case, you may start your survivorship plan. However, cancer cells may remain for some stage IB cancers. In these cases, chemotherapy may be received. Cancer likely remains when tumors are larger than 4 cm, after a wedge resection, or cancer cells barely look like normal cells.

When cancer cells are in the surgical margins, a second surgery is the option preferred by NCCN experts. A second option is radiation therapy. If you have stage IB cancer, chemotherapy may be added to surgery or radiation therapy.

After radiation therapy

For stage IA, no more treatment is needed. You may start your survivorship plan. For stage IB, no more treatment is needed if all the cancer was likely treated. Chemotherapy may be received if cancer cells likely remain in your body. Cancer likely remains when tumors are larger than 4 cm or cancer cells barely look like normal cells. Chemotherapy may also be given if it is unknown whether cancer is in lymph nodes.

Guide 8. Treatment for stages IA and IB

Initial treatment

Surgery status	What are the options?
You are approved and agree to surgery	• Surgery to remove lung tumor and lymph nodes
You are not approved or decline surgery	• Radiation therapy (including SABR)

Adjuvant treatment after surgery

Pathologic stage	Margin status	What are the options?
Stage IA	No cancer in the margins	• Start survivorship plan
	Cancer in the margins	• Another surgery (preferred) • Radiation therapy
Stage IB	No cancer in the margins	• Start survivorship plan, or • Chemotherapy if cancer may still be in your body
	Cancer in the margins	• Another surgery (preferred) ± chemotherapy, • Radiation therapy ± chemotherapy

Adjuvant treatment after radiation treatment

Pathologic stage	What are the options?
Stage IA	• Start survivorship plan
Stage IB	• Consider chemotherapy if cancer may still be in your body

Guide 9. Survivorship plan

Type of care	When is this care needed?
Medical history and physical exam	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then repeat every year
Chest CT ± contrast	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then LDCT every year
General health tests (eg, bone density)	• As needed
Prevent other diseases (eg, cancer screening)	• As needed
Healthy lifestyle (eg, healthy diet, no smoking)	• As needed

Survivorship plan

Guide 9 lists the health care that is advised for a survivorship plan. These plans start when treatment is done and tests show no signs of cancer. The plan should address your whole health and well-being. Talk with your doctor about making a plan together.

Cancer tests

Follow-up cancer tests are given to find any new lung tumors early. These tests include a medical history, physical exam, and chest CT scan with or without contrast. The timing of tests partly depends if radiation therapy was part of your treatment. Read Guide 9 for recommended time frames. Your doctor will decide when testing is needed within a time frame.

General health tests

Besides follow-up tests, tests of your general health are advised. After going through treatment for cancer, it may be hard to think about taking care of "less important" issues. However, your general health can have a big impact on your well-being. Have your blood pressure, cholesterol, and glucose checked on a regular basis. Some people also need bone density testing.

Disease prevention

Likewise, take steps to prevent other diseases. Such steps can include getting immunization shots for the flu, herpes, and other diseases. Dental cleaning and exams on a regular basis can prevent disease,

too. Screening tests for other cancers are also very important.

Healthy lifestyle

The last recommendation is to start or keep a healthy lifestyle. There is proof that healthy behaviors can improve your treatment results. Limiting your use of alcohol, protecting yourself from the sun, and being at a healthy weight are important.

Healthy eating includes eating a balanced diet, eating the right amount of food, and drinking enough fluids. However, you may have special food needs during and after treatment. A nutritionist—an expert in creating a healthy diet—can help.

Many patients benefit from some exercise. Exercise tones muscles, lowers stress, and improves health. Exercise programs differ between people based on their needs. Talk with your treatment team about which exercises would be best for you.

Being hooked on nicotine is one of the hardest addictions to stop. The stress of lung cancer may make it harder or easier to quit. Quitting is important since smoking can limit how well cancer treatment works. Talk with your treatment team about ways to quit.

Stage II

A stage IIA tumor is between 4 cm and 5 cm in size. TNM scores are T2b, N0, M0. Some of these tumors may have invaded the main airway or inner lining of the lung. The tumor may have caused your lung to collapse or swell. Stage IIA hasn't spread to any lymph nodes.

A stage IIB tumor may be as large as 5 cm and spread to the lung's lymph nodes. TMN scores are T1 or T2, N1, M0. Some of these tumors may have invaded the main airway or inner lining of the lung. The tumor may have caused your lung to collapse or swell.

Stage IIB also includes tumors that have not spread to lymph nodes. TMN scores are T3, N0, M0. These tumors are between 5 cm and 7 cm in size, have invaded structures, or have secondary tumors in the same lobe. Invaded structures may include the outer lining of the lung, chest wall, and the heart's lining.

Options for stage II cancers are grouped into four sections.

- *T2 or T3 without invasion* starts on this page.
- *T3 Superior sulcus tumors* starts on page 68
- *T3 Other invasive tumors* starts on page 68.
- *Survivorship plan* starts on page 70.

T2 or T3 without invasion

Guide 10 lists treatment options for all T2 tumors and only T3 tumors without invasion. For initial treatment, options depend on if you are able to have surgery.

Initial treatment

If lung surgery is an option, removal of the tumor and lymph nodes is advised. The goal of surgery is to cure the cancer. If chemotherapy is likely, you may receive it before surgery to shrink the tumor.

You may be unable or refuse to have surgery. Your options depend on if the cancer has spread to your lymph nodes. N0 means the lymph nodes are cancer-free. N1 means there is cancer in the lung's lymph nodes.

For N0 disease, you may be treated with radiation therapy. The goal is to try to cure the cancer. You may receive conventional radiation therapy. Conventional radiation therapy gives radiation in small doses for weeks and targets both the tumor and some normal tissue. One example is 3D-CRT. A newer type of radiation therapy—SABR—is also advised.

For N1 disease, you may receive chemoradiation. The two types of treatment should be received at the same time.

Adjuvant treatment

Adjuvant treatment is given to reduce the chances of the cancer returning. Options are grouped by type of initial treatment.

After surgery. For stage IIA, cancer-free margins are often a sign that all the cancer was removed. In this case, you may start your survivorship plan. However, cancer cells may remain for some stage IIA cancers. In these cases, chemotherapy may be received. Cancer likely remains when tumors are larger than

Guide 10. Treatment for T2 or T3 without invasion

Initial treatment

Surgery status	Cancer stage	What are the options?
You are approved and agree to surgery	Any stage II	• Surgery to remove lung tumor and lymph nodes
You are not approved or decline surgery	Stage II with N0 disease	• Radiation therapy (including SABR)
	Stage II with N1 disease	• Chemoradiation (at the same time)

Adjuvant treatment after surgery

Pathologic stage	Margin status	What are the options?
Stage IIA	No cancer in the margins	• Start survivorship plan • Chemotherapy if cancer may still be in your body
	Cancer in the margins	• Another surgery (preferred) • Chemoradiation (same time or back-to-back)
Stage IIB	No cancer in the margins	• Chemotherapy
	Cancer in margins that is only seen with a microscope	• Another surgery + chemotherapy • Chemoradiation (same time or back-to-back)
	Cancer in margins that is seen with the naked eye	• Another surgery + chemotherapy • Chemoradiation (at the same time)

Adjuvant treatment after radiation treatment

Initial treatment	What are the options?
Radiation therapy only	• Consider chemotherapy if cancer may still be in your body

4 cm, after a wedge resection, or cancer cells barely look like normal cells.

Some stage IIA tumors will be removed with cancer in the margins. In these cases, a second surgery is the option preferred by NCCN experts. Chemotherapy may be added. A second option is chemoradiation. These two types of treatment may be given at the same time or back-to-back.

For stage IIB, chemotherapy is advised when the margins are cancer-free. When the margins have cancer, a second surgery followed by chemotherapy is an option. The second option is chemoradiation. These two types of treatment can be given at the same time. They may also be given back-to-back if cancer in the margins can only be seen with a microscope.

After radiation therapy only. Chemotherapy may be received if cancer cells likely remain in your body. Cancer likely remains when tumors are larger than 4 cm or cancer cells barely look like normal cells. Chemotherapy may also be given if it is unknown whether cancer is in lymph nodes.

T3 Superior sulcus tumors

Guide 11 lists treatment options for stage IIB superior sulcus tumors. These tumors start at the top of the lung and easily grow into the chest wall. They are invasive cancers.

Options are based on if you can have surgery. If surgery is an option, preoperative treatment is advised. Chemoradiation may shrink the tumor and make surgery easier. After surgery, chemotherapy is advised. Chemotherapy will reduce the chances of the cancer returning.

You may be unable or refuse to have surgery. In this case, chemoradiation is an option. These two types of treatment should be received at the same time. The goal is to try to cure the cancer.

T3 Other invasive tumors

Other stage IIB tumors can be invasive like superior sulcus tumors. These tumors may have grown into the chest wall or bronchi. The cancer hasn't spread to lymph nodes.

Guide 12 lists treatment options for invasive T3 tumors. For initial treatment, options depend on if you are able to have surgery.

Initial treatment

If surgery is an option, surgery alone is the option preferred by NCCN experts. Other options are chemoradiation or chemotherapy before surgery. These treatments may shrink the cancer and make surgery easier.

You may be unable or refuse to have surgery. In this case, chemoradiation is an option. These two types of treatment should be received at the same time.

Adjuvant treatment

Adjuvant treatment is given to reduce the chances of the cancer returning. Treatment options differ by type of initial treatment. Cancer in the surgical margins also affects treatment options.

No preoperative treatment. Chemotherapy is advised when the margins are cancer-free. When the margins have cancer, a second surgery followed by chemotherapy is an option. The second option is chemoradiation. These two types of treatment can be given at the same time. They may also be given back-to-back if cancer in the margins can only be seen with a microscope.

Preoperative treatment. You may start your survivorship plan if the margins are cancer-free. Otherwise, a second surgery to remove the cancer is advised.

Guide 11. Treatment for T3 superior sulcus tumors

Surgery status	What are the options?		
You are approved and agree to surgery	• Chemoradiation (at the same time)	→	• Surgery + chemotherapy
You are not approved or decline surgery	• Chemoradiation (at the same time)		

Guide 12. Treatment for T3 other invasive tumors

Initial treatment

Surgery status	What are the options?
You are approved and agree to surgery	• Surgery (preferred)
	• Preoperative chemoradiation (at the same time) followed by surgery
	• Chemoradiation (at the same time)
You are not approved or decline surgery	• Chemoradiation (at the same time)

Adjuvant treatment after surgery

Initial treatment	Margin status	What are the options?
No preoperative treatment	No cancer in the margins	• Chemotherapy
	Cancer in margins that is only seen with a microscope	• Another surgery + chemotherapy, • Chemoradiation (same time or back-to-back)
	Cancer in margins that is seen with the naked eye	• Another surgery + chemotherapy • Chemoradiation (at the same time)
Preoperative treatment	No cancer in the margins	• Start survivorship plan
	Cancer in the margins	• Another surgery

Guide 13. Survivorship plan

Type of care	When is this care needed?
Medical history and physical exam	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then repeat every year
Chest CT ± contrast	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then LDCT every year
General health tests (eg, bone density)	• As needed
Prevent other diseases (eg, cancer screening)	• As needed
Healthy lifestyle (eg, healthy diet, no smoking)	• As needed

Survivorship plan

Guide 13 lists the health care that is advised for a survivorship plan. These plans start when treatment is done and tests show no signs of cancer. The plan should address your whole health and well-being. Talk with your doctor about making a plan together.

Cancer tests

Follow-up cancer tests are given to find any new lung tumors early. These tests include a medical history, physical exam, and chest CT scan with or without contrast. The timing of tests partly depends if radiation therapy was part of your treatment. Read Guide 13 for recommended time frames. Your doctor will decide when testing is needed within a time frame.

General health tests

Besides follow-up tests, tests of your general health are advised. After going through treatment for cancer, it may be hard to think about taking care of “less important” issues. However, your general health can have a big impact on your well-being. Have your blood pressure, cholesterol, and glucose checked on a regular basis. Some people also need bone density testing.

Disease prevention

Likewise, take steps to prevent other diseases. Such steps can include getting immunization shots for the flu, herpes, and other diseases. Dental cleaning and exams on a regular basis can prevent disease, too. Screening tests for other cancers are also very important.

Healthy lifestyle

The last recommendation is to start or keep a healthy lifestyle. There is proof that healthy behaviors can improve your treatment results. Limiting your use of alcohol, protecting yourself from the sun, and being at a healthy weight are important.

Healthy eating includes eating a balanced diet, eating the right amount of food, and drinking enough fluids. However, you may have special food needs during and after treatment. A nutritionist—an expert in creating a healthy diet—can help.

Many patients benefit from some exercise. Exercise tones muscles, lowers stress, and improves health. Exercise programs differ between people based on their needs. Talk with your treatment team about which exercises would be best for you.

Being hooked on nicotine is one of the hardest addictions to stop. The stress of lung cancer may make it harder or easier to quit. Quitting is important since smoking can limit how well cancer treatment works. Talk with your treatment team about ways to quit.

Stage III

Stage III is often defined by cancer spread to lymph nodes far outside the lungs. N2 nodes are between the lungs but next to the lung with cancer. Some are right below the windpipe. N3 nodes are between the lungs close to the lung without cancer. Other N3 nodes are near the collarbone or in the neck.

Some stage IIIA cancers have not spread far among lymph nodes. The N stage for these cancers is either N0 or N1. Instead, there may be a primary and secondary tumor in the same lung. Or instead, the tumor may have invaded the chest wall, bronchus, or mediastinum.

Options for stage III cancers are grouped into four sections.

- *N0 or N1 disease* starts on this page.
- *N2 disease* starts on page 75
- *N3 disease* starts on page 76.
- *Survivorship plan* starts on page 76.

N0 or N1 disease

Guide 16 lists options for initial treatment for N0 or N1 disease. N0 means that no cancer has been found in lymph nodes. N1 means that cancer has been found in peribronchial, intrapulmonary, or hilar nodes of the lung with the primary tumor.

Tumors without invasion

These tumors have not grown into the chest wall, bronchi, or mediastinum. For initial treatment, options depend on if you are able to have surgery.

Surgery. If lung surgery is an option, removal of the tumor and lymph nodes is advised. The goal of surgery is to cure the cancer. If chemotherapy is likely, you may receive it before surgery to shrink the tumor.

After surgery, adjuvant treatment will be given. This treatment is given to reduce the chances of the cancer returning. Chemotherapy is advised if the surgical margins are cancer-free. When the margins have cancer, chemoradiation is an option. These two types of treatment can be given at the same time. They may also be given back-to-back if cancer in the margins can only be seen with a microscope.

Chemoradiation. You may be unable or refuse to have surgery. In this case, chemoradiation is an option. These two types of treatment should be received at the same time. If the cancer does not worsen after 2 or more cycles of chemoradiation, durvalumab may be received. It may also slow down the growth of the cancer.

Guide 14. Treatment for N0 or N1 disease*

Tumors without invasion

What are the options for initial treatment?	Margin status	What are the options after initial treatment?
• Lung tumor and lymph node surgery	No cancer in the margins	• Chemotherapy
	Cancer in margins that is only seen with a microscope	• Chemoradiation (same time or back-to-back)
	Cancer in margins that is seen with the naked eye	• Chemoradiation (at the same time)
• Chemoradiation (at the same time)		• Durvalumab

Superior sulcus tumors

What are the options for initial treatment?	Surgery status	What are the options after initial treatment?
• Chemoradiation (at the same time)	Surgery is an option	• Chemotherapy
• Chemoradiation (at the same time)	Surgery is not an option	• Complete radiation therapy + chemotherapy + durvalumab
• Chemoradiation (at the same time)		• Durvalumab

Guide 14 continued on page 74

Superior sulcus tumors

Superior sulcus tumors start at the top of the lung. They easily grow into the chest wall. They are invasive cancers.

Treatment options are based on if you can have surgery. Surgery is likely an option for T3 tumors but may not be for T4 tumors. In either case, chemoradiation is the first treatment given.

Chemoradiation may shrink the cancer enough for surgery. The tumor will be re-assessed using imaging tests. A chest CT with or without contrast is advised. PET/CT may also be used. If surgery is still not an option, finish chemoradiation.

After surgery, more chemotherapy is advised. It will reduce the chances of the cancer returning.

The tumor may have not shrunk enough. In this case, you may complete radiation therapy. More chemotherapy is advised.

If surgery wasn't received, durvalumab may be an option. It is given if the cancer does not worsen after 2 or more cycles of chemoradiation. It may also slow down the growth of the cancer.

Guide 14. N0 or N1 disease *continued*

Other invasive tumors

What are the options for initial treatment?	Margin status	What are the options after initial treatment?
• Surgery (preferred)	No cancer in the margins	• Chemotherapy
	Cancer in margins that is only seen with a microscope	• Another surgery + chemotherapy • Chemoradiation (same time or back-to-back)
	Cancer in margins that is seen with the naked eye	• Another surgery + chemotherapy • Chemoradiation (at the same time)
• Chemoradiation (at the same time) + surgery	No cancer in the margins	• Start survivorship plan
	Cancer in the margins	• Another surgery
• Chemotherapy + surgery	No cancer in the margins	• Start survivorship plan
	Cancer in the margins	• Another surgery
• Chemoradiation (at the same time)		• Durvalumab

Other invasive tumors
Other stage III tumors can be invasive like superior sulcus tumors. These other tumors have grown into the chest wall, bronchi, or mediastinum. For initial treatment, options depend on if you are able to have surgery.

Surgery. If surgery is an option, surgery alone is the preferred option of NCCN experts. Removal of the tumor and lymph nodes is advised to try to cure the cancer. Other options are chemoradiation or chemotherapy to shrink the cancer before surgery.

After surgery, adjuvant treatment will be given. This treatment is given to reduce the chances of the cancer returning. If not received before, chemotherapy is advised if the surgical margins are cancer-free. Otherwise, you can start your survivorship plan.

When the margins have cancer, a second surgery is an option. If not received before, chemotherapy may follow surgery. If prior radiation, you may receive a boost to improve treatment results.

When the margins have cancer, a second option is chemoradiation if not received before. These two types of treatment can be given at the same time. They may also be given back-to-back if cancer in the margins can only be seen with a microscope.

Chemoradiation. You may be unable or refuse to have surgery. In this case, chemoradiation is an option. These two types of treatment should be received at the same time. If the cancer does not worsen after 2 or more cycles of chemoradiation, durvalumab may be received. It may also slow down the growth of the cancer.

N2 disease

Guide 15 lists treatment options for N2 disease. N2 nodes are between the lungs but next to the lung with cancer. Some are right below the windpipe.

Initial treatment

There are two options for initial treatment. Chemoradiation is one option. These two types of treatments should be given at the same time. Chemoradiation may greatly reduce tumor size. If the cancer does not worsen after 2 or more cycles of chemoradiation, durvalumab may be received. It may also slow down the growth of the cancer.

Your doctor may decide that induction treatment is an option. It is used only under certain conditions. These conditions include T1–T3 tumors and no invasion. In such cases, chemotherapy with or without radiation therapy is advised. Induction treatment may stop the cancer from getting worse. If induction treatment works, surgery may be received.

Post-initial treatment for N2 at diagnosis

More treatment is advised to improve the results of initial treatment. After chemoradiation, durvalumab may be received. It is given if the cancer does not worsen after 2 or more cycles of chemoradiation. It may also slow down the growth of the cancer.

You may have received induction chemotherapy with or without surgery. After induction treatment or surgery, radiation therapy is advised if not received before. You may receive more chemotherapy before radiation therapy.

Adjuvant treatment for N2 found after surgery

Sometimes N2 disease is found only after surgery. Adjuvant treatment is given to reduce the chances of the cancer returning. Options are based on if there's cancer in the surgical margins. If there's no cancer, chemotherapy alone or chemoradiation given back-to-back is an option.

When the margins have cancer, chemoradiation is an option. These two types of treatment can be given at the same time. They may also be given back-to-back if cancer in the margins can only be seen with a microscope.

Guide 15. Treatment for N2 disease

Initial treatment

What are the options?
• Chemoradiation (at the same time)
• Induction chemotherapy ± radiation therapy ◦ If no cancer growth, surgery may be an option ◦ If local growth, start post-initial treatment ◦ If metastasis, read Part 7

Post-initial treatment for N2 at diagnosis

Initial treatment	What are the options for the next treatment?
Chemoradiation	• Durvalumab
Induction chemotherapy	• Adjuvant radiation therapy (if not received before) ± chemotherapy

Adjuvant treatment for N2 found after surgery

Margin status	What are the options for the next treatment?
No cancer in the margins	• Chemotherapy • Chemoradiation (back-to-back)
Cancer in margins that is only seen with a microscope	• Chemoradiation (same time or back-to-back)
Cancer in margins that is seen with the naked eye	• Chemoradiation (at the same time)

N3 disease

Guide 16 lists treatment options for N3 disease. Surgery will not remove enough of the cancer. Thus, chemoradiation is an option. These two types of treatments should be given at the same time. Chemoradiation may greatly reduce tumor size. If the cancer does not worsen after 2 or more cycles of chemoradiation, durvalumab may be received. It may also slow down the growth of the cancer.

Survivorship plan

Guide 17 lists the health care that is advised for a survivorship plan. These plans start when treatment is done and tests show no signs of cancer. The plan should address your whole health and well-being. Talk with your doctor about making a plan together.

Cancer tests

Follow-up cancer tests are given to find any new lung tumors early. These tests include a medical history, physical exam, and chest CT scan with or without contrast. The timing of tests partly depends if radiation therapy was part of your treatment. Read Guide 17 for recommended time frames. Your doctor will decide when testing is needed within a time frame.

General health tests

Besides follow-up tests, tests of your general health are advised. After going through treatment for cancer, it may be hard to think about taking care of “less important” issues. However, your general health can have a big impact on your well-being. Have your blood pressure, cholesterol, and glucose checked on a regular basis. Some people also need bone density testing.

Disease prevention

Likewise, take steps to prevent other diseases. Such steps can include getting immunization shots for the flu, herpes, and other diseases. Dental cleaning and exams on a regular basis can prevent disease, too. Screening tests for other cancers are also very important.

Healthy lifestyle

The last recommendation is to start or keep a healthy lifestyle. There is proof that healthy behaviors can improve your treatment results. Limiting your use of alcohol, protecting yourself from the sun, and being at a healthy weight are important.

Guide 16. Treatment for N3 disease

What are the options?		
• Chemoradiation (at the same time)	→	• Durvalumab

Guide 17. Survivorship plan

Type of care	When is this care needed?
Medical history and physical exam	• Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then repeat every year
Chest CT ± contrast	• Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then LDCT every year
General health tests (eg, bone density)	• As needed
Prevent other diseases (eg, cancer screening)	• As needed
Healthy lifestyle (eg, healthy diet, no smoking)	• As needed

Healthy eating includes eating a balanced diet, eating the right amount of food, and drinking enough fluids. However, you may have special food needs during and after treatment. A nutritionist—an expert in creating a healthy diet—can help.

Many patients benefit from some exercise. Exercise tones muscles, lowers stress, and improves health. Exercise programs differ between people based on their needs. Talk with your treatment team about which exercises would be best for you.

Being hooked on nicotine is one of the hardest addictions to stop. The stress of lung cancer may make it harder or easier to quit. Quitting is important since smoking can limit how well cancer treatment works. Talk with your treatment team about ways to quit.

Multiple primary tumors

This section presents treatment options for two or more unrelated masses of cancer cells. These masses are called multiple primary tumors. Those that have spread to N2 or N3 lymph nodes are treated like metastatic disease. Read Part 7 for treatment options.

Read this section to learn treatment options for N0 or N1 disease. Treatment options are grouped by whether symptoms are present. Options for survivorship are on page 80.

Symptoms absent

Guide 18 lists treatment options for multiple tumors not causing symptoms. Options are grouped by whether the tumors appeared at the same time or not.

Co-occurring tumors

These tumors appeared at the same time. Some of these tumors may not cause symptoms soon. They may be slow-growing. Others may be in a place that won't cause severe symptoms. If symptoms won't start soon, treatment isn't needed at this time.

Some co-occurring tumors may cause symptoms in the near future. In these cases, treatment is advised. Treatment options depend on if local treatments may cure the cancer.

If local treatments are options, surgery is preferred by NCCN experts. The surgery should spare as much of the lung as possible. Other options for local treatment are radiation therapy or ablation.

Local treatment may not be an option. In these cases, chemotherapy with or without local treatments for symptom relief may be received. A second option is observation, also known as watch and wait. Observation is a period of testing to watch changes in cancer status.

Back-to-back tumors

These tumors appeared one after the other. If local treatments are options, surgery is preferred by NCCN experts. The surgery should spare as much of the lung as possible. Other options for local treatment are radiation therapy or ablation.

Local treatment may not be an option. In these cases, chemotherapy with or without local treatments for symptom relief may be given. A second option is observation, also known as watch and wait. Observation is a period of testing to watch changes in cancer status.

Symptoms present

Guide 19 lists treatment options for multiple tumors causing symptoms. Treatment options depend on if local treatments may cure the cancer.

If local treatments are options, surgery is preferred by NCCN experts. The surgery should spare as much of the lung as possible. Other options for local treatment are radiation therapy or ablation.

Local treatment may not be an option. In these cases, chemotherapy with or without local treatments for symptom relief may be received. A second option is observation, also known as watch and wait. Observation is a period of testing to watch changes in cancer status.

Guide 18 Treatment when symptoms absent

Co-occurring tumors

Symptom onset	Treatment status	What are the options?
Symptoms won't likely start soon	Any	• Start survivorship plan
Symptoms likely to start soon	Local treatments may cure	• Surgery (preferred) • Radiation therapy • Ablation
	Local treatments won't cure	• Chemotherapy with or without local treatment to prevent symptoms • Watch and wait

Back-to-back tumors

Treatment status	What are the options?
Local treatments may cure	• Surgery (preferred) • Radiation therapy • Ablation
Local treatments won't cure	• Chemotherapy with or without local treatment to prevent symptoms • Watch and wait

Guide 19. Treatment when symptoms present

Treatment status	What are the options?
Local treatments may cure	• Surgery (preferred) • Radiation therapy • Ablation
Local treatments won't cure	• Chemotherapy with or without local treatment to prevent symptoms • Watch and wait

Survivorship plan

Guide 20 lists the health care that is advised for a survivorship plan. These plans start when treatment is done and tests show no signs of cancer. The plan should address your whole health and well-being. Talk with your doctor about making a plan together.

Cancer tests

Follow-up cancer tests are given to find any new lung tumors early. These tests include a medical history, physical exam, and chest CT scan with or without contrast. The timing of tests partly depends if radiation therapy was part of your treatment. Read Guide 20 for recommended time frames. Your doctor will decide when testing is needed within a time frame.

General health tests

Besides follow-up tests, tests of your general health are advised. After going through treatment for cancer, it may be hard to think about taking care of "less important" issues. However, your general health can have a big impact on your well-being. Have your blood pressure, cholesterol, and glucose checked on a regular basis. Some people also need bone density testing.

Disease prevention

Likewise, take steps to prevent other diseases. Such steps can include getting immunization shots for the flu, herpes, and other diseases. Dental cleaning and exams on a regular basis can prevent disease, too. Screening tests for other cancers are also very important.

Guide 20. Survivorship plan

Type of care	When is this care needed?
Medical history and physical exam	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then repeat every year
Chest CT ± contrast	**Radiation was not part of treatment** • Every 6 months for 2–3 years ◦ If normal results, then repeat every year **Radiation was part of treatment** • Every 3–6 months for 3 years ◦ If normal results, then repeat every 6 months for 2 years - If normal results, then LDCT every year
General health tests (eg, bone density)	• As needed
Prevent other diseases (eg, cancer screening)	• As needed
Healthy lifestyle (eg, healthy diet, no smoking)	• As needed

Healthy lifestyle

The last recommendation is to start or keep a healthy lifestyle. There is proof that healthy behaviors can improve your treatment results. Limiting your use of alcohol, protecting yourself from the sun, and being at a healthy weight are important.

Healthy eating includes eating a balanced diet, eating the right amount of food, and drinking enough fluids. However, you may have special food needs during and after treatment. A nutritionist—an expert in creating a healthy diet—can help.

Many patients benefit from some exercise. Exercise tones muscles, lowers stress, and improves health. Exercise programs differ between people based on their needs. Talk with your treatment team about which exercises would be best for you.

Being hooked on nicotine is one of the hardest addictions to stop. The stress of lung cancer may make it harder or easier to quit. Quitting is important since smoking can limit how well cancer treatment works. Talk with your treatment team about ways to quit.

Review

One primary tumor

- To try to cure stage I lung cancers, surgery or radiation therapy is given. You may receive more treatment for any remaining cancer. Once treatment is done, follow a survivorship plan.
- Stage II tumors without invasion may be cured with surgery. More treatment is often given after surgery. If surgery isn't an option, radiation therapy to cure is used for N0 disease, and chemoradiation is used for N1 disease. More treatment may be given after radiation. Once treatment is done, follow a survivorship plan.
- Stage II tumors with invasion may be cured with surgery. You may receive chemotherapy or chemoradiation beforehand and more treatment afterward. If surgery isn't an option, chemoradiation is used to cure. Once treatment is done, follow a survivorship plan.
- For stage III tumors, N0 or N1 disease may be cured with surgery or chemoradiation. Chemotherapy, radiation therapy, or both is given after surgery. Chemoradiation is the most common treatment for N2 and N3 disease found before treatment was started. Once treatment is done, follow a survivorship plan.

Multiple primary tumors

- Multiple primary tumors that have spread to N2 or N3 nodes or outside the chest area are treated the same as metastatic disease. Read Part 7.
- Multiple primary tumors with N0 or N1 disease are treated based on traits of the cancer.
- When cancer symptoms are unlikely, multiple primary tumors that appear at the same time don't need treatment right away.
- Signs that treatment is needed include current or soon-to-start symptoms. Another sign is primary tumors that appear one after the other. In these cases, local treatments are an option if the cancer may be cured. Otherwise, chemotherapy with or without local treatments may be received.

7
Treatment guide: Metastatic cancer

Part 7 is a guide to the treatment options for metastatic lung cancer. This cancer has spread to distant sites. The treatment aim is to reduce symptoms, control the cancer, and extend life. Supportive care is also important for your well-being.

Overview

This section is a guide to treatment for metastatic lung cancer. These cancers include stage IV. They also include earlier stages that have spread to distant sites.

A score of M1a means the cancer has spread to distant sites within the chest. A score of M1b means the cancer has spread to sites beyond the chest.

Supportive care

Talk with your treatment team about starting supportive care early. Supportive care has been shown to extend and enhance life for people with metastatic lung cancer.

Performance score

Doctors use many factors to plan treatment for metastases. One important factor is your health. If your health is poor, some treatments may not be good for you.

A performance score is a rating of your ability to do activities. It is used by doctors as a measure of general health. The ECOG (**E**astern **C**ooperative **O**ncology **G**roup) Performance Scale is a common scoring system. It consists of four scores.

- A **score of 0** means you are fully active.
- A **score of 1** means you are able to do all self-care activities but are unable to do hard physical work.
- A **score of 2** means you are able to do all self-care activities and spend most of waking time out of bed but are unable to do any work.
- A **score of 3** means you are unable to do all self-care activities and any work and spend most of waking time in bed.
- A **score of 4** means you are fully disabled.

Limited sites

You may be able to receive local treatment if metastases are limited. You should also be in fairly good health other than cancer. Local treatments include surgery, radiation therapy, and chemoradiation. In certain cases, local treatments may provide the best chance for a cancer control.

For M1a, local treatment may be used if the cancer spread is limited. An example is one tumor in the non-primary lung. M1a also includes cancer spread to the pleura and its fluid. If needed, the pleural fluid may be drained or the two pleural layers fused.

Very rarely does M1b disease spread to only one site beyond the chest. Such sites include the brain and adrenal gland. In these cases, local treatment may be received. However, local treatment isn't suggested if there is N3 disease. N3 disease includes cancer spread to lymph nodes near the collarbone or in the neck.

Multiple sites

Most often, local treatment is not a good option for metastatic lung cancer. Such cancers include those that have spread to more than one site within and beyond the chest. In these cases, treatment depends on the type of lung cancer and biomarkers.

Overactive *EGFR* mutation

Guide 21 lists treatments options for overactive *EGFR* mutations. These options may help you no matter your performance status.

First-line treatment

Your options may be erlotinib, afatinib, gefitinib, or osimertinib. These treatments are targeted therapies. This mutation may be found while you are on first-line chemotherapy. In this case, you may stop chemotherapy early and start targeted therapy. Otherwise, you may start targeted therapy as a maintenance treatment after completing chemotherapy.

Next-in-line treatment

The cancer may worsen while on first-line treatment. If it worsens on erlotinib, afatinib, or gefitinib, T790M testing is advised. Results will help to plan treatment.

If the cancer doesn't worsen much, one option may be to stay on your first-line treatment. Local treatment may be added to first-line treatment. It is sometimes used when the metastasis is within a confined area, such as the brain or adrenal gland.

If you need to switch treatment, osimertinib may be received. It is given if not received before and a *T790M* mutation is present.

Platinum-based chemotherapy may be another option. The *T790M* mutation must not be present or the cancer worsened while on osimertinib. Chemotherapy is often used if there are multiple metastatic tumors causing symptoms. Read Guide 26 to learn more options for *Adenocarcinoma, large cell, and unknown types*. Read Guide 27 to learn more options for *Squamous cell carcinoma*.

Guide 21. Treatment for *EGFR* mutation

First-line treatment

What are the options?	
• Erlotinib	• Gefitinib
• Afatinib	• Osimertinib

Next-in-line treatment

First-line treatment	What are the options?
Erlotinib, afatinib, or gefitinib	• Stay on first-line treatment ± local treatment • Switch to osimertinib if *T790M* present and not previously given • Start treatment for histologic type if *T790M* not present ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)
Osimertinib	• Stay on osimertinib ± local treatment • Start treatment for histologic type ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)

ALK gene rearrangement

Guide 22 lists treatment options for *ALK* gene rearrangements. These options may help you no matter your performance status.

First-line treatment

You may have three options. The preferred option of NCCN experts is alectinib. Other options are crizotinib or ceritinib. These treatments are targeted therapies.

The *ALK* mutation may be found while you are on first-line chemotherapy. In this case, you may stop chemotherapy early and start targeted therapy. Otherwise, you may start targeted therapy as a maintenance treatment after completing chemotherapy.

Next-in-line treatment

The cancer may worsen while on first-line treatment. If the cancer doesn't worsen much, one option may be to stay on first-line treatment. Local treatment may be added. It is sometimes used when the metastasis is within a confined area. Examples of these areas are the brain or adrenal gland.

If you need to switch treatment, ceritinib, alectinib, or brigatinib are options after taking crizotinib. Local treatment may be added in this case, too.

Platinum-based chemotherapy may be another option. It is often used if there are multiple metastatic tumors causing symptoms. Read Guide 26 to learn more options for *Adenocarcinoma, large cell, and unknown types*. Read Guide 27 to learn more options for *Squamous cell carcinoma*.

Guide 22. Treatment for *ALK* gene rearrangement

First-line treatment

What are the options?
• Alectinib (preferred)
• Crizotinib
• Ceritinib

Next-in-line treatment

What are the options?
• Stay on first-line treatment ± local treatment
• Switch from crizotinib to ceritinib, alectinib, or brigatinib ± local treatment
• Start treatment for histologic type ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)

ROS1 gene rearrangement

Guide 23 lists treatment options for *ROS1* gene rearrangements. These options may help you no matter your performance status.

First-line treatment

You may have two options. The preferred option of NCCN experts is crizotinib. The other option is ceritinib. These treatments are targeted therapies.

Next-in-line treatment

The cancer may worsen while on first-line treatment. If the cancer doesn't worsen much, one option may be to stay on first-line treatment. Local treatment may be added. It is sometimes used when the metastasis is within a confined area. Examples of these areas are the brain or adrenal gland.

Platinum-based chemotherapy may be an option. It is often used if there are multiple metastatic tumors causing symptoms. Read Guide 26 to learn more options for *Adenocarcinoma, large cell, and unknown types*. Read Guide 27 to learn more options for *Squamous cell carcinoma*.

Guide 23. Treatment for *ROS1* gene rearrangement

First-line treatment

What are the options?
• Crizotinib (preferred)
• Ceritinib

Next-in-line treatment

What are the options?
• Start treatment for histologic type ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)

“

The people that are truly there for you are your angels!

– Jon
Lung cancer survivor

BRAF V600E mutation

Guide 24 lists treatment options for *BRAF* V600E mutation. Dabrafenib with trametinib is one option. If these treatments make you too sick, you may receive dabrafenib or vemurafenib alone. Another option is platinum-based chemotherapy. However, more research is needed to learn how well these treatments work.

PD-L1 positive

Guide 25 lists treatment options for cancers PD-L1 positive ≥50%. Pembrolizumab is an option for first-line treatment. Platinum-based chemotherapy may be an option if you can't take pembrolizumab.

The cancer may worsen while taking pembrolizumab. In this case, platinum-based chemotherapy may be an option. Read Guide 26 to learn more options for *Adenocarcinoma, large cell, and unknown types*. Read Guide 27 to learn more options for *Squamous cell carcinoma*.

Guide 24. Treatment for *BRAF* V600E mutation

What are the options?
• Dabrafenib + trametinib
• Start treatment for histologic type ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)

Guide 25. Treatment for PD-L1 positive ≥50%

What are the options?
• Pembrolizumab
• Start treatment for histologic type if you can't take pembrolizumab ◦ Adenocarcinomas, large cell, unknown types (see Guide 26) ◦ Squamous cell carcinoma (see Guide 27)

Biomarkers not present or unknown

This section lists treatments for when biomarkers are absent or unknown. These treatments may also be used as after first-line treatment for metastatic lung cancers with known biomarkers.

Adenocarcinomas, large cell carcinomas, and unknown types

Guide 26 lists treatment options for adenocarcinomas, large cell carcinomas, and unknown types. Treatment options are based on performance status.

First-line treatment

You may be treated with chemotherapy if your performance score is between 0 and 2. Your doctor will choose a regimen based on how well it will stop cancer growth compared to how harmful it could be.

The use of two drugs is called doublet chemotherapy. It is an option if your performance score is 0 or 1. Another option is bevacizumab used with chemotherapy. To receive this treatment, you should not have a recent history of coughing up blood (hemoptysis). A third option is pembrolizumab and chemotherapy.

After 2 cycles of chemotherapy, the cancer's response to treatment will be tested. It will be tested again every 2 to 4 cycles. If there's no cancer growth, a total of 4 to 6 chemotherapy cycles are advised.

A performance score of 3 or 4 suggests that chemotherapy will be too harmful. Therefore, the best supportive care is advised. Supportive care aims to treat the symptoms caused by the cancer.

Maintenance treatment

First-line treatment may stop the cancer from getting worse. In this case, you may stay on some of your first-line treatments. This is called continuation maintenance. Another option is changing to a medicine that you didn't take as a first-line treatment. This is called switch maintenance. A third option is to start close observation. Observation is a period of testing to watch changes in cancer status.

Next-in-line treatment

The cancer may worsen during or after first-line treatment. Treatment is based on performance status. Joining a clinical trial is always an option for lung cancer treatment. Ask your treatment team if there is a clinical trial you can join. Also ask about the pros and cons of the trial.

Performance scores 0–2

For these scores, nivolumab, pembrolizumab, and atezolizumab are preferred by NCCN experts. Pembrolizumab is approved for lung cancers that are PD-L1 positive. Other options include regimens with chemotherapy. Do not take the chemotherapy drugs listed if you've had them before.

Performance scores 3–4

If these scores, most cancer drugs are likely to seriously harm your health. Thus, best supportive care is advised.

Guide 26. Treatment for adenocarcinoma, large cell, unknown types

First-line treatment

Performance scores	What are the options?
0 or 1	• Platinum-based chemotherapy • Bevacizumab + platinum-based chemotherapy • Pembrolizumab + chemotherapy
2	• Chemotherapy
3 or 4	• Supportive care

Maintenance treatment

Maintenance type	What are the options?
Continuation	• Bevacizumab • Pemetrexed • Bevacizumab + pemetrexed • Gemcitabine
Switch	• Pemetrexed
Either type	• Watch and wait

Next-in-line treatment

Performance scores	What are the options?
0 or 1 or 2	• Nivolumab (preferred) • Pembrolizumab (preferred) • Atezolizumab (preferred) • Docetaxel • Pemetrexed • Gemcitabine • Ramucirumab + docetaxel
3 or 4	• Supportive care

Squamous cell carcinoma

Guide 27 lists treatments for squamous cell carcinoma. Treatment options are based on performance status.

First-line treatment

You may be treated with chemotherapy if your performance score is between 0 and 2. Your doctor will choose a regimen based on how well it will stop cancer growth compared to how harmful it could be.

A performance score of 3 or 4 suggests that chemotherapy will be too harmful. Therefore, the best supportive care is advised. Supportive care aims to treat the symptoms caused by the cancer.

Maintenance treatment

First-line treatment may stop the cancer from getting worse. In this case, you may stay on some of your first-line treatments. This is called continuation maintenance. Another option is changing to a medicine that you didn't take as a first-line treatment.

Guide 27. Treatment for squamous cell carcinoma

First-line treatment

Performance scores	What are the options?
0 or 1	• Platinum-based chemotherapy
2	• Chemotherapy
3 or 4	• Supportive care

Maintenance treatment

Maintenance type	What are the options?
Continuation	• Gemcitabine
Switch	• Docetaxel
Either type	• Watch and wait

Next-in-line treatment

Performance scores	What are the options?
0 or 1 or 2	• Nivolumab (preferred) • Pembrolizumab (preferred) • Atezolizumab (preferred) • Docetaxel • Gemcitabine • Ramucirumab + docetaxel
3 or 4	• Supportive care

This is called switch maintenance. A third option is to start close observation. Observation is a period of testing to watch changes in cancer status.

Next-in-line treatment
The cancer may worsen during or after first-line treatment. Treatment is based on performance status. Joining a clinical trial is always an option for lung cancer treatment. Ask your treatment team if there is a clinical trial you can join. Also ask about the pros and cons of the trial.

Performance scores 0–2
Nivolumab, pembrolizumab, and atezolizumab are preferred by NCCN experts over other options. Pembrolizumab is approved for lung cancers that are PD-L1 positive. Other options include regimens with chemotherapy. Do not take the chemotherapy drugs listed if you've had them before.

Performance scores 3–4
If your performance score is 3 or 4, most drugs for lung cancer are likely to seriously harm your health. Thus, best supportive care is advised.

Review

- For stage IV cancers, supportive care may enhance and extend life. Ask your treatment team for a supportive care plan.
- Metastatic cancer should be tested for mutations. If a mutation is present, first-line treatment consists of targeted therapy. First-line pembrolizumab may be used to treat lung cancers that are PD-L1 positive ≥50%.
- If you are healthy enough, metastatic disease with no known mutations is first treated with chemotherapy. Bevacizumab or pembrolizumab may be added for adenocarcinoma, large cell, and unknown subtypes. If the cancer worsens, nivolumab, pembrolizumab, and atezolizumab are preferred treatment options. If you are unhealthy, supportive care is an option.
- Clinical trials are an option for all metastatic disease. Ask your treatment team if there is a clinical trial you can join. Also ask about the pros and cons of the trial.

8
Making treatment decisions

Having cancer is very stressful. While absorbing the fact that you have cancer, you have to learn about tests and treatments. In addition, the time you have to accept a treatment plan feels short. Parts 1 through 7 described the cancer and treatment options. Part 8 aims to help you make decisions that are in line with your beliefs, wishes, and values.

It's your choice

The role each person wants in choosing his or her treatment differs. You may feel uneasy about making treatment decisions. This may be due to a high level of stress. It may be hard to hear or know what others are saying. Stress, pain, and drugs can limit your ability to make good decisions. You may feel uneasy because you don't know much about cancer. You've never heard the words used to describe cancer, tests, or treatments. Likewise, you may think that your judgment isn't any better than your doctors'.

Letting others decide which option is best may make you feel more at ease. But, whom do you want to make the decisions? You may rely on your doctors alone to make the right decisions. However, your doctors may not tell you which option to choose if you have multiple good options. You can also have loved ones help. They can gather information, speak on your behalf, and share in decision-making with your doctors. Even if others decide which treatment you will receive, you still have to agree by signing a consent form.

On the other hand, you may want to take the lead or share in decision-making. Most patients do. In shared decision-making, you and your doctors share information, weigh the options, and agree on a treatment plan. Your doctors know the science behind your plan but you know your concerns and goals. By working together, you are likely to get a higher quality of care and be more satisfied. You'll likely get the treatment you want, at the place you want, and by the doctors you want.

Questions to ask your doctors

You may meet with experts from different fields of medicine. Strive to have helpful talks with each person. Prepare questions before your visit and ask questions if the person isn't clear. You can also take notes and get copies of your medical records.

It may be helpful to have your spouse, partner, family member, or a friend with you at these visits. A patient advocate or navigator might also be able to come. They can help to ask questions and remember what was said. Suggested questions to ask are listed on the following pages.

What's my diagnosis and prognosis?

It's important to know that there are different types of cancer. Cancer can greatly differ even when people have a tumor in the same organ. Based on your test results, your doctor can tell you which type of cancer you have. He or she can also give a prognosis. A prognosis is a prediction of the pattern and outcome of a disease. Knowing the prognosis may affect what you decide about treatment.

1. Where did the cancer start? In what type of cell? Is this cancer common?
2. What is the cancer stage? Does this stage mean the cancer has spread far?
3. Is this a fast- or slow-growing cancer?
4. What tests do you recommend for me?
5. Where will the tests take place? How long will the tests take and will any test hurt?
6. What if I am pregnant?
7. How do I prepare for testing?
8. Should I bring a list of my medications?
9. Should I bring someone with me?
10. How often are these tests wrong?
11. Would you give me a copy of the pathology report and other test results?
12. Who will talk with me about the next steps? When?

What are my options?

There is no single treatment practice that is best for all people. There is often more than one treatment option along with clinical trial options. Your doctor will review your test results and recommend treatment options.

1. What will happen if I do nothing?
2. Can I just carefully monitor the cancer?
3. Do you consult NCCN recommendations when considering options?
4. Are you suggesting options other than what NCCN recommends? If yes, why?
5. Do your suggested options include clinical trials? Please explain why.
6. How do my age, health, and other factors affect my options? What if I am pregnant?
7. Which option is proven to work best?
8. Which options lack scientific proof?
9. What are the benefits of each option? Does any option offer a cure or long-term cancer control? Are my chances any better for one option than another? Less time-consuming? Less expensive?
10. What are the risks of each option? What are possible complications? What are the rare and common side effects? Short-lived and long-lasting side effects? Serious or mild side effects? Other risks?
11. How do you know if treatment is working?
12. What are my options if treatment doesn't working?
13. What can be done to prevent or relieve the side effects of treatment?
14. What are my chances that the cancer will return?

What does each option require of me?

Many patients consider how each option will practically affect their lives. This information may be important because you have family, jobs, and other duties to take care of. You also may be concerned about getting the help you need. If you have more than one option, choosing the option that is the least taxing may be important to you:

1. Will I have to go to the hospital or elsewhere? How often? How long is each visit?
2. What do I need to think about if I will travel for treatment?
3. Do I have a choice of when to begin treatment? Can I choose the days and times of treatment?
4. How do I prepare for treatment? Do I have to stop taking any of my medicines? Are there foods I will have to avoid?
5. Should I bring someone with me when I get treated?
6. Will the treatment hurt?
7. How much will the treatment cost me? What does my insurance cover?
8. Will I miss work or school? Will I be able to drive?
9. Is home care after treatment needed? If yes, what type?
10. How soon will I be able to manage my own health?
11. When will I be able to return to my normal activities?

What is your experience?

More and more research is finding that patients treated by more experienced doctors have better results. It is important to learn if a doctor is an expert in the cancer treatment he or she is offering.

1. Are you board-certified? If yes, in what area?
2. How many patients like me have you treated?
3. How many procedures like the one you're suggesting have you done?
4. Is this treatment a major part of your practice?
5. How many of your patients have had complications?

Deciding between options

Deciding which option is best can be hard. Doctors from different fields of medicine may have different opinions on which option is best for you. This can be very confusing. Your spouse or partner may disagree with which option you want. This can be stressful. In some cases, one option hasn't been shown to work better than another. Some ways to decide on treatment are discussed next.

2nd opinion

The time around deciding a treatment is very stressful. People with cancer often want to get treated as soon as possible. They want to make their cancer go away before it spreads farther. While cancer can't be ignored, usually there is time to think about and choose which option is best for you.

You may wish to have another doctor review your test results and suggest a treatment plan. This is called getting a 2nd opinion. You may completely trust your doctor, but a 2nd opinion about which option is best can help.

Copies of the pathology report, a DVD of the imaging tests, and other test results need to be sent to the doctor giving the 2nd opinion. Some people feel uneasy asking for copies from their doctors. However, a 2nd opinion is a normal part of cancer care.

When doctors have cancer, most will talk with more than one doctor before choosing their treatment. What's more, some health plans require a 2nd opinion. If your health plan doesn't cover the cost of a 2nd opinion, you have the choice of paying for it yourself.

If the two opinions are the same, you may feel more at peace about the treatment you accept to have. If the two opinions differ, think about getting a 3rd opinion. A 3rd opinion may help you decide between your options. Choosing your cancer treatment is a very important decision. It can affect your length and quality of life.

Support groups

Besides talking to health experts, it may help to talk to other people who have walked in your shoes. At support groups, you can ask questions and hear about the experiences of other people with lung cancer. Find a support group at the websites listed on page 99.

Compare benefits and downsides

Every option has benefits and downsides. Consider these when deciding which option is best for you. Talking to others can help identify benefits and downsides you haven't thought of. Scoring each factor from 0 to 10 can also help since some factors may be more important to you than others.

> "Get the best advice, then follow your gut!
>
> – Jon
> Lung cancer survivor

Websites

American Cancer Society
cancer.org/cancer/lung-cancer.html

American Lung Association
Lung.org

Bonnie J. Addario Lung Cancer Foundation
lungcancerfoundation.org

Caring Ambassadors
lungcancercap.org

Dusty Joy Foundation (LiveLung)
LiveLung.org

Free ME from Lung Cancer
freeMEfromLungCancer.org

Lung Cancer Alliance
lungcanceralliance.org

Lung Cancer Initiative of North Carolina
lungcancerinitiativenc.org

Lung Cancer Research Council
lungcancerresearchcouncil.org

National Cancer Institute (NCI)
cancer.gov/types/lung

National Coalition for Cancer Survivorship
canceradvocacy.org/toolbox

NCCN Patient and Caregiver Resources
nccn.org/patients

Review

- Shared decision-making is a process in which you and your doctors plan treatment together.
- Asking your doctors questions is vital to getting the information you need to make informed decisions.
- Getting a 2nd opinion, attending support groups, and comparing benefits and downsides may help you decide which treatment is best for you.

Glossary

Dictionary

ablation
Treatment that destroys very small tumors with heat or cold.

adenocarcinoma
Cancer of cells that make fluids or hormones.

adjuvant treatment
Treatment that is given to lower the chances of the cancer returning.

adrenal gland
A small organ on top of each kidney that makes hormones.

alveoli
The tiny sacs in the lungs where gases are transferred in and out of the blood.

anaplastic lymphoma kinase (ALK)
Proteins on the edge of a cell that send signals for the cell to grow.

atelectasis
Collapse of a lung.

biomarker
Any molecule in your body that can be measured to assess your health.

biomarker testing
Tests of any molecule in your body that can be measured to assess your health. Also called molecular testing.

biopsy
Removal of small amounts of tissue or fluid to be tested for disease.

board certified
A status to identify doctors who finished training in a specialized field of medicine.

body plethysmograph
A test done in a small room with a small tube to measure how much air is in your lungs after inhaling or exhaling.

brachytherapy
Radiation received from a radioactive object placed near or in the tumor.

bronchi
The two airways extending from the windpipe into the lungs.

bronchioli
Branches of small airways within the lungs.

bronchoscope
A thin, long tube fitted with tools that is guided down the mouth.

bronchoscopy
Use of a thin tool guided down the mouth into the lungs.

bronchus
One of the two main airways that extends into the lungs.

cancer screening
The use of tests to find cancer before signs of cancer appear.

cancer stage
Rating of the growth and spread of tumors.

carcinoma
Cancer of cells that form the lining of structures or form glands.

carina
Firm, flexible, supportive tissue at the base of the windpipe.

chemoradiation
Treatment that combines chemotherapy with radiation therapy.

chemistry profile
Measurement of the amount of chemicals in the blood.

chemotherapy
Drugs that stop the life cycle of cells so they don't increase in number.

chest wall
The layer of muscles and bones under the skin that covers the chest area.

chronic obstructive pulmonary disease (COPD)
Trouble with breathing due to lung damage or too much mucus.

clinical stage
Rating the extent of a tumor based on tests before treatment.

clinical trial
Research on a test or treatment to assess its safety or how well it works.

complete blood count (CBC)
A test of the number of blood cells.

computed tomography (CT)
A test that uses x-rays to view body parts.

continuation maintenance
One or more first-line drugs is continued.

contrast
A dye put into your body to make clearer pictures during imaging tests.

conventional radiation therapy
Radiation that is given in small doses for weeks and targets both the tumor and some normal tissue.

core needle biopsy
Removal of a sample of solid tissue with a needle.

diagnosis
To identify a disease.

diaphragm
A sheet of muscles below the ribs that helps a person to breathe.

doublet chemotherapy
Treatment with two chemotherapy drugs.

endobronchial ultrasound–guided transbronchial needle aspiration (EBUS-TBNA)
Removal of fluid with a needle guided with imaging into the main airway into the lung.

endoscopic ultrasound–guided fine needle aspiration (EUS-FNA)
Removal of fluid with a needle guided with imaging into the long organ between the mouth and stomach.

epidermal growth factor receptor (EGFR)
Proteins on the edge of a cell that send signals for the cell to grow.

esophagus
The tube-shaped organ between the mouth and stomach.

excision
Removal of a tumor but not too much healthy tissue.

external beam radiation therapy (EBRT)
Radiation therapy received from a machine outside the body.

fine-needle aspiration (FNA)
Use of a thin needle to remove fluid or tissue from the body to test for disease.

four-dimensional computed tomography (4D-CT)
An imaging test that can show movement of organs.

gas diffusion
A test that uses harmless gas to measure how much you breathe out.

gene
Instructions in cells for making and controlling cells.

gene rearrangement
The fusion of one gene with another gene to create a new gene.

general anesthesia
A controlled loss of wakefulness from drugs.

hilar lymph nodes
Groups of disease-fighting cells where the main airways enter the lungs.

human epidermal growth factor receptor 2 (HER2)
Proteins on the edge of a cell that send signals for the cell to grow.

image-guided radiation therapy (IGRT)
Radiation therapy that uses imaging tests during treatment to better target the tumor.

immunotherapy
Treatment that uses the body's natural defense against disease.

intensity-modulated radiation therapy (IMRT)
Radiation therapy that uses small beams of different strengths based on the thickness of the tissue.

intrapulmonary lymph nodes
Groups of disease-fighting cells in the lungs around the small airways.

invasion
A mass of cancer cells that has grown from one structure into another.

large-cell lung carcinoma
A lack of features to classify the cancer as any other carcinoma.

lobe
A clearly seen division in the lungs.

lobectomy
Surgical removal of an entire lobe.

local anesthesia
A loss of feeling in a small area of the body caused by drugs.

low-dose computed tomography (LDCT)
A test that uses little amounts of radiation to make pictures of inside the body.

lymph
A clear fluid containing white blood cells.

lymph node
Small groups of special disease-fighting cells located throughout the body.

lymph node dissection
All groups of disease-fighting cells are removed from a cluster.

lymph node sampling
One group of disease-fighting cells is removed from a cluster.

magnetic resonance imaging (MRI)
A test that uses radio waves and powerful magnets to see the shape and function of body parts.

maintenance treatment
Treatment given to continue good treatment results.

mediastinal lymph nodes
Groups of disease-fighting cells in the middle of the chest.

mediastinal pleura
The lining of the lung at the center of the chest.

mediastinoscope
A thin, long tube fitted with tools to work inside the chest.

mediastinoscopy
Use of a thin tool inserted above the breastbone to do work in the middle of the chest.

mediastinum
The area of the chest between the lungs.

medical history
All health events and medications taken to date.

metastasis
The spread of cancer cells from the first tumor to another body part.

molecular testing
Tests of any molecule in your body that can be measured to assess your health. Also called biomarker testing.

multiple primary tumor
One or more unrelated masses of cancer cells.

mutation
Abnormal changes in the instructions within cells for making and controlling cells (genes).

navigational bronchoscopy
Use of a thin tool guided down the mouth into the smallest airways of the lung.

nodule
A small mass of tissue.

non-small cell lung cancer
A cancer that starts in lung cells that are not small.

non-solid nodule
A small mass of tissue of low density.

observation
A period of testing for cancer growth.

parietal pleura
The outer layer of the lining around the lungs.

part-solid nodule
A small mass of tissue with areas of low and high density.

pathologic stage
Rating the extent of a tumor based on tests after treatment.

pathologist
A doctor who's an expert in testing cells to find disease.

percutaneous needle biopsy
Insertion of a needle through the skin into a mass to remove tissue for testing.

performance status
A rating of one's ability to do daily activities.

peribronchial lymph nodes
Groups of disease-fighting cells in the lung around the main airway.

pericardial effusion
Excess fluid between the two tissue layers of the heart's lining.

pericardiocentesis
Use of a needle inserted between the ribs to remove fluid around the heart.

pericardium
The tissue lining around the heart.

phrenic nerve
A bundle of fibers that sends signals between the spine and muscles used to breathe.

physical exam
A review of the body by a health expert for signs of disease.

platinum-doublet chemotherapy
Treatment with two chemotherapy drugs, one of which is platinum-based.

pleura
The tissue lining around the lungs.

pleural cavity
The space between the two layers of the lung's lining.

pleural effusion
Excess fluid between the two tissue layers of the lung's lining.

pleural fluid
The liquid in the space between the two layers of the lung's lining.

pneumonectomy
Surgical removal of the entire lung.

pneumonitis
Swelling of the air sacs in a lung.

positron emission tomography (PET)
A test that uses radioactive material to see the shape and function of body parts.

positron emission tomography/computed tomography (PET/CT)
A test that uses radioactive material and x-rays to view the shape and function of organs and tissues.

primary tumor
The first mass of cancer cells of their kind.

prognosis
The expected pattern and outcome of a disease based on tests.

proton therapy
Radiation therapy that uses protons to treat a disease. Also called hadron therapy.

pulmonary fibrosis
Major scarring of lung tissue.

pulmonary function tests
A set of breathing tests to test the strength of the lungs.

pulmonologist
A doctor who's an expert in lung diseases.

radial endobronchial ultrasound (EBUS) bronchoscopy
Use of a thin tool that is guided down the mouth and into the lungs and is fitted with an imaging device to see through the walls of the lungs.

radiation oncologist
A doctor who's an expert in treating cancer with radiation.

radiation therapy
The use of radiation to treat cancer.

recurrent laryngeal nerve
A bundle of fibers that sends signals between the spine and voice box.

respiratory system
The group of organs that transfers gases in and out of the body.

risk factor
Something that increases the chance of getting a disease.

ROS1
Proteins on the edge of a cell that send signals for the cell to grow.

scalene lymph nodes
Groups of disease-fighting cells in the neck.

secondary tumor
A mass of cancer cells that formed from the first mass of cancer cells.

sedative
A drug that helps a person to relax or go to sleep.

segmentectomy
Surgical removal of a large part of a lobe.

side effect
An unplanned physical or emotional response to treatment.

simulation
The steps needed to prepare for radiation therapy.

sleeve lobectomy
Surgical removal of an entire lobe and part of the bronchus.

small cell lung cancer
Lung cancer of small, round cells.

solid nodule
A small mass of tissue of high density.

spirometry
A test that uses a tube to measure how fast you breathe.

squamous cell carcinoma
A cancer of thin, flat cells that line many surfaces of the body.

stereotactic ablative radiotherapy (SABR)
Radiation therapy that uses precise, high-dose beams.

stereotactic radiosurgery (SRS)
Precise, high-dose photon beams used for brain tumors.

subcarinal lymph nodes
Groups of disease-fighting cells below the windpipe.

superior sulcus tumor
A mass of cancer cells at the top of the lung that has grown into the chest wall.

supportive care
Treatment for symptoms of a disease.

supraclavicular lymph nodes
Groups of disease-fighting cells above the collarbone.

surgical margin
The normal tissue around the tumor removed during surgery.

surgery
An operation to remove or repair a part of the body.

switch maintenance
All first-line drugs are stopped and a new drug is started.

targeted therapy
Drugs that stop the growth process of cancer cells.

thoracentesis
Use of a needle inserted between the ribs to remove fluid around the lungs.

thoracic radiologist
A doctor who's an expert in reading imaging tests of the chest.

thoracic surgeon
A doctor who's an expert in surgery within the chest.

thoracoscopy
Use of thin tools inserted between the ribs to do work in the chest.

thoracotomy
Surgery done through a large cut to remove all or part of the lungs.

three-dimensional conformal radiation therapy (3D-CRT)
Radiation therapy that uses beams that match the shape of the tumor.

trachea
The airway between the throat and bronchi; also called the windpipe.

transthoracic needle aspiration (TTNA)
Use of a needle inserted through the chest to remove fluid or tissue from the body to test for disease.

ultrasound
A test that uses sound waves to take pictures of the inside of the body.

vascular endothelial growth factor (VEGF)
A molecule that triggers the growth of blood vessels.

video-assisted thoracic surgery (VATS)
Use of thin tools inserted between the ribs to do work in the chest.

visceral pleura
The inner layer of the lining around the lungs.

wedge resection
Surgical removal of a small part of a lobe.

whole brain radiation therapy (WBRT)
Small amounts of radiation given to treat the entire brain for cancer.

Acronyms

3D-CRT
three-dimensional conformal radiation therapy

4D-CT
four-dimensional computed tomography

AJCC
American Joint Committee on Cancer

ALK
anaplastic lymphoma kinase

CAM
complementary and alternative medicine

CBC
complete blood count

cm
centimeter

COPD
chronic obstructive pulmonary disease

CT
computed tomography

DNA
deoxyribonucleic acid

EBRT
external beam radiation therapy

EBUS
endobronchial ultrasound

EBUS-TBNA
endobronchial ultrasound-guided transbronchial needle aspiration

ECOG
Eastern Cooperative Oncology Group

EGFR
epidermal growth factor receptor

EUS
endoscopic ultrasound

EUS-FNA
endoscopic ultrasound-guided fine-needle aspiration

FDA
Food and Drug Administration

FDG
fluorodeoxyglucose

FNA
fine-needle aspiration

GGN
ground-glass nodule

GGO
ground-glass opacity

HER2
human epidermal growth factor receptor 2

IGRT
image-guided radiation therapy

IMRT
intensity-modulated radiation therapy

LDCT
low-dose computed tomography

LINAC
linear accelerator

MRI
magnetic resonance imaging

NCCN
National Comprehensive Cancer Network

NSCLC
non-small cell lung cancer

PET
positron emission tomography

SABR
stereotactic ablative radiotherapy

SRS
stereotactic radiosurgery

TTNA
transthoracic needle aspiration

VATS
video-assisted thoracic surgery

VEGF
vascular endothelial growth factor

WBRT
whole brain radiation therapy

State Fundraising Notices

FLORIDA: A COPY OF THE OFFICIAL REGISTRATION AND FINANCIAL INFORMATION OF NCCN FOUNDATION MAY BE OBTAINED FROM THE DIVISION OF CONSUMER SERVICES BY CALLING TOLL-FREE WITHIN THE STATE 1-800-HELP-FLA. REGISTRATION DOES NOT IMPLY ENDORSEMENT, APPROVAL, OR RECOMMENDATION BY THE STATE. FLORIDA REGISTRATION #CH33263. **GEORGIA:** The following information will be sent upon request: (A) A full and fair description of the programs and activities of NCCN Foundation; and (B) A financial statement or summary which shall be consistent with the financial statement required to be filed with the Secretary of State pursuant to Code Section 43-17-5. **KANSAS:** The annual financial report for NCCN Foundation, 275 Commerce Drive, Suite 300, Fort Washington, PA 19034, 215-690-0300, State Registration # 445-497-1, is filed with the Secretary of State. **MARYLAND:** A copy of the NCCN Foundation financial report is available by calling NCCN Foundation at 215-690-0300 or writing to 275 Commerce Drive, Suite 300, Fort Washington, PA 19034. For the cost of copying and postage, documents and information filed under the Maryland charitable organizations law can be obtained from the Secretary of State, Charitable Division, State House, Annapolis, MD 21401, 1-410-974-5534. **MICHIGAN:** Registration Number MICS 45298. **MISSISSIPPI:** The official registration and financial information of NCCN Foundation may be obtained from the Mississippi Secretary of State's office by calling 888-236-6167. Registration by the Secretary of State does not imply endorsement by the Secretary of State. **NEW JERSEY:** INFORMATION FILED WITH THE ATTORNEY GENERAL CONCERNING THIS CHARITABLE SOLICITATION AND THE PERCENTAGE OF CONTRIBUTIONS RECEIVED BY THE CHARITY DURING THE LAST REPORTING PERIOD THAT WERE DEDICATED TO THE CHARITABLE PURPOSE MAY BE OBTAINED FROM THE ATTORNEY GENERAL OF THE STATE OF NEW JERSEY BY CALLING (973) 504-6215 AND IS AVAILABLE ON THE INTERNET AT www.njconsumeraffairs.gov/ocp.htm#charity. REGISTRATION WITH THE ATTORNEY GENERAL DOES NOT IMPLY ENDORSEMENT. **NEW YORK:** A copy of the latest annual report may be obtained from NCCN Foundation, 275 Commerce Drive, Suite 300, Fort Washington, PA 19034, or the Charities Bureau, Department of Law. 120 Broadway, New York, NY 10271. **NORTH CAROLINA: FINANCIAL INFORMATION ABOUT THIS ORGANIZATION AND A COPY OF ITS LICENSE ARE AVAILABLE FROM THE STATE SOLICITATION LICENSING BRANCH AT 888-830-4989 (within North Carolina) or (919) 807-2214 (outside of North Carolina). THE LICENSE IS NOT AN ENDORSEMENT BY THE STATE. PENNSYLVANIA:** The official registration and financial information of NCCN Foundation may be obtained from the Pennsylvania Department of State by calling toll-free within Pennsylvania, 800-732-0999. Registration does not imply endorsement. **VIRGINIA:** A financial statement for the most recent fiscal year is available upon request from the State Division of Consumer Affairs, P.O. Box 1163, Richmond, VA 23218; 1-804-786-1343. **WASHINGTON:** Our charity is registered with the Secretary of State and information relating to our financial affairs is available from the Secretary of State, toll free for Washington residents 800-332-4483. **WEST VIRGINIA:** West Virginia residents may obtain a summary of the registration and financial documents from the Secretary of State, State Capitol, Charleston, WV 25305. Registration does not imply endorsement.

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For disclosures, visit www.nccn.org/about/disclosure.aspx.

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University School of Medicine
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New Haven, Connecticut
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Lung Cancer

2018

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