SHOULD YOU be screened for lung cancer?

Cancer screening is testing for cancer before signs of cancer appear. This book describes who should be screened and the test used for lung cancer screening. It also has special guides for the screening process recommended by experts in lung cancer.

The National Comprehensive Cancer Network® (NCCN®) is a not-for-profit alliance of 27 of the world’s leading cancer centers. Experts from NCCN have written treatment guidelines for doctors who screen for 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 lung cancer screening. Key points of the book are summarized in the NCCN Quick Guide™ series for Lung Cancer Screening. NCCN also offers patient books on non-small cell lung cancer, malignant pleural mesothelioma, and many other cancer types. Visit NCCN.org/patients for the full library of patient books as well as other patient and caregiver resources.
These patient guides 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 healthcare 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. Panels may include surgeons, radiation oncologists, medical oncologists, and patient advocates. 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 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 the world’s 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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**Lung Cancer Alliance**
For over 20 years, Lung Cancer Alliance has focused on saving lives and advancing research by empowering those living with or at risk for lung cancer. LCA is proud to collaborate with NCCN to sponsor and endorse the NCCN Guidelines for Patients: Lung Cancer Screening. [www.lungcanceralliance.org](http://www.lungcanceralliance.org)

**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*
[www.lungcancerresearchcouncil.org](http://www.lungcancerresearchcouncil.org)
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Who should read this book?

This book is about screening for lung cancer. People who are deciding whether to be screened or not may find this book helpful. It may also help you discuss a screening plan with your doctor.

Help! What do the words mean?

In this book, many medical words are included. These are words you will likely hear from your medical team. Most of these words may be new to you, and it may be a lot to learn.

Don't be discouraged as you read. Keep reading and review the information. Don't be shy to ask your medical 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. Words in the Dictionary are underlined when first used in the book.

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 LDCT for low-dose computed tomography.

Does the whole book apply to you?

This book includes information for many situations. Your medical team can help. They can point out what parts of the book apply to you. They can also give you more information. As you read through this book, you may find it helpful to make a list of questions to ask your doctors.

The recommendations in this book are based on science and the experience of NCCN experts. However, these recommendations may not be right for you. Your doctors may suggest another screening program based on your health and other factors. If other suggestions are given, feel free to ask your medical team questions.
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Why get screened?

8  The lungs
9  Detect lung cancer early
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The lungs

The lungs are a pair of organs in the chest that are vital to life. The lungs move important gases in and out of the blood. You breathe in oxygen and let out carbon dioxide (a toxic gas) from the body.

The lungs have sections called lobes. The left lung has 2 lobes and the right lung has 3 lobes. A thin layer of tissue (membrane) surrounds the lungs called the pleural membrane.

The two large breathing tubes that go from the windpipe (trachea) to the lungs are called bronchi. A single tube is called a bronchus. Then inside of the lungs are small tubes (bronchioles) and small air sacs (alveoli). See Figure 1.

Figure 1. The lungs

The lungs have sections called lobes. The left lung has 2 lobes and the right lung has 3 lobes.
Detect lung cancer early

Lung cancer is a disease that starts in the cells that make up the lungs. Normal cells make new cells when needed, die when old or damaged, and stay in place. Cancer cells don’t do this. They grow out of control and invade other tissue. Without treatment, cancer cells can form a tumor (abnormal mass of cells) and spread to other organs in the body. Lung cancer causes more deaths than any other cancer in both men and women. See Figure 2. Of all causes of death, lung cancer ranks second behind heart disease. The high number of deaths is due in part to lung cancer being found after it has spread. Screening for lung cancer is done before you have symptoms and the doctor wants to check for disease. Cancer screening can help find lung cancer at an early stage when it can be cured.

Figure 2. Cancer deaths in the U.S.

About 27 out of 100 deaths caused by cancer are due to lung cancer.
### Types of lung cancer

Lung cancer has two main types called **non-small cell lung cancer (NSCLC)** and small cell lung cancer. The most common type of lung cancer is NSCLC. It accounts for 85 out of 100 of all lung cancers that are diagnosed. NSCLC can be broken down even further into sub-types. The sub-types are found by looking at the cancer cells under a **microscope**. This is known as histology. The sub-types listed from the most common to least common are:

- **Adenocarcinoma** is a type of NSCLC that starts in the cells that line the alveoli in the lungs.

- **Squamous cell carcinoma** starts in the cells that are flat and thin in the airways of the lungs.

- **Large cell** starts in large cells that can grow anywhere in the lungs.

### Review

- The lungs are a pair of organs in the chest that are vital to life.

- Lung cancer causes more deaths than any other cancer in both men and women.

- Lung cancer has two main types called NSCLC and small cell lung cancer.
2 Are you at risk?

12 Risk factors for lung cancer
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Risk factors for lung cancer

Guide 1. Risk Factors

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Some people are more likely to develop lung cancer than others. Anything that increases your chances of lung cancer is called a risk factor. Risk factors can be activities that people do, things in the environment, or traits passed down from parents to children through genes. Genes are a set of coded instructions in cells needed to make new cells and control how cells behave. If one or more risk factors applies to you, it doesn’t mean you’ll get lung cancer. Likewise, lung cancer occurs in some people who have no known risk factors. The known risk factors for lung cancer are listed in Guide 1.

Tobacco smoking
Tobacco smoking is the major risk factor for lung cancer. It accounts for 85 out of 100 people dying from lung cancer. The link between smoking and lung cancer was first reported in 1939, and since then it has been firmly proven. Smoking also increases the risk for cancer in many other areas of the body, such as the bladder, esophagus, and head and neck.

Second-hand smoke
In 1981, a link between second-hand smoke and lung cancer was first suggested. Since then, many studies have found that second-hand smoke can cause lung cancer in people who don’t smoke. The more contact you have with second-hand smoke, the higher your risk for lung cancer.

Radon
Uranium is a metallic chemical found in rocks and soil. As it decays, radon is made and gets into the air and water. Miners of uranium have a high risk for developing lung cancer. Some studies of radon in the home have linked radon to lung cancer while other studies have not.

What you can do:

✓ If you smoke tobacco, ask your doctor about support resources.

✓ Learn about counseling or drugs that might help you quit.

✓ When you are ready to quit, reach out to your family and friends for support.
The risk for lung cancer may depend on how much radon is in the home. For people who’ve had major contact with radon, such as uranium miners, the risk for lung cancer is higher for those who smoke than for those who don’t smoke.

Other cancer-causing agents
Besides radon, 10 other agents are known to cause lung cancer. Five are metallic chemicals: arsenic, beryllium, cadmium, chromium, and nickel. The others are asbestos, coal smoke, soot, silica, and diesel fumes. Among people who’ve had contact with these agents, the risk for lung cancer is higher for those who’ve smoked than for those who’ve never smoked.

History of lung disease
Two lung diseases have been linked to lung cancer. A history of COPD (chronic obstructive pulmonary disease) 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. Pulmonary fibrosis puts someone at higher risk for lung cancer regardless of their age, being male or female, or history of smoking.

Family history of lung cancer
Your risk is even higher if your relative had cancer at a young age or if multiple relatives have had lung cancer. Lung cancer in families may be due to a shared environment, genes, or both.

Review
- Anything that increases your chances of lung cancer is called a risk factor.
- Tobacco smoking is the major risk factor for lung cancer.
- Ask your doctor for support resources that can help you quit smoking.
### 3

Should you start now?

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Should you start now?

Start before you have symptoms

Guide 2. Symptoms of lung cancer

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<tr>
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</tr>
<tr>
<td>Wheezing</td>
</tr>
<tr>
<td>Pain in chest area</td>
</tr>
<tr>
<td>Tiredness that lasts</td>
</tr>
<tr>
<td>Pneumonia</td>
</tr>
<tr>
<td>Hoarse voice</td>
</tr>
<tr>
<td>Pain when swallowing</td>
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<tr>
<td>Weight loss</td>
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Screening can help find disease early, before symptoms occur. If you find disease early, you can start treatment and have a higher chance of a cure. The goal of lung cancer screening is to find lung cancer when treatments will work best. Treatments usually work best if started at the earliest stage of cancer, before there are symptoms of cancer. However, at this time, most lung cancer is found after symptoms appear.

Common symptoms of lung cancer are listed in Guide 2. See your doctor if you have these symptoms. Most often, these symptoms are caused by health problems other than lung cancer. If your doctor thinks your symptoms may be caused by lung cancer, he or she may suggest other types of tests to check for cancer. If you have no symptoms of lung cancer, a screening program may be right for you. Certain people are at risk for lung cancer.

Because of this risk, it is important to tell your doctor about your health history and your family’s health history. Let the doctor know if you smoked in the past and how many years it has been since you quit. Also, let the doctor know if you smoke now. Your doctor can then share the level of risk you have for lung cancer. The level of risk can be high, moderate, or low. If you are at high risk, learn about your screening options.
Guide 3 lists the criteria for high-, moderate-, and low-risk groups. There are two groups of people who are considered to be high risk for lung cancer. At this time, the strongest evidence is for the first high-risk group. The first high-risk group consists of people 55 years old and older who have smoked for 30 or more pack years. However, there is evidence to show that the second group, people 50 years old or older, could also benefit from screening.

As seen in Guide 3, the risk groups are divided mostly by age and the amount of smoking. The amount of smoking is based on pack years. A pack year is defined as 20 cigarettes smoked every day for 1 year. It can be calculated by the number of cigarette packs smoked every day multiplied by the number of years of smoking.
3 Should you start now?

The amount of smoking is based on pack years

Number of packs per day

1.5 packs a day

Years of smoking

x 30 years

Pack years

= 45 pack years

Make a decision with your doctor

Screening isn’t recommended for high-risk people with poor health, who if diagnosed with cancer would not be able to get curative treatment. Poor health might involve health conditions that are serious like heart disease or another cancer diagnosis. NCCN experts recommend that people at high risk for lung cancer discuss and decide with their doctor whether to start lung cancer screening or not. It is also recommended that there be a multidisciplinary team approach for lung cancer screening. This means doctors or medical staff from different areas of medicine come together and decide on a lung screening plan.

Get the best screening test

For lung cancer screening, it is helpful to include doctors from:

➤ Thoracic (chest) radiology
➤ Pulmonary (lung) medicine
➤ Thoracic surgery

The team could be involved from initial screening with an LDCT (low-dose computed tomography) through follow-up screening. Initial screening is called the first LDCT or baseline LDCT. Follow-up LDCTs are done at certain time points and are based on the first LDCT results.

It is important to talk openly about the benefits and risks of lung cancer screening with your medical team. See Part 6 for some benefits and risks you can talk about with your doctors.

Get the best screening test

Research supports using spiral (also called helical) LDCT of the chest for lung cancer screening. It is the only screening test proven to reduce the number of deaths from lung cancer. However, a single LDCT test may show abnormalities that suggest there is cancer when there is no cancer. Figures 3 and 4 depict some of the benefits and risks of lung cancer screening.
Figure 3. 
LDCT vs. x-ray

LDCT detects lung cancer better than x-ray among people at high risk for lung cancer. However, more so than an x-ray, a single LDCT test can suggest there may be cancer when there isn’t. In other words, LDCT finds cancer more often but also has more false alarms.

Figure 4. 
LDCT lowers risk

People have a lower chance of dying from lung cancer when screened with LDCT.
The LDCT test

LDCT takes many pictures of the inside of your body from different angles using x-rays. The amount of radiation used is much lower than standard doses of a CT (computed tomography) scan. Contrast dye should not be used for screening LDCT.

You will be alone in the room, but a CT technologist will operate the machine in a nearby room. The CT technologist can see you and the machine through a window. He or she will be able to hear and speak with you at all times.

Before the test
You should remove any metal objects on your body. These objects can affect the pictures taken of your lungs. The machine is large and has a tunnel in the middle. See Figure 5. During the test, you will lie on a table that moves through the tunnel. Pillows or straps may be used to keep you still during the test.

During the test
You will be asked to take a deep breath and hold it in for a few seconds while the pictures are taken. This is done to make sure the images are of good quality and not blurry. As the machine takes pictures, you may hear buzzing, clicking, or whirring sounds. While it only takes seconds to take the pictures, the whole process takes about 20–30 minutes.

Figure 5.
Computed tomography

A CT machine is large and has a tunnel in the middle. During the test, you will need to lie on a table that moves through the tunnel.
After the test
You may not learn of the results for a few days since a radiologist needs to look at and interpret the pictures. The radiologist will send the test results to your doctor or directly to you. A radiologist is a doctor who’s an expert in reading imaging tests like LDCT scans.

The LDCT test results
The American College of Radiology (ACR) recommends that the LDCT machine meet certain standards of quality when used for a test. The ACR is an association of experts in radiology. The ACR put together a Lung Imaging Reporting and Data System (Lung-RADS). A radiologist can use this system to look at pictures of your lungs to determine what the results mean. He or she can recommend how abnormalities found on the LDCT tests should be managed.

More about Lung-RADS
This system has been shown to improve the ability to find lung cancer. It has lowered the number of abnormalities found on LDCT that are suspicious for lung cancer, but that are not actually lung cancer. These abnormalities are known as false-positive results. These results say that cancer has been found when it actually hasn’t. False-positive results can lead to additional testing that isn’t needed.

The LDCT should be done by medical staff trained in screening for lung cancer. Learn more about screening sites in Part 6.

What you can find out:
- Ask your doctor or radiologist for more information on Lung-RADS or lung cancer screening tests like LDCT.
- Check if your hospital or imaging facility has experience with LDCT.

Review
- Lung cancer screening should be started before cancer symptoms appear.
- Only people at high risk for lung cancer should consider starting a screening program.
- Lung cancer screening should be done with LDCT.
What happens after the first test?

22 Types of lung nodules
23 Overview of screening tests
24 First screening LDCT
26 Follow-up or yearly screening LDCT
32 Review
Types of lung nodules

Screening with LDCT is used to find nodules in the lungs. Nodules are small, round areas of abnormal tissue. Nodules can be caused by cancer, infection, scar tissue, or other conditions. Most nodules found on LDCT are not cancer (benign). People can have one lung nodule or more than one nodule found during screening.

Lung nodules:

- Have features that can be used to tell if it is cancer or not.
- That are completely calcified (lots of calcium) and that contain fat are not cancer.
- That are cancer often have rough edges (called spiculations).
- That are cancer often grow faster and are larger in size than nodules that are not cancer.

Many of the nodules found on screening are small, about the size of a pea, and most of those nodules are not cancer. Nodules are measured in mm (millimeters). This letter “o” is about 1 mm long.

Doctors assess the density of a nodule. The density of a nodule is a clue to whether the nodule is cancer or not. Density is how solid versus hazy a nodule looks on the LDCT pictures. Nodules are divided into three groups based on density:

- **Solid nodules** look about as solid as your muscle does on an LDCT picture.
- **Non-solid nodules** look like a fuzzy or hazy cloud on an LDCT picture. These nodules are also called a “ground-glass opacity” or a “ground-glass nodule.”
- **Part-solid nodules** have both solid and non-solid areas in them. These nodules are also called “semi-solid nodules” or “subsolid nodules.”

Solid nodules are the most common kind of nodules. Non-solid nodules are usually followed by more LDCT tests. Even if the non-solid nodules are cancer, these are considered the kind of cancer that will not grow and spread. The part-solid nodules have the greatest chance of being lung cancer.
Overview of screening tests

Guide 4. Screening tests

<table>
<thead>
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<th>Time of screening</th>
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<td>First (baseline) screening LDCT</td>
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<tr>
<td>First follow-up screening LDCT</td>
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<tr>
<td>Follow-up or yearly screening LDCT</td>
</tr>
<tr>
<td>If needed, chest CT or PET/CT</td>
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</table>

Screening tests are repeated over time to assess if a nodule may be cancer. See Guide 4. The schedule and type of screening test depend on whether there are changes in a nodule’s size, density, or both. Often, the use of one LDCT detects a nodule but isn’t clear whether the nodule is lung cancer or not. Thus, the first LDCT—the baseline test—is compared to follow-up LDCTs. Your doctors will look for increases in size or density. Such changes may be a sign of cancer.

If needed, other tests can be done during follow-up. They are a chest CT scan (CT scan of the lungs) or PET (positron emission tomography) scan. The standard dose of radiation is used for the chest CT; a low dose is not used as is for LDCT. A PET scan would check further for disease in your body not just the chest area. Modern PET scanners are often called PET/CT (positron emission tomography/computed tomography) scans.

More about PET scans
A PET scan may be used to look at a nodule that is found on a screening LDCT. A PET scan involves an injection of a small and safe amount of a radioactive sugar called glucose. After you get the glucose, pictures will be taken of the inside of your body. The doctor will look to see if the glucose has deposited inside a lung nodule. Nodules that are cancer appear brighter on the pictures. This happens because cancer cells use sugar more quickly than normal cells. However, very small nodules are not easily seen on PET. These nodules could be the size of a large pea or smaller. Cancers of that size don’t use enough sugar to be detected. Therefore, PET scans are not recommended for most nodules found on screening LDCT.

If you are high risk for lung cancer you will have an LDCT test. Your doctor will check for anything abnormal like a lung nodule. You will then follow a plan based on what the doctor finds on your first (baseline) screening LDCT test. You will learn more about what happens next when there are no nodules.

In the guides below, you can read about the next steps if a solid lung nodule, part-solid lung nodule, or non-solid lung nodule is found.

Next steps if no lung nodules
If no lung nodules are found, your next LDCT should be in 1 year. This would be your first follow-up LDCT test. Screening with LDCT should occur every year until a diagnosis of cancer that would not be able to get curative treatment. This treatment would be given with a plan to cure the cancer. Doctors are not completely sure how long screening should be and at what age it should stop. Your doctor will be able to look at your individual needs and decide how long screening should continue.
First screening LDCT

Guide 5. Solid or part-solid lung nodule on the first LDCT

<table>
<thead>
<tr>
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<th>Size of part-solid lung nodule</th>
<th>When should you get the first follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 mm</td>
<td>&lt;6 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td>6–&lt;8 mm</td>
<td>≥6 mm with solid part &lt;6 mm</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td>8–&lt;15 mm</td>
<td>≥6 mm with solid part 6–&lt;8 mm</td>
<td>Get an LDCT in 3 months or Consider getting PET/CT</td>
</tr>
<tr>
<td>≥15 mm</td>
<td>Solid part ≥8 mm</td>
<td>Chest CT with or without contrast and/or PET/CT</td>
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Navigating the guides

The following set of guides (5–6) will list your next screening test based on the type of lung nodule found on the first (baseline) LDCT test.

Next steps if solid or part-solid lung nodule

Guide 5 lists when you should get your next screening test based on the results of the first LDCT test for a solid or part-solid lung nodule. The time of the next test depends on the size and density of any lung nodules found. If you have smaller nodules, no additional testing is needed before your next LDCT test 1 year from now. Slightly larger nodules should have a follow-up LDCT in 3 or 6 months. For the largest nodules, with the highest risk of cancer, you may have an additional test such as a PET/CT scan.
If there is high concern for cancer, the next step would be to have a biopsy (remove one or more samples of tissue) or surgery (remove the entire nodule) to check for cancer. This is done by looking at the cells under a microscope. If no cancer is found, your next LDCT should be in 1 year. If cancer is confirmed, you can start cancer treatment.

If a solid endobronchial nodule is found, your next LDCT will be in 1 month. This type of nodule can grow in the large breathing tubes that lead to the lungs. If the nodule is found and intense coughing starts, the LDCT will be done soon after. If there is no resolve, then a bronchoscopy should be done. A bronchoscopy is when a thin, long tool is guided into the airways to look at or remove tissue.

<table>
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<tr>
<th>Size of lung nodule</th>
<th>When should you get the first follow-up test?</th>
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<tr>
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<td>Get an LDCT in a year</td>
</tr>
<tr>
<td>≥20 mm</td>
<td>Get an LDCT in 6 months</td>
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Next steps if non-solid lung nodule

Guide 6 lists when you should get your next screening test based on the results of the first LDCT test for a non-solid nodule. Many of these nodules can be followed with an LDCT once a year. You should have an LDCT in 6 months for a non-solid lung nodule that is 20 mm or larger.

Non-solid nodules may be cancer, but they may also be small areas of infection or inflammation that can resolve. Nodules that are large are more likely to be cancer than smaller nodules. The more likely there’s cancer, the sooner the second test will be suggested. If a non-solid nodule develops a solid part on a future LDCT, this is a sign it could be cancer. A biopsy or surgery is usually recommended.
Follow-up or yearly screening LDCT

After the first follow-up test, you will have other follow-up tests such as LDCT, chest CT, or PET/CT as suggested by your doctor. Which test you receive depends on the results of your first follow-up test. Your doctor will compare your first follow-up test to the first (baseline) screening test. Then, he or she will decide when the next follow-up test will occur.

**Why more tests are needed**
There may be cancer if the nodule is the same size or larger. A PET/CT is suggested rather than LDCT if the nodule is larger than 8 mm. PET/CT may find if there’s cancer quicker than LDCTs repeated over a period of time. It may also show signs of cancer spreading in the body.

If the PET/CT suggests that cancer isn’t likely, an LDCT in 3 months is recommended. An LDCT is done because some cancers may not be seen on a PET scan. A chest CT can also be done in place of a PET/CT to check a lung nodule. If the chest CT or PET/CT suggests that cancer is likely, a biopsy or surgery is recommended. To learn more about biopsies and surgery, see Part 5.

**Navigating the guides**
The next set of guides (7–12) will list your next screening test based on the type of lung nodule found on a follow-up or yearly screening test.

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**When the tests are done**
Follow-up screening is done to check your lungs at certain time points like months or years. The time for follow-up LDCT tests are listed in the guides in this chapter. You will learn about follow-up tests for a solid, part-solid, and non-solid lung nodule. Your doctors will let you know how often you will need a screening test. Screening isn’t recommended for people with poor health, who if diagnosed with cancer would not be able to get curative treatment.

**What your doctor is checking**
Doctors will look for new nodules on a follow-up LDCT. The doctor can check for any growth or change in the density of nodules that were seen on your first LDCT. In some cases, if there is a small change, an LDCT will be recommended in 3 or 6 months. This allows your doctor to assess the nodule sooner than waiting a year for your next screening LDCT. The nodule may be caused by an infection, inflammation, or cancer. If the nodule growth or size of a new solid area is concerning for cancer, a biopsy or surgery may be recommended.
Guide 7. Solid lung nodule on follow-up or yearly LDCT

<table>
<thead>
<tr>
<th>Results</th>
<th>Size of lung nodule</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change on follow-up LDCT</td>
<td>&lt;8 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>8–&lt;15 mm</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td></td>
<td>≥15 mm</td>
<td>Get an LDCT in 6 months or PET/CT</td>
</tr>
<tr>
<td>No change on yearly LDCT</td>
<td>No change on yearly LDCT</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td>New nodule</td>
<td>&lt;4 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>4–&lt;6 mm</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td></td>
<td>6–&lt;8 mm</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td>≥8 mm</td>
<td>Chest CT with or without contrast or PET/CT</td>
</tr>
<tr>
<td>Growing nodule</td>
<td>&lt;8 mm</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td>≥8 mm</td>
<td>Chest CT with or without contrast or PET/CT</td>
</tr>
</tbody>
</table>

**Next steps if solid lung nodule on follow-up**

Guide 7 lists when you should get your follow-up or yearly screening LDCT test for a solid lung nodule. The doctor will decide when you get your next screening test by comparing what was seen on the LDCT test you had before. If the solid lung nodule had no change from the LDCT done last year, is 8 mm or smaller, or is new but very small, your next LDCT should be in 1 year.

The timing of the LDCT test is based on the size of the nodule and whether it is new or growing. Guide 7 shares the specific size in mm for a nodule seen on LDCT. For those nodules that are a larger size, additional tests are usually recommended such as a chest CT or PET/CT scan.
Guide 8. Solid lung nodule on follow-up chest CT or PET/CT

<table>
<thead>
<tr>
<th>Results</th>
<th>Size of lung nodule</th>
<th>Concern for cancer</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change on follow-up LDCT</td>
<td>≥15 mm</td>
<td>Low</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Biopsy or surgery*</td>
</tr>
<tr>
<td>New nodule</td>
<td>≥8 mm</td>
<td>Low</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Biopsy or surgery*</td>
</tr>
<tr>
<td>Growing nodule</td>
<td>≥8 mm</td>
<td>Low</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Biopsy or surgery*</td>
</tr>
</tbody>
</table>

* If cancer, start cancer treatment.
If no cancer, you will have an LDCT every year until curative treatment is not an option.

Guide 8 lists when you should get your follow-up test for a solid lung nodule seen on chest CT or PET/CT. If there is a low concern for cancer, you should get an LDCT in 3 or 6 months. If there is a high concern for cancer, you should have a biopsy or surgery. This is done instead of waiting to see if anything changes over time. A biopsy or surgery of the nodule can confirm if cancer is present.
Guide 9. Part-solid lung nodule on follow-up or yearly LDCT

<table>
<thead>
<tr>
<th>Results</th>
<th>Size of lung nodule</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change on follow-up LDCT</td>
<td>&lt;6 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>≥6 mm with 6–&lt;8 mm solid part</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>≥6 mm with ≥8 mm solid part</td>
<td>Get an LDCT in 6 months or PET/CT</td>
</tr>
<tr>
<td>No change on yearly LDCT</td>
<td>No change on yearly LDCT</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td>New nodule</td>
<td>&lt;6 mm</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td>New or growing nodule</td>
<td>≥6 mm with growing &lt;4 mm solid part</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td>≥4 mm solid part</td>
<td>Chest CT with or without contrast or PET/CT</td>
</tr>
</tbody>
</table>

**Next steps if part-solid lung nodule on follow-up**

Guide 9 lists when you should get your follow-up or yearly screening LDCT test for a part-solid lung nodule. The doctor will decide when you get your next follow-up test by comparing what was seen on the LDCT test you had before.

If the part-solid lung nodule had no change on the LDCT done last year and is smaller than 6 mm, your next LDCT should be in 1 year. For those part-solid nodules that are new, or growing and 6 mm or larger, your next LDCT should be in 3 or 6 months.

The specific time point of your next screening test depends on the size. It is based on the size of the nodule and the size of the solid part seen on LDCT. For those nodules with a larger solid part, chest CT or PET/CT is recommended.
What happens after the first test? Follow-up or yearly screening LDCT

Guide 10. Part-solid lung nodule on follow-up chest CT or PET/CT

<table>
<thead>
<tr>
<th>Results</th>
<th>Size of lung nodule</th>
<th>Concern for cancer</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change on follow-up LDCT</td>
<td>≥6 mm with ≥8 mm solid part</td>
<td>Low</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Biopsy or surgery*</td>
</tr>
<tr>
<td>New or growing nodule</td>
<td>≥4 mm solid part</td>
<td>Low</td>
<td>Get an LDCT in 3 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Biopsy or surgery*</td>
</tr>
</tbody>
</table>

* If cancer, start cancer treatment.
If no cancer, you will have an LDCT every year until curative treatment is not an option.

Guide 10 lists when you should get your follow-up test for a part-solid lung nodule seen on chest CT or PET/CT. You will have further testing based on the nodule size and concern for cancer. If there is a low concern for cancer, you should get an LDCT in 3 or 6 months. If there is a high concern for cancer, you should have a biopsy or surgery. This is done instead of waiting to see if anything changes over time. A biopsy or surgery of the nodule can confirm if cancer is present.
## Guide 11. Non-solid lung nodule on follow-up or yearly LDCT

<table>
<thead>
<tr>
<th>Results</th>
<th>Size of lung nodule</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New nodule</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;20 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>≥20 mm</td>
<td>Get an LDCT in a year or Consider biopsy* or Consider surgery*</td>
</tr>
<tr>
<td><strong>Stable nodule</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;20 mm</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td>≥20 mm</td>
<td>Get an LDCT in 6 months (If nodule is still stable on this test, get LDCT in a year)</td>
</tr>
<tr>
<td><strong>Growing nodule</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;20 mm</td>
<td>Get an LDCT in 6 months</td>
</tr>
<tr>
<td></td>
<td>≥20 mm</td>
<td>Get an LDCT in 6 months or Consider biopsy* or Consider surgery*</td>
</tr>
</tbody>
</table>

* If cancer, start cancer treatment.
If no cancer, you will have an LDCT every year until curative treatment is not an option.

### Next steps if non-solid lung nodule on follow-up

Guide 11 lists the recommended care based on the results of the follow-up or yearly LDCT test for a non-solid lung nodule. If the non-solid nodule has disappeared or gotten smaller, there is a good chance that it was a small infection that resolved and was not cancer. For a new or stable but small non-solid nodule, your next LDCT should be in 1 year. If stable and 20 mm or larger or growing, your next LDCT should be in 6 months.

If a nodule has grown or become more solid, it may be cancer. Because of this concern, a biopsy or surgery is recommended.

For multiple non-solid nodules, doctors will measure the largest nodule. They can use the guides (like those in this chapter) to manage the nodules. If the doctor thinks the nodules are an infection or inflammation, your next LDCT will be in 1 to 3 months. If the nodules grow quickly, the doctor should check for inflammation or another cancer.
Guide 12. New nodule on follow-up or yearly LDCT

<table>
<thead>
<tr>
<th>Results</th>
<th>Next LDCT</th>
<th>Look of new lung nodule on LDCT</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible infection/inflammation</td>
<td>Get a LDCT in 1–3 months</td>
<td>Getting better</td>
<td>Get an LDCT in 3–6 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Better</td>
<td>Get an LDCT in a year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Still growing</td>
<td>See other guides for solid, part-solid, and non-solid lung nodules</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results</th>
<th>When should you get the next follow-up test?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No possibility of infection/inflammation</td>
<td>See other guides for solid, part-solid, and non-solid lung nodules</td>
</tr>
</tbody>
</table>

### Next steps if new lung nodule on follow-up

Guide 12 describes the suggested course of care if your doctors think there’s an infection or inflammation. During the screening process, a new nodule or more than one new nodule may appear. The nodule should be re-checked with LDCT in 1 to 3 months. During this time, your doctors may treat the infection or inflammation.

If the nodule is smaller or gone, it is not likely to be cancer. Screening with LDCT will be in 3 to 6 months for a nodule (or more than one nodule) that is getting better. You should get an LDCT in a year if the nodules are gone and they improved on this LDCT. If the new nodule is not an infection or inflammation, the doctor will follow the other guides when scheduling the next screening test.

### Review

- Many people have nodules in their lung. Nodules can be caused by cancer, infections, scar tissue, or other conditions.
- Often, screening tests are repeated over time to assess if a nodule may be cancer.
- The schedule and type of screening test depend on whether there are changes in a nodule’s size, density, or both.
5
How can you know for sure it’s lung cancer?

34  Biopsy
35  Surgery
37  Care after a biopsy or surgery
37  Review
Biopsy

To test for cancer, tissue from the nodule must be removed from your body. The tissue will then be sent to a lab and examined with a microscope to look for cancer cells. A biopsy removes small samples of tissue. Surgery removes the entire nodule for testing. Since a biopsy only removes a very small piece of the nodule, the results could be wrong. There may be cancer cells in another part of the nodule. Thus, your doctors may suggest surgery to remove the whole nodule instead of a biopsy if your risk for cancer is high. Likewise, your doctors may suggest another biopsy, surgery, or frequent testing if the first biopsy shows no cancer.

There are two types of biopsies used for lung nodules. Before either biopsy, you may be asked to stop eating, stop taking some medicines, or stop smoking. A sedative, local anesthesia, or both may be used. A biopsy is generally a safe test and takes about 30 to 60 minutes to complete.

**Percutaneous needle biopsy**
This biopsy uses a very thin needle. Before and during the biopsy, CT is used to find the right spot. Your skin will be cleaned and your doctors will make a small cut after numbing the area with local anesthesia. The needle will be inserted through the cut, between the ribs and into the nodule. During the biopsy, you may be asked to keep still and hold your breath for a few seconds at a time. After the biopsy, you will be given a chest x-ray to check for air that can build up between the lungs and chest wall. This kind of biopsy generally takes about an hour. You are usually observed for 4 to 6 hours afterwards.

**Bronchoscopy**
A bronchoscopy allows your doctor to biopsy a nodule using a bronchoscope. A standard bronchoscope has a thin, long tube about as thick as a pencil. The tube has a very small light, camera, and open channel for taking biopsies. The light and camera allow your doctor to guide the bronchoscope down your mouth into your lungs. A small tool is inserted down the channel to remove tissue from the nodule.

The airways of the lungs get smaller as they extend toward the side of the body. Standard bronchoscopes are often too large to travel through these small airways. A navigational bronchoscopy can be done instead to guide a probe and biopsy instrument to the site of the nodule.

For a navigational bronchoscopy, your doctor will plan how to reach the nodule using a picture made by CT. During the biopsy, you will lie on an electromagnetic plate. The bronchoscope will be fitted with another very small tube through which a sensor probe will be inserted. The electromagnetic plate allows your doctor to see and guide the sensor probe. When the nodule is in reach, the sensor probe will be removed and a small tool will be inserted to collect tissue.
Surgery

Surgery removes the nodule as well as a rim of tissue around the nodule. The rim of tissue around the nodule is called the surgical margin. The whole nodule and the surgical margin will be examined for cancer cells.

Surgery types
There is more than one type of surgery for lung nodules. See Figure 6. Often, a small part of a lobe will be removed to test for cancer. This surgery is called a wedge resection. If cancer is found, then a larger part of the lung may be removed. A segmentectomy removes a large part of a lobe, whereas a lobectomy removes the whole lobe.

A lung on the right side of the body has three lobes. The left-sided lung has two lobes. Removing one lobe typically reduces lung capacity by 20% to 25%. For example, if before surgery your lungs were able to take in 6 liters of air, then after removing one lobe your lungs would take in 4.5 to 4.8 liters. Thus, your surgeon will likely test your lung capacity to make sure that it is safe to remove part of your lung.

Surgery methods
Surgery may be done with one of two methods. The classic method is thoracotomy. VATS (video-assisted thoracic surgery) is a newer method. VATS is often preferred for a small nodule, but a thoracotomy is sometimes preferred because of nodule size, nodule location, or other reasons.

Before surgery
You will be asked to stop eating, drinking, and taking some medicines for a short period of time.

Figure 6
Lung tumor surgeries

In the far left column, a small piece of the lobe was removed by a surgery called a wedge resection. In the middle column, the results of a segmentectomy are shown. A lobe of lung was removed in the right column by a surgery called a lobectomy.
If you smoke, it is important to stop to get the best results possible. General anesthesia is used for both surgeries.

**During surgery**

With thoracotomy, a cut is made in the side of the chest 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 nodule is deflated and a breathing tube is used to help you breathe with the other lung. After surgery the cut is sewn closed, but tubes are left in for a few days to drain fluid and air. The surgery can take 2 to 3 hours. You may stay in the hospital for a few days to recover.

With VATS, 3 to 4 small cuts are made between the ribs on the side of the chest. A camera and surgical tools are inserted through the cuts. Video from the camera is shown on a computer so the surgeon can see your organs. Tissue is removed through the small cuts rather than a large opening in the chest wall. During surgery, the lung with the nodule is deflated and a breathing tube is used to help you breathe with the other lung. After surgery the cuts are sewn closed, but tubes are left in for a few days to drain fluid and air. The surgery can take 2 to 3 hours. You may stay in the hospital for 1 to 3 days to recover.

**Newer type of surgery**

A newer type of surgery being studied in clinical trials (research studies) is RATS (robotic-assisted thoracic surgery). This type of surgery requires the surgeon be trained to use a robotic system. The doctor makes small incisions like VATS and uses a camera to guide robotic controls during the surgery. At this time, only a limited number of surgeons are trained to do this type of surgery in the United States.
Care after a biopsy or surgery

Guide 13. Care after a biopsy or surgery

<table>
<thead>
<tr>
<th>Lung nodule found</th>
<th>Results of tissue sample</th>
<th>What should you do next?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopsy of new lung nodule or nodules that could be an infection or inflammation</td>
<td>✅ Not cancer</td>
<td>If high concern for cancer, get an LDCT, biopsy, or surgery in 3 months</td>
</tr>
<tr>
<td></td>
<td>✅ Cancer</td>
<td>Start cancer treatment</td>
</tr>
<tr>
<td>Surgery of new lung nodule or nodules that could be an infection or inflammation</td>
<td>✅ Not cancer</td>
<td>Get an LDCT in an year</td>
</tr>
<tr>
<td></td>
<td>✅ Cancer</td>
<td>Start cancer treatment</td>
</tr>
</tbody>
</table>

Guide 13 shows the recommended care after testing lung tissue for cancer. If cancer cells are found in the biopsy or surgical tissue, read the NCCN Patient Guidelines: Non-Small Cell Lung Cancer®. Treatment options are recommended for every stage of lung cancer. When no cancer is found in the biopsy or surgical tissue, yearly screening is suggested.

Biopsy sample
Sometimes a sample of tissue from the biopsy does not have enough cells to check for cancer or may be abnormal but not cancer. If there is a high concern for cancer, you should get an LDCT, have another biopsy, or have surgery in 3 months. Ask your doctor if you have any questions about your test results.

Review

- A biopsy removes small samples of tissue that will be tested for cancer.
- Surgery removes the entire nodule that will be tested for cancer.
- If neither the biopsy nor surgery results find cancer, keep getting the screening LDCT tests. If cancer is found, start treatment.
6
How can you learn more about screening?

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Where to go for screening</td>
</tr>
<tr>
<td>40</td>
<td>Find a good screening plan</td>
</tr>
<tr>
<td>41</td>
<td>Questions to ask your doctors</td>
</tr>
<tr>
<td>44</td>
<td>Review</td>
</tr>
<tr>
<td>44</td>
<td>Websites</td>
</tr>
</tbody>
</table>
Where to go for screening

Guide 14. Must-haves for screening sites

<table>
<thead>
<tr>
<th>Screening sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow an organized plan that is updated to include new technology and knowledge like that from NCCN.</td>
</tr>
<tr>
<td>Have a high-quality screening program with enough staff and resources.</td>
</tr>
<tr>
<td>Be accredited to do CT scans by a certifying organization, such as the American College of Radiology.</td>
</tr>
<tr>
<td>Get scans read by an American Board of Radiology board-certified radiologist who’s an expert in lung cancer screening.</td>
</tr>
<tr>
<td>Offer modern multislice CT equipment that does high-quality, low-dose, and non-contrast spiral CT.</td>
</tr>
<tr>
<td>Partner with a health center that has:</td>
</tr>
<tr>
<td>• Experience and excellence in biopsy methods.</td>
</tr>
<tr>
<td>• Board-certified pulmonologists (lung doctor).</td>
</tr>
<tr>
<td>• Board-certified thoracic (chest) surgeons who are experts in lung cancer.</td>
</tr>
</tbody>
</table>

Your primary care doctor can help you decide whether or not to start lung cancer screening. This decision should take into account your chance for developing lung cancer and your health history. Since your doctor knows this information, he or she can make a good suggestion and help guide you to the right screening site. What to look for in a screening site is listed in Guide 14.

Keep in mind, most sites require a doctor’s prescription before the visit. Other sites will talk to you (via a representative from the site) without a prescription to decide if you should be screened. A representative also may ask about your health history and your risk for lung cancer. Before the date is set, you can call your insurance plan. They can help you understand what information is needed from you before you schedule the visit.
Find a good screening plan

Guide 15. Screening programs

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Screening can reduce the number of deaths from lung cancer and other causes.</td>
<td>• Screening doesn’t always find cancer early enough to be cured.</td>
</tr>
<tr>
<td>• Lung cancer found by screening is often an earlier stage of disease than cancer found because of symptoms.</td>
<td>• Some people get treated even though the cancer grows so slowly that it won’t cause death. They can also get treated because screening results were unclear or wrong.</td>
</tr>
<tr>
<td>• People whose cancer was found with screening more often can have minimally invasive surgery and have less lung tissue removed.</td>
<td>• Some people get unneeded tests. Imaging tests can include unnecessary contact with radiation.</td>
</tr>
</tbody>
</table>

List what you think are benefits and risks for you. Share them with your doctor.

• ____________________________________________________________________________________
• ____________________________________________________________________________________
• ____________________________________________________________________________________

A good screening plan will have many benefits with few and minor risks. Before starting a screening plan, talk with your doctor about all of the possible benefits and risks of the plan. Some benefits and risks of screening plans are listed in Guide 15.

What benefits should include:

✓ Better survival and quality of life
✓ Less testing and treatment
✓ Support to quit smoking
✓ Lower costs
Questions to ask your doctors

It is important to learn all you can about screening so you can make a good decision with the help of your doctor. It is a good idea to get your questions ready before your visit and repeat back what answers you hear. You can also think about bringing a family member or friend to the visit.

The questions below are suggestions to learn more about lung cancer screening that you read about in this book. Feel free to use these questions or come up with your own questions for your doctor.

Questions about screening

1. Should I be screened for lung cancer?

2. What screening plan do you recommend for me?

3. What are the benefits and risks of this screening plan?

4. Do you use LDCT for screening?

5. Where will the screening take place? Will I have to go to the hospital?

6. Do you have a team of experts who are dedicated to lung cancer screening? Do they include pulmonologists, thoracic surgeons, and specialists in chest radiology?

7. Are the radiologists board certified in diagnostic radiology?

8. Are the pulmonary medicine physicians board certified in pulmonary and critical care medicine?

9. Are the surgeons board certified in thoracic surgery? Do they have a major part of their practice dedicated to lung cancer surgery? Do they do VATS or RATS surgery?

10. Do I have to do anything to prepare for screening?

11. How long will screening take?

12. How soon will I know the results and who will explain them to me?
Questions about biopsies

1. What type of biopsy will I have?

2. Where will it take place?

3. How long will it take? Will I be awake?

4. Will it hurt? Will I need anesthesia?

5. What are the risks? What are the chances of lung collapse, infection, or bleeding afterward?

6. How do I prepare for the biopsy? Should I not take aspirin or eat beforehand?

7. Should I bring someone with me?

8. How long will it take for me to recover? Will I be given an antibiotic or another drug afterward?

9. Will I get a copy of the results? How soon will I know the results and who will explain them to me?

10. Who will talk about the next steps? When?
Questions about surgery

1. What type of surgery will I have?

2. What are the benefits and risks of the surgery?

3. What should I do to prepare for surgery? Should I stop taking my medications? Should I store my blood in case I need a transfusion?

4. Are you board certified in thoracic surgery?

5. How many lung surgeries do you do per year? What other types of surgery do you do?

6. How much will the surgery cost? How can I find out how much my insurance company will cover?

7. How long does the surgery last?

8. Do you test any lymph nodes before surgery? During surgery?

9. What will my lung capacity be after surgery? Will it change my life?

10. When will I be able to return to my normal activities?

11. How soon will I know the results and who will explain them to me?

12. If I have cancer, how likely is it that I’ll be cancer-free after surgery? Will I need any other treatment?
### Review

- Find a screening site that provides high-quality care.
- Start a good screening plan that has many benefits and few risks.
- Ask your doctor questions. Getting the right information is vital to making decisions about screening.

### Websites

- Lung Cancer Alliance
  - www.lungcanceralliance.org
- Lung Cancer Research Council
  - www.lungcancerresearchcouncil.org
- NCCN
  - www.nccn.org/patients
  - www.nccn.org/patients/guidelines/cancers.aspx
- Smoking cessation (help to quit smoking)
  - www.smokefree.gov
alkylating agent
A type of cancer-killing drug.

arsenic
A very toxic metallic chemical.

asbestos
A mineral fiber used in housing and commercial materials.

baseline test
A starting point to which future tests are compared.

benign
Tissue without cancer cells.

beryllium
A hard, gray metallic chemical.

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

bladder
An organ that holds and expels urine from the body.

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

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.

cadmium
A heavy metallic chemical.

calcium
A mineral found in body tissues.

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

chromium
A hard, semi-gray metallic chemical.

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

computed tomography (CT)
A test that combines many x-rays to make pictures of the inside of the body.

curative treatment
A medicine that cures disease or symptoms.

diesel fumes
Gases from fuel that is thick, heavy, and made from crude oil.

early stage
Cancer that has had little or no growth into nearby tissues.

electromagnetic
A force that attracts or repels and is produced by an electric current.

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

follow-up test
A close watch by doctors of possible cancer using tests.

general anesthesia
A controlled loss of wakefulness from drugs.

genes
Instructions in cells for making and controlling cells.

ground-glass opacity
A small mass of lung cells with low density.

Hodgkin lymphoma
A cancer of white blood cells.

infection
An illness caused by germs.

inflammation
Redness, heat, pain, and swelling from injury or infection.

lobe
A clearly seen division in the lungs.

lobectomy
The removal of an entire lobe of the lung.

local anesthesia
A loss of feeling in a small area of the body from drugs.
low-dose computed tomography (LDCT)  
A test that uses little amounts of radiation to make pictures of the inside of the body.

lung  
An organ in the body made of airways and air sacs.

lung capacity  
The amount of air the lungs can hold.

lymph node  
A small group of disease-fighting cells.

microscope  
A tool that uses lenses to see things the eyes can’t.

mucus  
A sticky, thick liquid that moisturizes or lubricates.

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

nickel  
A silvery-white metal.

nodule  
A small mass of tissue.

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

pack years  
The number of cigarette packs smoked every day multiplied by the number of years of smoking.

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

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

pneumonia  
An infection causing the lungs to fill up with pus.

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

pulmonary fibrosis  
Major scarring of lung tissue.

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

radiation therapy  
Treatment with radiation.

radiologist  
A doctor who’s an expert in reading imaging tests.

radon  
A gas without odor, taste, or color that is made from uranium as it decays.

retractors  
A tool that holds back the edges of a surgical cut.

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

robotic-assisted thoracic surgery (RATS)  
Use of robotic controls guided by a surgeon to do work in the chest.

scar tissue  
Supportive fibers formed to heal a wound.

second-hand smoke  
Inhaled smoke from a lit smoking product or that was exhaled from a smoker.

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

segmentectomy  
Surgical removal of a large part of a lobe.

silica  
A natural mineral mostly found in sand.

solid nodule  
A small mass of tissue of high density.

surgery  
An operation to remove or repair tissue.

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

symptom  
A physical sign or patient report of a health condition.
Acronyms

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

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

**tumor**
An abnormal mass of cells.

**uranium**
A silvery-white metallic chemical.

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

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

**wheezing**
A coarse, whistling sound while breathing.

---

**ACR**
American College of Radiology

**COPD**
chronic obstructive pulmonary disease

**CT**
computed tomography

**LDCT**
low-dose computed tomography

**Lung-RADS**
Lung Imaging Reporting and Data System

**mm**
millimeters

**NCCN**
National Comprehensive Cancer Network

**NSCLC**
nonsmall cells lung cancer

**PET**
positron emission tomography

**PET/CT**
positron emission tomography/computed tomography

**RATS**
robotic-assisted thoracic surgery

**VATS**
video-assisted thoracic surgery
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Multiple Myeloma
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Follicular Lymphoma
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