LUNG CANCER DETECTION

UPDATED APRIL 2021


What you need to know about...

lung cancer screening and early detection






LUNGEVITY

foreword

About LUNGevity

LUNGevity is the nation's premier lung cancer-focused nonprofit, changing outcomes for people with lung cancer through research, education, and support.

About the LUNGevity PATIENT EDUCATION SERIES

LUNGevity has developed a comprehensive series of materials for lung cancer patients and their caregivers, focused on understanding how lung cancer develops, how it can be diagnosed, and treatment options. Whether you or someone you care about has been diagnosed with lung cancer, or is concerned about lung cancer risk, we have resources to help you.

The medical experts and lung cancer patients who provided their valuable expertise and experience in developing these materials all share the belief that well-informed patients make their own best advocates.

In addition to this and other booklets in the LUNGevity patient education series, information and resources can be found on LUNGevity's website at www.LUNGevity.org.

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introduction

A number of factors determine the outlook for any lung cancer patient, including when the cancer is detected, the type of lung cancer, the cancer's responsiveness to treatment, and the patient's health in general. However, lung cancer is easiest to treat when it is found early, and treating it early saves lives.

This booklet will help you:

- Understand the benefits of early detection
- Learn who is eligible for lung cancer screening
- Learn how lung cancer screening is conducted
- Understand what happens when lung cancer screening detects an abnormality

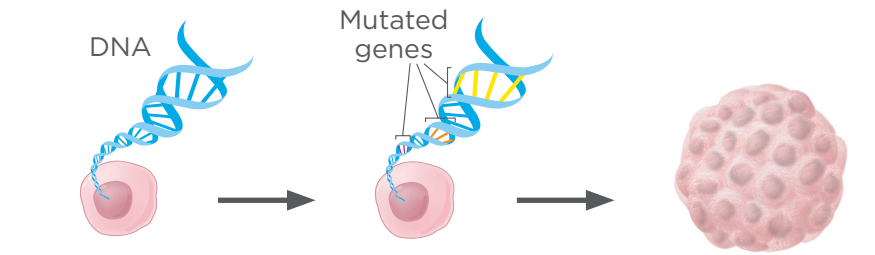
YOU'LL FIND A GLOSSARY TOWARD THE END OF THIS BOOKLET. Words included in the glossary appear **blue** the first time that they are used in the text.

01 understanding lung cancer

What is lung cancer?

Lung cancer is cancer that develops in the tissue of the lungs. Normally, the **cells** in lungs have a specific growth and death cycle that keeps their number in check. Lung cancer develops when changes, called mutations, develop in the **genes** of a previously normal cell, allowing the cell to multiply without limitation. Mutations occur often, and normally the body can correct them. However, depending on where in a cell's gene the change occurred, the small change may go undetected by the body and become part of the cell's blueprint. Over time, an accumulation of mutations can result in the formation of a **tumor**. While there continue to be significant advances in the treatment of lung cancer, lung cancer remains the cancer responsible for more deaths both in the U.S. and globally than any other.

MUTATION



Risk factors for developing lung cancer

As with other cancers, several factors can increase your risk of developing lung cancer:

- **Active exposure to tobacco:** Smoking, either in the form of cigarettes or other forms of tobacco products, such as marijuana or cigars, has been shown to increase the risk of developing lung cancer. Among those newly diagnosed, it is estimated that about 80%–90% are either current or former smokers; the remaining 10%–20% are never-smokers. As of now, there is inadequate evidence to conclude that electronic cigarettes (e-cigarettes), which do not contain tobacco but do contain cancer-causing agents, are associated with an increased risk of developing lung cancer. This is because it will take many years to gather data to clearly show whether there is a link. However, it is highly likely that the harmful effects seen in regular cigarettes will also be seen with e-cigarettes.

Even those who smoke can significantly lower their risk of developing lung cancer by quitting. Although lung cancer risk can't be eliminated, even after many years of nonsmoking, it is never too late to quit. There are health benefits, including more prolonged survival and a lower likelihood of a recurrence of lung cancer, even for those who don't stop smoking until after a lung cancer diagnosis. There are many tobacco cessation programs to help a smoker quit; two such programs are the U.S. government's program at www.smokefree.gov and the American Lung Association's Freedom from Smoking® program at www.lung.org/quit-smoking.

- **Passive exposure to tobacco:** Sometimes referred to as secondhand exposure, passive exposure (for example, exposure to another's cigarette smoke) is another risk factor for lung cancer.
- **Radon:** Radon is a radioactive gas that you cannot see, smell, or taste. It forms naturally in soil and rocks. Radon damages lung cells, and people exposed to radon are at increased risk of lung cancer. Radon may be the second leading cause of lung cancer, and the risk of lung cancer from radon is even higher for smokers. Radon can be present in buildings. Because there is no way to know for sure without testing whether radon is present, the U.S. Environmental Protection Agency (EPA) recommends that people test their homes for radon levels. If a high level is found, there are ways to lower it to make a home safer.
- **Occupational exposure to cancer-causing chemicals (carcinogens):** Certain jobs (such as those in construction and chemical industries) can increase the risk of lung cancer. Exposure to asbestos, arsenic, chromium, nickel, soot, tar, and other substances can cause lung cancer. The risk is highest for those with years of exposure. The risk of lung cancer from these carcinogens is even higher for smokers.

- **Air pollution:** *Outdoor air pollution*, which can include, among other pollutants, diesel fumes, dust, and solvents as well as particulate matter (a mixture of very small solid particles and liquid droplets, such as sulfur dioxide, soot, and many others) may increase the risk of lung cancer. The risk from air pollution is higher for smokers. *Indoor air pollution* is also a risk factor, specifically for those who cook and/or heat their homes with kerosene fuels, coal, and biomass (organic matter used as fuel).
- **Family history of lung cancer:** People with an immediate family member—father, mother, brother, sister, son, or daughter—who have had lung cancer may be at increased risk for developing lung cancer. This is particularly the case when more than one family member is or has been affected by the disease or if a relative was diagnosed at a young age. The increased risk may be due to exposure to the same environmental risk factors, including tobacco smoke, or possibly, in rare cases, an inherited mutation. Several studies are looking at the genetic causes of lung cancer. If you have been diagnosed with lung cancer and have a biological relative who has been diagnosed with lung cancer, you may qualify to participate in the Family Lung Study (https://med2.uc.edu/eh/research/projects/gelcc) at the University of Cincinnati. If you have been diagnosed with lung cancer or have a family member who has been diagnosed with lung cancer, you may qualify to participate in the Louisiana Lung Cancer Study (www.medschool.lsuhsc.edu/lungcancer/) at the Louisiana State University Health Sciences Center in New Orleans. You do not need to be a resident of Cincinnati or Louisiana to participate in these studies.
- **History of lung disease:** Having chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema, or pulmonary fibrosis, which causes scarring in lung tissue, increases lung cancer risk. In both cases, smoking increases the risk further.

- **Diet:** Drinking water from public sources is tested to ensure that the level of arsenic is below that which could cause any adverse effects. However, drinking water from private sources (e.g., wells) should be tested as it may contain a level of arsenic that could increase lung cancer risk.
- **History of prior radiation therapy:** People who have had radiation therapy to the chest for cancers other than lung cancers have a higher risk of developing lung cancer, including those treated for Hodgkin lymphoma and women with breast cancer who were treated with radiation after a mastectomy. Lung cancer may take many years to develop. Note that modern radiation therapy techniques and practices may be able to reduce this risk, but it is still a risk to be discussed with your doctor.

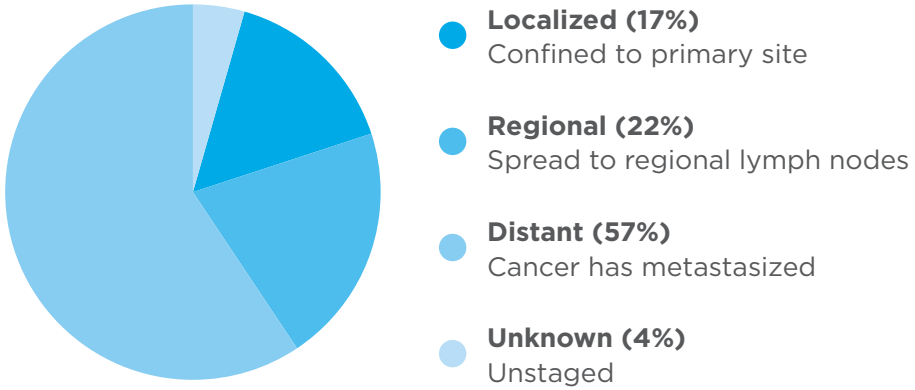
02 screening and early detection of lung cancer

Why is early detection of lung cancer important?

Early detection of lung cancer is defined as strategies that can detect lung cancer at a **stage** where surgery or stereotactic body radiation therapy (SBRT) can be offered with the goal of a cure. There are a number of factors that determine the outlook for any lung cancer patient in addition to when the lung cancer is detected, including the type of lung cancer, the patient's health in general, and the responsiveness of the patient's lung cancer to treatment. However, lung cancer is most easily and effectively treated when it is found at an early stage. Statistically, those with lung cancer caught early on have a much higher likelihood of surviving at least five years after diagnosis than those diagnosed when the lung cancer is more advanced.

However, currently, only 17% of lung cancers are diagnosed while the tumor is still localized—that is, only found at the site where it started. This is commonly referred to as stage I. The major challenge is that most people with lung cancer only have symptoms when they are in later stages of the disease, so lung cancer is not usually suspected and discovered until it has had the chance to grow and spread.

PERCENTAGE OF LUNG CANCER DIAGNOSES BY STAGE



How can lung cancer be detected early?

Lung cancer can be detected early via screening.

Screening for cancer means checking for cancer before there are any symptoms. Examples of commonly used screening tests for cancer are mammograms for breast cancer, colonoscopies for colon cancer, and the Pap smear and human papillomavirus (HPV) tests for cervical cancer.

For lung cancer, early-detection screening by a **low-dose computed tomography (LDCT) scan** (also called low-dose spiral CT scan or helical CT scan) has proven to be effective among individuals

considered to be at high risk. It is also only recommended for these individuals. The usefulness of LDCT in high-risk individuals was demonstrated by the National Lung Screening Trial (NLST) and confirmed by the Nederlands-Leuvens Longkanker Screenings Onderzoek (NELSON) trial.

LDCT is much more sensitive than chest **X-rays** and can detect smaller abnormalities that may be lung cancer. Chest X-rays are not recommended for lung cancer screening because they often miss early-stage lung cancers and have not resulted in decreased **mortality**. This is also the case for **sputum** cytology, a test that checks for abnormal cells in sputum.

The National Lung Screening Trial (NLST) and the NELSON trial

The National Lung Screening Trial (NLST) was funded by the National Institutes of Health (NIH). It used an annual LDCT to screen for lung cancer. Over 53,000 current and former heavy smokers aged 55 to 74 participated at 33 sites across the U.S. Starting in August 2002, participants were recruited over a 20-month period, randomly assigned to receive three annual screens with either an LDCT or a standard chest X-ray, and followed for several years to determine whether an LDCT and an X-ray were equally effective in catching lung cancer early. The study found that those who were screened with an LDCT had a 20% lower chance of dying of lung cancer than those who were screened with a chest X-ray.

More recently, the results of the NELSON trial confirmed that LDCT is effective in reducing lung cancer mortality. The NELSON trial began in 2000, included 15,789 participants, and ended in 2015. All participants were followed up for at least 10 years. The risk of dying of lung cancer decreased by 25% among those who received screening.

Who should be screened for lung cancer?

There are several sets of guidelines, including the ones outlined below, to help determine who should be screened by LDCT for lung cancer. *These guidelines are primarily based on active (current or prior) tobacco exposure*. The guidelines have been established in large part from the results of the National Lung Screening Trial (NLST). They are very similar, with the differences primarily related to the role of screening for the oldest patients and risk factors other than smoking. All of the patients who are recommended for screening are considered to be at high risk for developing lung cancer but do not currently have any symptoms to suggest that they do have lung cancer. Patients should discuss these guidelines with their doctor and understand the risks and benefits before undergoing LDCT screening.

The 2021 guidelines from the **U.S. Preventive Services Task Force (USPSTF)** include annual screening with LDCT in adults who:

- Are aged 50 to 80 years *and*
- Have a 20 pack-year smoking history *and*
- Currently smoke or have quit within the past 15 years

A pack-year is the equivalent of one pack (20 cigarettes) smoked daily for one year. To have a 20 pack-year smoking history, a person could have smoked one pack daily for 20 years, two packs daily for 10 years, or any other combination of daily packs times the number of years that totals 20.

*20 cigarettes

*40 cigarettes

The USPSTF recommends that lung cancer screening stop once an adult:

- Reaches 81 years of age *or*
- Has not smoked in 15 years *or*
- Develops a health problem that substantially limits life expectancy or the ability or willingness to have curative lung surgery

The Centers for Medicare & Medicaid Services (CMS) covers costs associated with lung cancer screening based on the USPSTF criteria.

The guidelines from the **National Comprehensive Cancer Network® (NCCN®)** include an annual screening with LDCT for individuals in two high-risk groups. These are adults who are either:

- Aged 55–77 years *and*
- Have smoked for 30 or more pack-years *and*
- Are current smokers or quit smoking within the past 14 years

or:

- Aged 50 years or older *and*
- Have smoked for 20 or more pack-years *and*
- Have risk factors other than secondhand smoke

The NCCN® guidelines suggest follow-up screening. Usually, the next LDCT will occur after one year, but this depends on the doctor's recommendation based on the screening test results.

The guidelines from the **American College of Chest Physicians® (CHEST®)** include an annual screening with low-dose CT scans in adults who are:

- Aged 55–77 years *and*
- Have smoked 30 pack-years or more *and*
- Either continue to smoke or have quit within the past 15 years

What about screening for those who do not meet the current screening criteria?

Those who do not meet the current screening criteria should speak with their doctor about the current status of their eligibility for screening. Note that health insurance (both government and private) typically does not cover LDCT screening for those who do not meet the USPSTF screening criteria.

The current criteria for lung cancer screening are based on active tobacco exposure. If you feel that you may have been exposed to other risk factors of lung cancer as outlined earlier in this booklet, you may choose to discuss the possibility of screening with your doctor.

03 lung nodules

What is a lung (pulmonary) nodule?

The abnormalities that can be detected by LDCT are known as lung nodules. They may also be referred to as **pulmonary nodules**. Nodules are tissue growths that appear as round or oval-shaped white shadows. Lung nodules are very common, and most are not cancerous. In fact, only about 4% of lung nodules detected by screening are cancerous. What happens if one or more lung nodules are found, and how it is determined whether a lung nodule is cancerous, are discussed in detail in a later section in this booklet.

A nodule is characterized by:

- **Size:** Nodules are measured in millimeters (mm). Many nodules are very small. For example, they are about the size of a pea (typically about 5 mm).
- **Shape:** Lung nodules may have smooth surfaces or have uneven surfaces due to the presence of spicules (spikes or points) or lobules (the appearance of several rounded nodules together). Most often, spiculated or lobulated nodules are cancerous.

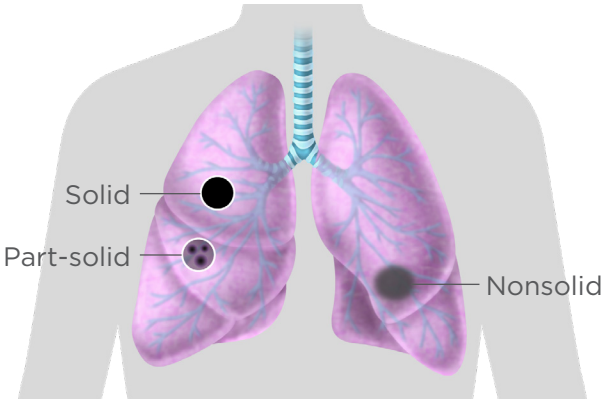
LUNG NODULE SHAPES

Round | Lobulated | Spiculated

- **Density:** Lung nodules are characterized according to how solid or fuzzy—how dense—they appear in an LDCT image. They are characterized as either solid, nonsolid, or part-solid:
  - Solid nodules are the densest and appear similar to the way muscle would appear. Solid nodules are the type most often detected.
  - Nonsolid nodules look the fuzziest. Because of their appearance, they are also referred to as ground-glass nodules. These are considered to be the least likely to be cancerous.
  - Part-solid nodules also have a fuzzy look, but they have both solid and nonsolid (ground-glass) areas. Part-solid nodules are considered to be the most likely to be cancerous.

LUNG NODULE DENSITY

Solid and part-solid nodules are more likely to be cancerous, invasive, and faster growing than nonsolid nodules



What can cause lung nodules to form?

As mentioned earlier, lung nodules are common. There are a number of reasons, in addition to lung cancer, why someone may develop lung nodules. Most lung nodules are, in fact, not cancerous. While lung cancer is one cause of lung nodules, other reasons for lung nodules include:

- **Infections:** Bacterial and fungal infections can cause a nodule in the lung called a granuloma, which is a small cluster of cells that forms after the infection as a result of inflammation. Examples of bacterial infections include mycobacterium (*Mycobacterium tuberculosis* or *Mycobacterium avium-intracellulare).* Examples of fungal infections include histoplasmosis and coccidioidomycosis.
- **Noninfectious causes:** Noninfectious illnesses, such as sarcoidosis—which causes granulomas in the lungs and other parts of the body—and rheumatoid arthritis can also cause lung nodules.
- **Neoplasms:** Neoplasms refer to any abnormal growths; they may be either cancerous or noncancerous. The most common type of benign neoplasm is a **hamartoma**.

04 specifics about lung cancer screening

What to expect during a low-dose CT (LDCT) screening scan

The LDCT scan is a computerized X-ray imaging procedure that yields detailed pictures, or scans, of areas inside the body. Because the scanning produces multiple images from different angles, it can show both two-dimensional (2D) and three-dimensional (3D) images of anything abnormal in the chest. LDCT images show more detail than a traditional X-ray.

LDCT is a painless and noninvasive procedure: the patient needs no dyes or injections and has nothing to swallow.

The LDCT scan itself takes less than a minute. During the procedure, the patient lies very still on the CT table. Depending on the scanner, either the table passes slowly through the center of the scanner or the table stays still while the scanner moves around the patient. There may be whirring sounds during the procedure. At times during

the procedure, the technician operating the equipment will ask the patient to hold their breath; this prevents blurring of the images.

An LDCT can provide very detailed information, including the size, shape, and location of any abnormalities. However, a scan cannot diagnose whether or not an abnormality is cancerous. What happens when a pulmonary nodule is found is discussed in a later section.

WHAT TO EXPECT DURING AN LDCT SCAN

What else to know about lung cancer screening

Despite the benefits of LDCT lung cancer screening, including decreased mortality from lung cancer, decreased mortality from lung cancer treatment, and improved quality of life, there are some drawbacks and risks, including that LDCT may:

- Find abnormalities that have to be checked with either another scan or a **biopsy** if considered suspicious. The vast majority of the time, these end up ***not*** being cancerous.

- Miss very small cancers or cancers that are hidden behind other structures in the chest.
- Expose the patient to a small amount of radiation. While the dose from an LDCT is smaller than that from a standard CT scan, multiple LDCTs can lead to greater radiation exposure. High doses of radiation exposure can lead to other types of cancer in the future.
- Detect tumors that would not become problematic. Such tumors may be indolent (tumors that grow slowly and may not always require treatment).
- Have costs for the patient that are not covered by the patient's insurance.
- Cause stress while waiting for test results.

In addition:

- Not all tumors that are found will be at an early stage.
- Screening can only be done at facilities that can perform an LDCT, so the patient may have to travel to obtain a screening.

It is important to keep in mind that an LDCT can find other abnormal growths in tissues outside the lungs (incidental nonpulmonary findings). These findings need to be followed up on by your doctor or a specialist.

What is shared decision-making? Why is it important for lung cancer screening?

Ideally, the decision to be screened or not should be made together by the patient and the patient's primary care doctor or pulmonologist. The doctor knows the patient's history and possible risk factors best and can help guide the patient to the right screening center. (Some screening centers require a doctor's prescription in advance for a scan. Others will do an evaluation,

also called a risk assessment, without a prescription to determine whether a patient's history and risk factors warrant a scan.) In most cases, before screening is initiated, a face-to-face visit between you and your primary care doctor or pulmonologist is required. During this visit, your doctor will ask you for specific information relating to your current and past cigarette use, and together you will discuss the benefits and harms of CT lung screening and tobacco cessation counseling. This is termed a shared decision-making visit. Information gathered and documented in the office visit notes (medical record) will determine whether you are eligible for an LDCT lung screening program.

Choosing a screening center

The NCCN® recommends going to screening centers that:

- Follow an organized plan that is updated to include new technology and knowledge.
- Have a high-quality screening program with enough staff and resources.
- Are accredited to do CT scans by a certifying organization, such as the **American College of Radiology**.
- Get scans read by an American Board of Radiology board-certified radiologist who is an expert in lung cancer screening.
- Offer modern multislice CT equipment (which is able to take multiple images in one rotation of the equipment) that does high-quality, low-dose, and noncontrast spiral CT scan.
- Partner with a health center that has experience and excellence in biopsy methods, board-certified pulmonologists (lung doctors), and board-certified thoracic surgeons who are experts in lung cancer.

What happens if a lung nodule is detected during lung cancer screening?

An LDCT can detect lung (pulmonary) nodules—small and roundish or oval growths of tissue in the lung that appear white on an LDCT—with great accuracy. However, an LDCT does not indicate whether the nodule is cancerous or not. Pulmonary nodules are associated with infectious and inflammatory diseases as well as lung cancer. As discussed earlier, most pulmonary nodules detected by LDCT are benign, that is, not cancerous.

The first LDCT is known as the baseline screening. All LDCTs after this, known as follow-up screenings, are compared with the baseline screening to determine whether there is a reason to suspect lung cancer. The patient's medical history, the characteristics of the nodule, and how fast the nodule grows determine follow-up care.

Based on whether a lung nodule is detected during the baseline screening, the NCCN® recommends the following:

If **no nodule** is detected at this screening, the next LDCT should be in 12 months, with additional follow-ups every 12 months after that. The doctor will determine how many follow-up screenings the patient needs.

If **one or more nodules** is detected at the baseline screening, additional tests (including a CT and/or a **PET/CT scan** to get a clearer view of the nodules and what is going on throughout the body) or a follow-up LDCT sooner than 12 months may be indicated. The type of follow-up recommended—which test(s) and the timing of follow-up LDCTs—is based on several factors:

- **Size:** The larger the nodule, the sooner the follow-up is likely to be. Nodules with a diameter of 5 mm or less are of the least concern.
- **Density:** Density is how solid the nodule is, as determined by how well the X-rays from the LDCT pass through it. As mentioned, nodules that are solid and part-solid are of more concern for lung cancer than those that are nonsolid.

- **Location:** Nodules that are located in the upper lobes of the lung are more likely to be cancerous.
- **Rate of growth:** Nodules that grow faster are more likely to be cancerous. The growth rate of a nodule can be calculated by looking at the size of the nodule in follow-up scans.
- **Medical history:** The healthcare team considers the presence of risk factors of lung cancer, including age and family history of lung cancer.

If **solid nodules** are detected in the **baseline** scan:

<table>
<tr><th>Size of solid lung nodule</th><th colspan="5">Follow-up needed</th></tr>
<tr><td>5 mm or smaller</td><td colspan="5">LDCT in 12 months</td></tr>
<tr><td>6 to 7 mm</td><td colspan="5">LDCT in 6 months</td></tr>
<tr><td rowspan="3">8 to 14 mm</td><td colspan="5">LDCT in 3 months</td></tr>
<tr><td rowspan="2">Consider getting a PET/CT</td><td>Low concern for lung cancer</td><td colspan="3">LDCT in 3 months</td></tr>
<tr><td>High concern for lung cancer</td><td colspan="3">Biopsy or surgical excision (removal)</td></tr>
<tr><td rowspan="3">15 mm or larger</td><td rowspan="3">Chest CT with contrast and/or PET/CT</td><td>Low concern for lung cancer</td><td colspan="3">LDCT in 3 months</td></tr>
<tr><td rowspan="2">High concern for lung cancer</td><td rowspan="2">Biopsy or surgical excision</td><td>No cancer</td><td>LDCT every 12 months until treatment is not an option</td></tr>
<tr><td>Cancer</td><td>Start treatment</td></tr>
<tr><td>Solid endobronchial nodule</td><td colspan="2">LDCT in 1 month or less (if intense coughing is present)</td><td>No result</td><td colspan="2">Bronchoscopy</td></tr>
</table>

Current as of November 2020

If **part-solid nodules** are detected in the **baseline** scan:

<table>
<tr><th colspan="2">Size of part-solid lung nodule</th><th colspan="5">Follow-up needed</th></tr>
<tr><td colspan="2">5 mm or smaller</td><td colspan="5">LDCT in 12 months</td></tr>
<tr><td rowspan="2">6 mm or larger</td><td>With solid part 5 mm or smaller</td><td colspan="5">LDCT in 6 months</td></tr>
<tr><td>With solid part 6 to 7 mm</td><td colspan="5">LDCT in 3 months or consider getting PET/CT</td></tr>
<tr><td colspan="2" rowspan="3">Solid part 8 mm or larger</td><td rowspan="3">Chest CT with contrast and/or PET/CT</td><td>Low concern for lung cancer</td><td colspan="3">LDCT in 3 months</td></tr>
<tr><td rowspan="2">High concern for lung cancer</td><td rowspan="2">Biopsy or surgical excision</td><td>No cancer</td><td>LDCT every 12 months until treatment is not an option</td></tr>
<tr><td>Cancer</td><td>Start treatment</td></tr>
</table>

Current as of November 2020

If **nonsolid nodules** are detected in the **baseline** scan:

Size of nonsolid lung nodule	Follow-up needed
29 mm or smaller	LDCT in 12 months
30 mm or larger	LDCT in 6 months

Current as of November 2020

If at baseline or at a follow-up LDCT, a nodule's characteristics make it of high concern for lung cancer, either a biopsy or surgical removal of the nodule will be done to confirm whether the nodule is cancerous. If the patient does have lung cancer, further tests may be needed to determine the stage. For early-stage patients, treatment will be surgery or SBRT. For advanced-stage patients, treatment will

begin, ideally after **comprehensive biomarker testing** takes place and a personalized treatment plan is developed.

The American College of Radiology has developed a scoring system called Lung CT Screening Reporting & Data System® (Lung-RADS®) to standardize how results from LDCT scans are reported to reduce confusion in lung cancer screening CT interpretations and improve follow-up CT scans and care.

Category descriptor	Lung-RADS® score
Incomplete	0
Negative: No nodules and definitely benign nodules	1
Benign appearance or behavior: Nodules with a very low likelihood of becoming a clinically active cancer due to size or lack of growth	2
Probably benign: Probably benign finding(s) - short term follow-up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	3
Suspicious: Findings for which additional diagnostic testing is recommended	4A
Very suspicious: Findings for which additional diagnostic testing and/or tissue sampling is recommended	4B
	4X
Other: Clinically significant or potentially clinically significant findings (non-lung cancer)	S

The higher the score, the higher the probability of the nodule being cancerous and requiring follow-up. Not all LDCT results are reported in Lung-RADS® at this time.

Latest research in lung cancer screening

Advances in imaging techniques, such as the LDCT, have improved the chances of finding lung cancer early. Researchers continue to look for other techniques that could help identify lung cancer at an early stage. More sensitive tests that can find evidence of lung cancer in sputum or blood, even before the cancer is seen on a CT scan, are being studied. Research is also being done on whether biomarker testing can identify which patients have a higher risk of lung cancer. There are many **clinical trials**—research studies—underway looking at these approaches to screening as well as others.

For detailed information about clinical trials and the potential benefits and risks of participating in one, download LUNGevity's clinical trial education booklet at www.LUNGevity.org.

If you are considering participating in a clinical trial, start by asking your doctor whether there is one for which you may qualify in your area. In addition, here are several resources to help you find one that may be a good match for you:

RESOURCES TO HELP YOU NAVIGATE YOUR CLINICAL TRIALS SEARCH:

- **LUNGevity Clinical Trial Finder:** https://clinicaltrials.LUNGevity.org/
  - Find available clinical trials by type of lung cancer and geographic location
  - Also find information and links to the medical centers at which these clinical trials are taking place
- **EmergingMed:** https://app.emergingmed.com/lcctal/home
  - LUNGevity partners with this free clinical trials matching service to help you with the decision of whether to participate in a clinical trial; EmergingMed helps you identify lung cancer clinical trials for which you may be eligible
- **National Cancer Institute (NCI):** www.clinicaltrials.gov
- **My Cancer Genome:** www.mycancergenome.org/content/clinical_trials/
  - My Cancer Genome gives up-to-date information on what mutations make cancers grow and related treatment options, including available clinical trials
- **Lung Cancer Master Protocol (Lung-MAP):** www.lung-map.org/
  - For patients with NSCLC, Lung-MAP is a collaboration of many research sites across the country. Lung-MAP uses a unique approach to match patients to one of several drugs being developed

QUESTIONS TO ASK YOUR HEALTHCARE TEAM ABOUT LUNG CANCER SCREENING AND EARLY DETECTION:

- I have no symptoms. Why should I get screened now for lung cancer?
- Will my insurance cover the cost of the screening?
- Where do I go to get screened?
- How do I prepare for a screening?
- Is screening completely safe? Does it hurt?
- How long does it take to get the results?
- Who will explain the results to me?
- What is the next step if any abnormalities are found?
- What are my treatment options if I have a cancerous nodule?

05 glossary

American College of Chest Physicians® (CHEST®)—The professional organization for all chest medicine clinicians, including physicians, nurses, respiratory therapists, and others. Chest medicine includes pulmonology, thoracic (chest) oncology, etc. CHEST® advances best patient outcomes through innovative chest medicine education, clinical research, and team-based care. Their mission is to champion the prevention, diagnosis, and treatment of chest diseases through education, communication, and research

American College of Radiology—The professional organization representing nearly 40,000 diagnostic radiologists, radiation oncologists, interventional radiologists, nuclear medicine physicians, and medical physicists. Its core purpose is to serve patients and society by empowering members to advance the practice, science, and professions of radiological care

Biopsy—The removal of cells or tissues for examination by a pathologist. The pathologist may study the tissue under a microscope or perform other tests on the cells or tissue

Cell—In biology, the smallest unit that can live on its own and that makes up all living organisms and the tissues of the body. A cell has three main parts: the cell membrane, the nucleus, and the cytoplasm. The cell membrane surrounds the cell and controls the substances that go in and out of the cell. The nucleus is a structure inside the cell that contains the nucleolus and most of the cell's DNA

Clinical trial—Type of research study that tests how well new medical approaches work in people. These studies test new methods of screening, prevention, diagnosis, or treatment of a disease. Also called clinical research trial or study

Comprehensive biomarker testing—In lung cancer, analyzing DNA to look for gene mutations that can be treated with targeted therapy drugs and measuring the level of expression of the PD-L1 protein to determine the likelihood of a good response to immunotherapy drugs

Gene—Coded instructions within a cell that control how the cell grows in a systematic and precise way. Genes contain DNA

Hamartoma—A benign (not cancerous) growth made up of an abnormal mixture of cells and tissues normally found in the area of the body where the growth occurs

Low-dose computed tomography (LDCT) scan—A form of CT scan that uses less radiation than a standard chest CT and takes less than one minute to complete. It continuously rotates in a spiral motion and takes several three-dimensional (3D), very detailed X-rays of the lungs. This type of CT uses no dyes and no injections, and requires nothing to swallow by mouth. Also known as low-dose spiral (or helical) CT scan

Mortality—Death rate, or the number of deaths in a certain group of people in a specific period of time. Mortality may be reported for people who have a certain disease, live in one area of the country, or are of a specific gender, age, or ethnic group

National Comprehensive Cancer Network® (NCCN®)—A not-for-profit alliance of 30 leading cancer centers devoted to patient care, research, and education that is dedicated to improving and facilitating quality, effective, efficient, and accessible cancer care so that patients can live better lives. NCCN® offers a number of programs to give clinicians access to tools and knowledge that can help guide decision-making in the management of cancer

PET/CT scan—A special scan that is able to do a positron emission tomography (PET) scan and a computed tomography (CT) scan at the same time. It allows a comparison of areas of radioactivity on the PET scan with the more detailed appearance of that area on the CT. Also called positron emission tomography-computed tomography scan

Pulmonary nodule—A small and roundish or oval growth in the lung

Sputum—Mucus and other matter brought up from the lungs by coughing

Stage—The extent of a cancer in the body. In non-small cell lung cancer (NSCLC), lung cancer stages go from stage 0 to stage IV. The higher the stage, the more advanced the cancer is. In small cell lung cancer (SCLC), the same 0 to IV stages may be used, but most often a system with two stages is used: limited-stage disease and extensive-stage disease

Tumor—An abnormal mass of tissue that results when cells divide more than they should or do not die when they should

U.S. Preventive Services Task Force (USPSTF)—An independent, volunteer panel of national experts in disease prevention and evidence-based medicine. The Task Force works to improve the health of all Americans by making evidence-based recommendations about clinical preventive services. All recommendations are published on the Task Force's website and/or in a peer-reviewed journal

X-ray—A type of radiation used in the diagnosis and treatment of cancer and other diseases. In low doses, X-rays are used to diagnose diseases by making pictures of the inside of the body. In high doses, X-rays are used to treat cancer

06 notes

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