



# Treating Non-Small Cell Lung Cancer

If you've been diagnosed with non-small cell lung cancer (NSCLC), your cancer care team will discuss your treatment options with you. It's important to weigh the benefits of each treatment option against the possible risks and side effects.

## How is non-small cell lung cancer treated?

Treatments for NSCLC can include:

- [Surgery for Non-Small Cell Lung Cancer](#)
- [Radiofrequency Ablation \(RFA\) for Non-Small Cell Lung Cancer](#)
- [Radiation Therapy for Non-Small Cell Lung Cancer](#)
- [Chemotherapy for Non-Small Cell Lung Cancer](#)
- [Targeted Therapy Drugs for Non-Small Cell Lung Cancer](#)
- [Immunotherapy for Non-Small Cell Lung Cancer](#)
- [Palliative Procedures for Non-Small Cell Lung Cancer](#)

## Common treatment approaches

The treatment options for non-small cell lung cancer (NSCLC) are based mainly on the [stage](#) (extent) of the cancer, but other factors, such as a person's overall health and lung function, as well as certain traits of the cancer itself, are also important. In many cases, more than one of type of treatment is used.

- [Treatment Choices for Non-Small Cell Lung Cancer, by Stage](#)

## Who treats non-small cell lung cancer?

You may have different types of doctors on your treatment team, depending on the stage of your cancer and your treatment options. These doctors could include:

- A **thoracic surgeon**: a doctor who treats diseases of the lungs and chest with surgery
- A **radiation oncologist**: a doctor who treats cancer with radiation therapy
- A **medical oncologist**: a doctor who treats cancer with medicines such as chemotherapy, targeted therapy, and immunotherapy
- A **pulmonologist**: a doctor who specializes in medical treatment of diseases of the lungs

Many other specialists may be involved in your care as well, including nurse practitioners, nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

- [Health Professionals Associated With Cancer Care](#)

## **Making treatment decisions**

It's important to discuss all of your treatment options as well as their possible side effects with your family and your treatment team to make the choice that best fits your needs. If there's anything you don't understand, ask to have it explained.

If time permits, it is often a good idea to seek a second opinion. A second opinion can give you more information and help you feel more confident about the treatment plan you choose.

- [What Should You Ask Your Health Care Team About Non-Small Cell Lung Cancer?](#)
- [Seeking a Second Opinion](#)

## **Thinking about taking part in a clinical trial**

Clinical trials are carefully controlled research studies that are done to get a closer look at promising new treatments or procedures. Clinical trials are one way to get state-of-the-art cancer treatment. In some cases they may be the only way to get access to newer treatments. They are also the best way for doctors to learn better methods to treat cancer. Still, they're not right for everyone.

If you would like to learn more about clinical trials that might be right for you, start by asking your doctor if your clinic or hospital conducts clinical trials.

- [Clinical Trials](#)

## **Considering complementary and alternative methods**

You may hear about alternative or complementary methods that your doctor hasn't

mentioned to treat your cancer or relieve symptoms. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

Complementary methods refer to treatments that are used along with your regular medical care. Alternative treatments are used instead of a doctor's medical treatment. Although some of these methods might be helpful in relieving symptoms or helping you feel better, many have not been proven to work. Some might even be dangerous.

Be sure to talk to your cancer care team about any method you are thinking about using. They can help you learn what is known (or not known) about the method, which can help you make an informed decision.

- [Complementary and Alternative Medicine](#)

## **Help getting through cancer treatment**

Your cancer care team will be your first source of information and support, but there are other resources for help when you need it. Hospital- or clinic-based support services are an important part of your care. These might include nursing or social work services, financial aid, nutritional advice, rehab, or spiritual help.

The American Cancer Society also has programs and services – including rides to treatment, lodging, and more – to help you get through treatment. Call our National Cancer Information Center at 1-800-227-2345 and speak with one of our trained specialists.

- [Find Support Programs and Services in Your Area](#)

## **Choosing to stop treatment or choosing no treatment at all**

For some people, when treatments have been tried and are no longer controlling the cancer, it could be time to weigh the benefits and risks of continuing to try new treatments. Whether or not you continue treatment, there are still things you can do to help maintain or improve your quality of life.

Some people, especially if the cancer is advanced, might not want to be treated at all. There are many reasons you might decide not to get cancer treatment, but it's important to talk to your doctors and you make that decision. Remember that even if you choose not to treat the cancer, you can still get supportive care to help with pain or other symptoms.

- [If Cancer Treatments Stop Working](#)

- [Palliative or Supportive Care](#)

*The treatment information given here is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.*

## Surgery for Non-Small Cell Lung Cancer

Surgery to remove the cancer (often along with other treatments) may be an option for early stage non-small cell lung cancer (NSCLC). If surgery can be done, it provides the best chance to cure NSCLC. Lung cancer surgery is a complex operation that can have serious consequences, so it should be done by a surgeon who has a lot of experience operating on lung cancers.

If your doctor thinks the lung cancer can be treated with surgery, pulmonary function tests will be done beforehand to see if you would still have enough healthy lung tissue left after surgery. Other tests will check the function of your heart and other organs to be sure you're healthy enough for surgery.

Because surgery doesn't help more advanced stage lung cancers, your doctor will also want to check if the cancer has already spread to the lymph nodes between the lungs. This is often done just before surgery with mediastinoscopy or with some of the other techniques described in [How Is Non-Small Cell Lung Cancer Diagnosed?](#)

### Types of lung surgery

Different operations can be used to treat (and possibly cure) NSCLC:

- **Pneumonectomy:** This surgery removes an entire lung. This might be needed if the tumor is close to the center of the chest.
- **Lobectomy:** The lungs are made up of 5 lobes (3 on the right and 2 on the left). In this surgery, the entire lobe containing the tumor(s) is removed. This is often the preferred type of operation for NSCLC if it can be done.
- **Segmentectomy or wedge resection:** In these surgeries, only part of a lobe is removed. This approach might be used, for example, if a person doesn't have enough lung function to withstand removing the whole lobe.

- **Sleeve resection:** This operation may be used to treat some cancers in large airways in the lungs. If you think of the large airway with a tumor as similar to the sleeve of a shirt with a stain a couple of inches above the wrist, the sleeve resection would be like cutting across the sleeve above and below the stain and then sewing the cuff back onto the shortened sleeve. A surgeon may be able to do this operation instead of a pneumonectomy to preserve more lung function.

With any of these operations, nearby lymph nodes are also removed to look for possible spread of the cancer. These operations require general anesthesia (where you are in a deep sleep) and are usually done through a surgical incision between the ribs in the side of the chest (called a thoracotomy).

The type of operation your doctor recommends depends on the size and location of the tumor and on how well your lungs are functioning. Doctors often prefer to do a more extensive operation (for example, a lobectomy instead of a segmentectomy) if a person's lungs are healthy enough, as it may provide a better chance to cure the cancer.

When you wake up from surgery, you will have a tube (or tubes) coming out of your chest and attached to a special canister to allow excess fluid and air to drain out. The tube(s) will be removed once the fluid drainage and air leak subside. Generally, you will need to spend 5 to 7 days in the hospital after the surgery.

## **Video-assisted thoracic surgery (VATS)**

Increasingly, doctors now treat early-stage lung cancers in the outer parts of the lung with a procedure called *video-assisted thoracic surgery* (VATS), which requires smaller incisions than a thoracotomy.

During this operation, a thin, rigid tube with a tiny video camera on the end is placed through a small cut in the side of the chest to help the surgeon see inside the chest on a TV monitor. One or two other small cuts are created in the skin, and long instruments are passed through these cuts to do the same operation that would be done using an open approach (thoracotomy). One of the incisions is enlarged if a lobectomy or pneumonectomy is done to allow the specimen to be removed. Because only small incisions are needed, there is usually less pain after the surgery and a shorter hospital stay – typically 4 to 5 days.

Most experts recommend that only early-stage tumors near the outside of the lung be treated this way. The cure rate after this surgery seems to be the same as with surgery done with a larger incision. But it's important that the surgeon doing this procedure is experienced, because it requires a great deal of technical skill.

## Possible risks and side effects of lung surgery

Surgery for lung cancer is a major operation and can have serious side effects, which is why surgery isn't a good idea for everyone. While all surgeries carry some risks, these depend to some degree on the extent of the surgery and the person's health beforehand.

Possible complications during and soon after surgery can include reactions to anesthesia, excess bleeding, blood clots in the legs or lungs, wound infections, and pneumonia. While it is rare, some people may not survive the surgery.

Recovering from lung cancer surgery typically takes weeks to months. If the surgery is done through a thoracotomy (a long incision in the chest), the surgeon must spread ribs to get to the lung, so the area near the incision will hurt for some time after surgery. Your activity might be limited for at least a month or two. People who have VATS instead of thoracotomy tend to have less pain after surgery and to recover more quickly.

If your lungs are in good condition (other than the presence of the cancer) you can usually return to normal activities after some time if a lobe or even an entire lung has been removed. If you also have another lung disease such as emphysema or chronic bronchitis (which are common among long-time smokers), you might become short of breath with certain levels of activity after surgery.

## Surgery for lung cancers with limited spread to other organs

If the lung cancer has spread to your brain or to an adrenal gland and there is only one tumor, you may benefit from having the tumor removed. This surgery should be considered only if the tumor in the lung can also be removed completely. Even then, not all lung cancer experts agree with this approach, especially if the tumor is in the adrenal gland.

For tumors in the brain, this is done by surgery through a hole in the skull (called a *craniotomy*). It should only be done if the tumor can be removed without damaging vital areas of the brain.

For more general information about surgery, see [Cancer Surgery](#).

- [References](#)

[See all references for Non-Small Cell Lung Cancer](#)

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## Radiofrequency Ablation (RFA) for Non-Small Cell Lung Cancer

This treatment might be an option for some people some small lung tumors that are near the outer edge of the lungs, especially if they can't tolerate [surgery](#).

RFA uses high-energy radio waves to heat the tumor. A thin, needle-like probe is put through the skin and moved in until the tip is in the tumor. Placement of the probe is guided by CT scans. Once the tip is in place, an electric current is passed through the probe, which heats the tumor and destroys the cancer cells.

RFA is usually done as an outpatient procedure, using local anesthesia (numbing medicine) where the probe is inserted. You may be given medicine to help you relax as well.

You might have some pain where the needle was inserted for a few days after the procedure. Major complications are uncommon, but they can include the partial collapse of a lung (which often goes away on its own) or bleeding into the lung.

- [References](#)

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## Radiation Therapy for Non-Small Cell

# Lung Cancer

Radiation therapy uses high-energy rays (such as x-rays) or particles to kill cancer cells.

## When might radiation therapy be used?

Depending on the [stage](#) of the non-small cell lung cancer (NSCLC) and other factors, radiation therapy might be used:

- As the main treatment (sometimes along with [chemotherapy](#)), especially if the lung tumor can't be removed because of its size or location, if a person isn't healthy enough for surgery, or if a person doesn't want surgery.
- After surgery (alone or along with chemotherapy) to try to kill any small areas of cancer that surgery might have missed.
- Before surgery (usually along with chemotherapy) to try to shrink a lung tumor to make it easier to operate on.
- To treat a single area of cancer spread, such as a tumor in the brain or an adrenal gland. (This might be done along with surgery to treat the main lung tumor.)
- To relieve (palliate) symptoms of advanced NSCLC such as pain, bleeding, trouble swallowing, cough, or problems caused by spread to other organs such as the brain. For example, brachytherapy is most often used to help relieve blockage of large airways by cancer.

## Types of radiation therapy

There are 2 main types of radiation therapy:

- External beam radiation therapy
- Brachytherapy (internal radiation therapy)

### External beam radiation therapy

External beam radiation therapy (EBRT) focuses radiation from outside the body on the cancer. This is the type of radiation therapy most often used to treat NSCLC or its spread to other organs.



Before your treatments start, the radiation team will take careful measurements to determine the correct angles for aiming the radiation beams and the proper dose of radiation. This planning session, called *simulation*, usually includes getting imaging tests such as CT scans.

Treatment is much like getting an x-ray, but the radiation dose is stronger. The procedure itself is painless. Each treatment lasts only a few minutes, although the setup time – getting you into place for treatment – usually takes longer. Most often, radiation treatments to the lungs are given 5 days a week for 5 to 7 weeks, but this can vary based on the type of EBRT and the reason it's being given.

In recent years, newer EBRT techniques have been shown to help doctors treat lung cancers more accurately while lowering the radiation exposure to nearby healthy tissues. These include:

**Three-dimensional conformal radiation therapy (3D-CRT):** 3D-CRT uses special computers to precisely map the tumor's location. Radiation beams are then shaped and aimed at the tumor(s) from several directions, which makes it less likely to damage normal tissues.

**Intensity modulated radiation therapy (IMRT):** IMRT is an advanced form of 3D therapy. It uses a computer-driven machine that moves around you as it delivers radiation. Along with shaping the beams and aiming them at the tumor from several angles, the intensity (strength) of the beams can be adjusted to limit the dose reaching nearby normal tissues. This technique is used most often if tumors are near important structures such as the spinal cord. Many cancer centers now use IMRT.

A variation of IMRT is called *volumetric modulated arc therapy* (VMAT). It uses a machine that delivers radiation quickly as it rotates once around the body. This allows each treatment to be given over just a few minutes.

**Stereotactic body radiation therapy (SBRT):** SBRT, also known as *stereotactic ablative radiotherapy* (SABR), is sometimes used to treat very early-stage lung cancers when surgery isn't an option due to a person's health or in people who don't want surgery.

Instead of giving a small dose of radiation each day for several weeks, SBRT uses very focused beams of high-dose radiation given in fewer (usually 1 to 5) treatments. Several beams are aimed at the tumor from different angles. To target the radiation precisely, you are put in a specially designed body frame for each treatment. This reduces the movement of the lung tumor during breathing. Like other forms of external radiation, the treatment itself is painless.

Early results with SBRT for smaller lung tumors have been very promising, and it seems to have a low risk of complications. It is also being studied for tumors that have spread to other parts of the body, such as the bones or liver.

**Stereotactic radiosurgery (SRS):** SRS is a type of stereotactic radiation therapy that is given in only one session. It can sometimes be used instead of or along with surgery for single tumors that have spread to the brain. In one version of this treatment, a machine called a Gamma Knife<sup>®</sup> focuses about 200 beams of radiation on the tumor from different angles over a few minutes to hours. Your head is kept in the same position with a rigid frame. In another version, a linear accelerator (a machine that creates radiation) that is controlled by a computer moves around your head to deliver radiation to the tumor from many different angles. These treatments can be repeated if needed.

## **Brachytherapy (internal radiation therapy)**

In people with NSCLC, brachytherapy is sometimes used to shrink tumors in the airway to relieve symptoms.

For this type of treatment, the doctor places a small source of radioactive material (often in the form of small pellets) directly into the cancer or into the airway next to the cancer. This is usually done through a bronchoscope, but it may also be done during surgery. The radiation travels only a short distance from the source, limiting the effects on surrounding healthy tissues. The radiation source is usually removed after a short time. Less often, small radioactive “seeds” are left in place permanently, and the radiation gets weaker over several weeks.

## **Possible side effects of radiation therapy**

If you are going to get radiation therapy, it's important to ask your doctor beforehand about the possible side effects so you know what to expect. Common side effects depend on where the radiation is aimed and can include:

- [Fatigue](#)
- [Nausea and vomiting](#)
- Loss of appetite and weight loss
- Skin changes in the area being treated, which can range from mild redness to blistering and peeling
- Hair loss where the radiation enters the body

Often these go away after treatment. When radiation is given with chemotherapy, the side effects are often worse.

Radiation therapy to the chest may damage your lungs and cause a cough, problems breathing, and shortness of breath. These usually improve after treatment is over, although sometimes they may not go away completely.

Your esophagus, which is in the middle of your chest, may be exposed to radiation, which could cause a sore throat and trouble swallowing during treatment. This might make it hard to eat anything other than soft foods or liquids for a while. This also improves after completion of treatment.

Radiation therapy to large areas of the brain can sometimes cause memory loss, headaches, trouble thinking, or reduced sexual desire. Usually these symptoms are minor compared with those caused by a brain tumor, but they can affect your quality of life.

For more information, see [Radiation Therapy](#).

- [References](#)

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# Chemotherapy for Non-Small Cell Lung Cancer

Chemotherapy (chemo) is treatment with anti-cancer drugs injected into a vein or taken by mouth. These drugs enter the bloodstream and go throughout the body, making this treatment useful for cancer anywhere in the body.

## When might chemotherapy be used?

Depending on the [stage](#) of non-small cell lung cancer (NSCLC) and other factors, chemo may be used in different situations:

- Before [surgery](#) (sometimes along with [radiation therapy](#)) to try to shrink a tumor. This is known as *neoadjuvant therapy*.
- After surgery (sometimes along with radiation therapy) to try to kill any cancer cells that might have been left behind. This is known as *adjuvant therapy*.
- Along with radiation therapy (concurrent therapy) for some cancers that can't be removed by surgery because the cancer has grown into nearby important structures
- As the main treatment (sometimes along with radiation therapy) for more advanced cancers or for some people who aren't healthy enough for surgery.

Chemo is often not recommended for patients in poor health, but advanced age by itself is not a barrier to getting chemo.

## Drugs used to treat NSCLC

The chemo drugs most often used for NSCLC include:

- Cisplatin
- Carboplatin
- Paclitaxel (Taxol)
- Albumin-bound paclitaxel (nab-paclitaxel, Abraxane)
- Docetaxel (Taxotere)
- Gemcitabine (Gemzar)
- Vinorelbine (Navelbine)
- Irinotecan (Camptosar)
- Etoposide (VP-16)
- Vinblastine
- Pemetrexed (Alimta)

Most often, treatment for NSCLC uses a combination of 2 chemo drugs. Studies have shown that adding a third chemo drug doesn't add much benefit and is likely to cause more side effects. Single-drug chemo is sometimes used for people who might not tolerate combination chemotherapy well, such as those in poor overall health or who are elderly.

If a combination is used, it often includes cisplatin or carboplatin plus one other drug. Sometimes combinations that do not include these drugs, such as gemcitabine with vinorelbine or paclitaxel, may be used.

For people with advanced lung cancers who meet certain criteria, a [targeted therapy](#) drug such as bevacizumab (Avastin), ramucirumab (Cyramza), or necitumumab (Portrazza) may be added to treatment as well.

Doctors give chemo in cycles, with a period of treatment (usually 1 to 3 days) followed by a rest period to allow the body time to recover. Some chemo drugs, though, are given every day. Chemo cycles generally last about 3 to 4 weeks.

For advanced cancers, the initial chemo combination is often given for 4 to 6 cycles. Some doctors now recommend giving treatment beyond this with a single chemo or targeted drug, even in people who have had a good response to their initial chemotherapy. Some studies have found that this continuing treatment, known as *maintenance therapy*, might help keep the cancer in check and help some people live longer. For more information, see [What's New in Non-Small Cell Lung Cancer Research?](#)

If the initial chemo treatment for advanced lung cancer is no longer working, the doctor may recommend second-line treatment with a single chemo drug such as docetaxel or pemetrexed, or with a [targeted therapy](#) or immunotherapy drug. Again, advanced age is no barrier to receiving these drugs as long as the person is in good general health.

## Possible side effects

Chemo drugs attack cells that are dividing quickly, which is why they work against cancer cells. But other cells in the body, such as those in the bone marrow (where new blood cells are made), the lining of the mouth and intestines, and the hair follicles, also divide quickly. These cells are also likely to be affected by chemo, which can lead to certain side effects.

The side effects of chemo depend on the type and dose of drugs given and how long they are taken. Some common side effects include:

- Hair loss
- Mouth sores
- Loss of appetite
- [Nausea and vomiting](#)
- Diarrhea or constipation
- Increased chance of [infections](#) (from having too few white blood cells)
- Easy bruising or bleeding (from having too few blood platelets)
- [Fatigue](#) (from having too few red blood cells)

These side effects usually go away after treatment is finished. There are often ways to lessen these side effects. For example, drugs can be given to help prevent or reduce nausea and vomiting.

Some drugs can have specific side effects. For example, drugs such as cisplatin, vinorelbine, docetaxel, or paclitaxel can cause nerve damage (*peripheral neuropathy*). This can sometimes lead to symptoms (mainly in the hands and feet) such as pain, burning or tingling sensations, sensitivity to cold or heat, or weakness. In most people this goes away or gets better once treatment is stopped, but it may last a long time in some people. For more information, see [Peripheral Neuropathy Caused by Chemotherapy](#).

Be sure to report any side effects you notice while getting chemo to your medical team so that they can be treated promptly. In some cases, the doses of the chemo drugs may need to be reduced or treatment may need to be delayed or stopped to prevent the effects from getting worse.

To learn more, see [Chemotherapy](#).

- [References](#)

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## Targeted Therapy Drugs for Non-Small Cell Lung Cancer

As researchers have learned more about the changes in non-small cell lung cancer (NSCLC) cells that help them grow, they have developed newer drugs to specifically target these changes. Targeted drugs work differently from standard [chemotherapy](#) (chemo) drugs. They sometimes work when chemo drugs don't, and they often have different (and less severe) side effects. At this time, they are most often used for advanced lung cancers, either along with chemo or by themselves.

### Drugs that target tumor blood vessel growth (angiogenesis)

For tumors to grow, they need to form new blood vessels to keep them nourished. This process is called *angiogenesis*. Some targeted drugs, called *angiogenesis inhibitors*, block this new blood vessel growth:

- **Bevacizumab (Avastin)** is used to treat advanced NSCLC. It is a monoclonal antibody (a man-made version of a specific immune system protein) that targets vascular endothelial growth factor (VEGF), a protein that helps new blood vessels to form. This drug is often used with chemo for a time. Then if the cancer responds, the chemo may be stopped and the bevacizumab given by itself until the cancer starts growing again.
- **Ramucirumab (Cyramza)** can also be used to treat advanced NSCLC. VEGF has to bind to cell proteins called *receptors* to act. This drug is a monoclonal antibody that targets a VEGF receptor. This helps stop the formation of new blood vessels. This drug is most often given after another treatment stops working. It is often combined with chemo.

## Side effects

**Common side effects** of these drugs include:

- High blood pressure
- [Tiredness](#) (fatigue)
- Bleeding
- [Low white blood cell counts](#) (with increased risk of infections)
- Headaches
- Mouth sores
- Loss of appetite
- Diarrhea

**Rare but possibly serious side effects** can include blood clots, severe bleeding, holes (called *perforations*) forming in the intestine, heart problems, and slow wound healing. If a hole forms in the intestine it can lead to severe infection and may require surgery to correct.

Because of the risks of bleeding, these drugs typically aren't used in people who are coughing up blood or who are taking drugs called blood thinners. The risk of serious bleeding in the lungs is higher in patients with the squamous cell type of NSCLC, which is why most current guidelines do not recommend using bevacizumab in people with this type of lung cancer.

## Drugs that target cells with EGFR changes

Epidermal growth factor receptor (EGFR) is a protein on the surface of cells. It normally helps the cells grow and divide. Some NSCLC cells have too much EGFR, which makes them grow faster. Drugs called *EGFR inhibitors* can block the signal from EGFR that tells the cells to grow. Some of these drugs can be used to treat NSCLC.

### EGFR inhibitors used in NSCLC with *EGFR* gene mutations

- Erlotinib (Tarceva)
- Afatinib (Gilotrif)
- Gefitinib (Iressa)
- Osimertinib (Tagrisso)
- Dacomitinib (Vizimpro)

These drugs can be used alone (without chemo) as the first treatment for advanced NSCLCs that have certain mutations in the *EGFR* gene. These are more common in women and people who haven't smoked. Erlotinib can also be used for advanced NSCLC without these mutations if chemo isn't working. All of these medicines are taken as pills.

### EGFR inhibitors that also target cells with the T790M mutation

EGFR inhibitors can often shrink tumors for several months or more. But eventually these drugs stop working for most people, usually because the cancer cells develop another mutation in the *EGFR* gene. One such mutation is known as T790M.

**Osimertinib (Tagrisso)** is an EGFR inhibitor that works against cells with the T790M mutation.

Doctors now commonly get another tumor biopsy when EGFR inhibitors have stopped working to see if the patient has developed the T790M mutation.

### EGFR inhibitors used for squamous cell NSCLC

**Necitumumab (Portrazza)** is a monoclonal antibody (a man-made version of an immune system protein) that targets EGFR. It can be used along with chemotherapy as the first treatment in people with advanced squamous cell NSCLC. This drug is given as an infusion into a vein (IV).

### Side effects



**Common side effects** of all EGFR inhibitors include:

- Skin problems
- Diarrhea
- Mouth sores
- Loss of appetite

Skin problems can include an acne-like rash on the face and chest, which in some cases can lead to skin infections. For more detailed information on the skin problems that can result from anti-EGFR drugs, see [Targeted Therapy](#).

These drugs can also cause more serious, but less common, side effects. For example, necitumumab can lower the levels of certain minerals in the blood, which can affect the heart rhythm and in some cases might be life-threatening.

## **Drugs that target cells with ALK gene changes**

About 5% of NSCLCs have a rearrangement in a gene called *ALK*. This change is most often seen in non-smokers (or light smokers) who have the adenocarcinoma subtype of NSCLC. The *ALK* gene rearrangement produces an abnormal ALK protein that causes the cells to grow and spread. Drugs that target the abnormal ALK protein include:

- **Crizotinib (Xalkori)**
- **Ceritinib (Zykadia)**
- **Alectinib (Alecensa)**
- **Brigatinib (Alunbrig)**

These drugs can often shrink tumors in people whose lung cancers have the *ALK* gene change. Although they can help after chemo has stopped working, they are often used instead of chemo in people whose cancers have the *ALK* gene rearrangement.

At least some of these drugs also seem to be useful in treating people whose cancers have changes in the *ROS1* gene.

These drugs are taken as pills.

### **Side effects**

**Common side effects** of ALK inhibitors include:

- [Nausea and vomiting](#)

- Diarrhea
- Constipation
- [Fatigue](#)
- Changes in vision

**Other side effects** are also possible. Some side effects can be severe, such as low white blood cell counts, lung inflammation, liver damage, and heart rhythm problems.

## Drugs that target cells with BRAF gene changes

In some NSCLCs, the cells have changes in the *BRAF* gene. Cells with these changes make an altered BRAF protein that helps them grow. Some drugs target this and related proteins:

- **Dabrafenib (Tafinlar)** is a type of drug known as a *BRAF inhibitor*, which attacks the BRAF protein directly.
- **Trametinib (Mekinist)** is known as a *MEK inhibitor*, because it attacks the related MEK proteins.

These drugs can be used together to treat metastatic NSCLC if it has a certain type of *BRAF* gene change.

These drugs are taken as pills or capsules each day.

### Side effects

**Common side effects** can include skin thickening, rash, itching, sensitivity to the sun, headache, fever, joint pain, fatigue, hair loss, nausea, and diarrhea.

Less common but serious side effects can include bleeding, heart rhythm problems, liver or kidney problems, lung problems, severe allergic reactions, severe skin or eye problems, and increased blood sugar levels.

Some people treated with these drugs develop skin cancers, especially [squamous cell skin cancers](#). Your doctor will want to check your skin often during treatment and for several months afterward. You should also let your doctor know right away if you notice any new growths or abnormal areas on your skin.

- [References](#)

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# Immunotherapy for Non-Small Cell Lung Cancer

Immunotherapy is the use of medicines to stimulate a person's own immune system to recognize and destroy cancer cells more effectively. Immunotherapy can be used to treat some forms of non-small cell lung cancer (NSCLC).

## Immune checkpoint inhibitors

An important part of the immune system is its ability to keep itself from attacking normal cells in the body. To do this, it uses “checkpoints” – molecules on immune cells that need to be turned on (or off) to start an immune response. Cancer cells sometimes use these checkpoints to avoid being attacked by the immune system. But newer drugs that target these checkpoints hold a lot of promise as cancer treatments.

- **Nivolumab (Opdivo)** and **pembrolizumab (Keytruda)** target PD-1, a protein on immune system cells called *T cells* that normally helps keep these cells from attacking other cells in the body. By blocking PD-1, these drugs boost the immune response against cancer cells. This can shrink some tumors or slow their growth.
- **Atezolizumab (Tecentriq)** targets PD-L1, a protein related to PD-1 that is found on some tumor cells and immune cells. Blocking this protein can also help boost the immune response against cancer cells.

Nivolumab, pembrolizumab and atezolizumab can be used in people with certain types of NSCLC whose cancer starts growing again after chemotherapy or other drug treatments. Pembrolizumab can also be used as the first treatment in some people, either along with or instead of [chemo](#).

- **Durvalumab (Imfinzi)** also targets the PD-L1 protein. This drug is used a little differently than the other immunotherapy drugs. It is used in people with certain types of NSCLC whose cancer has **not** gotten worse after they have already

received chemotherapy along with radiation (chemoradiation). The goal of treatment with this drug is to keep the cancer from getting worse for as long as possible.

These immunotherapy drugs are given as an intravenous (IV) infusion every 2 or 3 weeks.

## **Possible side effects**

Side effects of these drugs can include fatigue, cough, nausea, itching, skin rash, loss of appetite, constipation, joint pain, and diarrhea.

Other, more serious side effects occur less often. These drugs work by basically removing the brakes on the body's immune system. Sometimes the immune system starts attacking other parts of the body, which can cause serious or even life-threatening problems in the lungs, intestines, liver, hormone-making glands, kidneys, or other organs.

It's very important to report any new side effects to your health care team promptly. If serious side effects do occur, treatment may need to be stopped and you may get high doses of corticosteroids to suppress your immune system.

- [References](#)

[See all references for Non-Small Cell Lung Cancer](#)

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# **Palliative Procedures for Non-Small Cell Lung Cancer**

Palliative, or supportive care, is aimed at relieving symptoms and improving a person's quality of life.

People with lung cancer often benefit from procedures to help with problems caused by

the cancer. For example, people with advanced lung cancer can have shortness of breath. This can be caused by a number of things, including fluid around the lung or an airway that is blocked by a tumor. Although treating the cancer with [chemotherapy](#) or other drugs may help with this, other treatments may be needed as well.

## Treating fluid buildup in the area around the lungs

Sometimes fluid can build up in the chest outside of the lungs. This is called a *pleural effusion*. It can press on the lungs and cause trouble breathing.

### Thoracentesis

This is done to drain the fluid. For this procedure, the doctor will numb an area in the chest, and then place a hollow needle into the space between the lungs and the ribs to drain the fluid. This is often done using ultrasound to guide the needle into the fluid.

### Pleurodesis

This procedure might be done to remove the fluid and keep it from coming back.

One way to do this is to make a small cut in the skin of the chest wall, and place a hollow tube (called a chest tube) into the chest to remove the fluid. Then a substance is instilled into the chest through the tube that causes the linings of the lung (visceral pleura) and chest wall (parietal pleura) to stick together, sealing the space and limiting further fluid buildup. A number of substances can be used for this, such as talc, the antibiotic doxycycline, or a chemotherapy drug like bleomycin. The tube is often left in for a couple of days to drain any new fluid that might collect.

Another way to do this is to blow talc into the space around the lungs during an operation. This is done through a small incision using thoracoscopy.

### Catheter placement

This is another way to control the buildup of fluid. One end of the catheter (a thin, flexible tube) is placed in the chest through a small cut in the skin, and the other end is left outside the body. This is done in a doctor's office or hospital. Once in place, the catheter can be attached to a special bottle or other device to allow the fluid to drain out on a regular basis.

## Treating fluid buildup around the heart

Lung cancer can sometimes spread to the area around the heart. This can lead to fluid buildup inside the sac around the heart (called a *pericardial effusion*). The fluid can press on the heart, affecting how well it works.

### Pericardiocentesis

In this procedure, the fluid is drained with a needle placed into the space around the heart. This is usually done using an ultrasound of the heart (echocardiogram) to guide the needle.

### Creating a pericardial window

This procedure can be done to keep the fluid from building up again. During surgery, a piece of the sac around the heart (the pericardium) is removed to allow the fluid to drain into the chest or belly.

## Treating an airway blocked by a tumor

If the cancer is growing into an airway in the lung, it can block the airway and cause problems like pneumonia or shortness of breath. Treatments can often relieve the blockage in the airway.

### Photodynamic therapy (PDT)

This type of treatment can be used to treat very early-stage lung cancers that are only in the outer layers of the lung airways, when other treatments aren't appropriate. It can also be used to help open up airways blocked by tumors to help people breathe better.

For this technique, a light-activated drug called porfimer sodium (Photofrin) is injected into a vein. This drug collects more in cancer cells than in normal cells. After a couple of days (to give the drug time to build up in the cancer cells), a bronchoscope is passed down the throat and into the lung. This may be done with either local anesthesia (where the throat is numbed) and sedation, or with general anesthesia (where you are in a deep sleep). A special laser light on the end of the bronchoscope is aimed at the tumor, which activates the drug and causes the cells to die. The dead cells are then removed a few days later during a bronchoscopy. This process can be repeated if needed.

PDT can cause swelling in the airway for a few days, which may lead to some shortness of breath, as well as coughing up blood or thick mucus. Some of this drug also collects in normal cells in the body, such as skin and eye cells. This can make you very sensitive to sunlight or strong indoor lights. Too much exposure can cause serious skin reactions (like a severe sunburn), so doctors recommend staying out of any strong light for several weeks after the injection.

For more information on PDT, see [Photodynamic Therapy](#).

## Laser therapy

Lasers can sometimes be used to treat very small tumors in the linings of airways. They can also be used to help open up airways blocked by larger tumors to help people breathe better.

You are usually asleep (under general anesthesia) for this type of treatment. The laser is on the end of a bronchoscope, which is passed down the throat and next to the tumor. The doctor then aims the laser beam at the tumor to burn it away. This treatment can usually be repeated, if needed.

## Stent placement

If a lung tumor has grown into an airway and is causing problems, sometimes a hard silicone or metal tube called a *stent* is placed in the airway to help keep it open using a bronchoscope. This is often done after other treatments such as PDT or laser therapy.

- [References](#)

[See all references for Non-Small Cell Lung Cancer](#)

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# Treatment Choices for Non-Small Cell Lung Cancer, by Stage

The treatment options for non-small cell lung cancer (NSCLC) are based mainly on the [stage](#) (extent) of the cancer, but other factors, such as a person's overall health and lung function, as well as certain traits of the cancer itself, are also important.

If you smoke, one of the most important things you can do to be ready for treatment is to [try to quit](#). Studies have shown that patients who stop smoking after a diagnosis of lung cancer tend to have better outcomes than those who don't.

## Treating occult cancer

For these cancers, malignant cells are seen on sputum cytology but no obvious tumor can be found with bronchoscopy or imaging tests. They are usually early-stage cancers. Bronchoscopy and possibly other tests are usually repeated every few months to look for a tumor. If a tumor is found, treatment will depend on the stage.

## Treating stage 0 NSCLC

Because stage 0 NSCLC is limited to the lining layer of airways and has not invaded deeper into the lung tissue or other areas, it is usually curable by surgery alone. No chemotherapy or radiation therapy is needed.

If you are healthy enough for [surgery](#), you can usually be treated by segmentectomy or wedge resection (removal of part of the lobe of the lung). Cancers in some locations (such as where the windpipe divides into the left and right main bronchi) may be treated with a sleeve resection, but in some cases they may be hard to remove completely without removing a lobe (lobectomy) or even an entire lung (pneumonectomy).

In some cases, treatments such as photodynamic therapy (PDT), laser therapy, or brachytherapy (internal radiation) may be alternatives to surgery for stage 0 cancers. If your cancer is truly stage 0, these treatments should cure you.

## Treating stage I NSCLC

If you have stage I NSCLC, [surgery](#) may be the only treatment you need. This may be done either by taking out the lobe of the lung containing the tumor (lobectomy) or by taking out a smaller piece of the lung (sleeve resection, segmentectomy, or wedge resection). At least some lymph nodes within the lung and in the space between the lungs will also be removed and checked for cancer cells.



Segmentectomy or wedge resection is generally an option only for very small stage I cancers and for patients with other health problems that make removing the entire lobe dangerous. Still, most surgeons believe it is better to do a lobectomy if the patient can tolerate it, as it offers the best chance for cure.

For people with stage I NSCLC that has a higher risk of coming back (based on size, location, or other factors), adjuvant [chemotherapy](#) after surgery may lower the risk that cancer will return. But doctors aren't always sure how to determine which people are likely to be helped by chemo. New lab tests that look at the patterns of certain genes in the cancer cells may help with this. Studies are now being done to see if these tests are accurate.

After surgery, the removed tissue is checked to see if there are cancer cells at the edges of the surgery specimen (called *positive margins*). This could mean that some cancer has been left behind, so a second surgery might be done to try to ensure that all the cancer has been removed. (This might be followed by chemotherapy as well.) Another option might be to use [radiation therapy](#) after surgery.

If you have serious health problems that prevent you from having surgery, you may get stereotactic body radiation therapy (SBRT) or another type of radiation therapy as your main treatment. Radiofrequency ablation (RFA) may be another option if the tumor is small and in the outer part of the lung.

## Treating stage II NSCLC

People who have stage II NSCLC and are healthy enough for [surgery](#) usually have the cancer removed by lobectomy or sleeve resection. Sometimes removing the whole lung (pneumonectomy) is needed.

Any lymph nodes likely to have cancer in them are also removed. The extent of lymph node involvement and whether or not cancer cells are found at the edges of the removed tissues are important factors when planning the next step of treatment.

In some cases, [chemotherapy](#) (often along with [radiation](#)) may be recommend before surgery to try to shrink the tumor to make the operation easier.

After surgery, the removed tissue is checked to see if there are cancer cells at the edges of the surgery specimen (called *positive margins*). This might mean that some cancer has been left behind, so a second surgery might be done to try to remove any remaining cancer. This may be followed by chemotherapy (chemo). Another option is to treat with radiation, sometimes along with chemo.

Even if positive margins are not found, chemo is usually recommended after surgery to try to destroy any cancer cells that might have been left behind. As with stage I cancers, newer lab tests now being studied may help doctors find out which patients need this adjuvant treatment and which are less likely to benefit from it.

If you have serious medical problems that would keep you from having surgery, you may get only radiation therapy as your main treatment.

## Treating stage IIIA NSCLC

Treatment for stage IIIA NSCLC may include some combination of [radiation therapy](#), [chemotherapy](#) (chemo), and/or [surgery](#). For this reason, planning treatment for stage IIIA NSCLC often requires input from a medical oncologist, radiation oncologist, and a thoracic surgeon. Your treatment options depend on the size of the tumor, where it is in your lung, which lymph nodes it has spread to, your overall health, and how well you are tolerating treatment.

For patients who can tolerate it, treatment usually starts with chemo, often combined with radiation therapy. Surgery may be an option after this if the doctor thinks any remaining cancer can be removed and the patient is healthy enough. (In some cases, surgery may be an option as the first treatment.) This is often followed by chemo, and possibly radiation therapy if it hasn't been given before.

For people who are not healthy enough for surgery, radiation therapy, which may be combined with chemo, is often used.

## Treating stage IIIB NSCLC

Stage IIIB NSCLC has spread to lymph nodes that are near the other lung or in the neck, and may also have grown into important structures in the chest. These cancers can't be removed completely by [surgery](#). As with other stages of lung cancer, treatment depends on the patient's overall health. If you are in fairly good health you may be helped by [chemotherapy](#) (chemo) combined with [radiation therapy](#). Some people can even be cured with this treatment. Patients who are not healthy enough for this combination are often treated with radiation therapy alone, or, less often, chemo alone.

These cancers can be hard to treat, so taking part in a [clinical trial](#) of newer treatments may be a good option for some people.

## Treating stage IV NSCLC

Stage IV NSCLC is widespread when it is diagnosed. Because these cancers have spread to distant sites, they are very hard to cure. Treatment options depend on where the cancer has spread, the number of tumors, and your overall health.

If you are in otherwise good health, treatments such as [surgery](#), [chemotherapy](#) (chemo), [targeted therapy](#), [immunotherapy](#), and [radiation therapy](#) may help you live longer and make you feel better by relieving symptoms, even though they aren't likely to cure you.

Other treatments, such as photodynamic therapy (PDT) or laser therapy, may also be used to [help relieve symptoms](#). In any case, if you are going to be treated for advanced NSCLC, be sure you understand the goals of treatment before you start.

### Cancer that has spread to only one other site

Cancer that is limited in the lungs and has only spread to one other site (such as the brain) is not common, but it can sometimes be treated (and even potentially cured) with surgery and/or radiation therapy to treat the area of cancer spread, followed by treatment of the cancer in the lung. For example, a single tumor in the brain may be treated with surgery or stereotactic radiation, followed by radiation to the whole brain. Treatment for the lung tumor is then based on its T and N stages, and may include surgery, chemo, radiation, or some of these in combination.

### Cancer that has spread widely

For cancers that have spread widely throughout the body, before any treatments start, your tumor will be tested for common gene mutations (such as in the *EGFR*, *ALK*, *ROS1*, or *BRAF* genes). If one of these genes is mutated in your cancer cells, your first treatment will likely be a [targeted therapy](#) drug:

- For tumors that have the *ALK* gene change, an ALK inhibitor like crizotinib (Xalkori), ceritinib (Zykadia), or alectinib (Alecensa) can often be the first treatment. Other ALK inhibitors, such as brigatinib (Alunbrig), can be used if crizotinib stops working or is not well tolerated.
- For people whose cancers have certain changes in the *EGFR* gene, the anti-EGFR drugs erlotinib (Tarceva), gefitinib (Iressa), afatinib (Gilotrif), or dacomitinib (Vizimpro) may be used as the first treatment.

- For people whose cancers have changes in the *ROS1* gene, an ALK inhibitor such as crizotinib might be used.
- For people whose cancers have a certain change in the *BRAF* gene, a combination of the targeted drugs dabrafenib (Tafinlar) and trametinib (Mekinist) might be used.

Your tumor cells might also be tested for the PD-L1 protein. Tumors with higher levels of PD-L1 are more likely to respond to certain [immunotherapy](#) drugs, so treatment with pembrolizumab (Keytruda) might be an option as the first treatment.

For most other cancers that have spread, [chemo](#) is usually at least part of the main treatment, as long as the person is healthy enough for it. Sometimes it might be used along with other types of drugs:

- The immunotherapy drug **pembrolizumab** might be used along with chemo in people who *do not* have the [squamous cell type](#) of NSCLC.
- For people who are not at high risk for bleeding (that is, they do not have squamous cell NSCLC and have not coughed up blood), the targeted drug **bevacizumab (Avastin)** might be given with chemo. Some people with squamous cell cancer might still be given bevacizumab, as long as the tumor is not near large blood vessels in the center of the chest. If bevacizumab is used, it is often continued even after chemo is finished.
- An option for people with squamous cell NSCLC is to get chemo along with the targeted drug **nectinimumab (Portrazza)**.

If the cancer has caused fluid buildup in the space around the lungs (a malignant pleural effusion), the fluid may be drained. If it keeps coming back, options include pleurodesis or placement of a catheter into the chest through the skin to let the fluid drain out. (Details of these are discussed in [Palliative Procedures for Non-Small Cell Lung Cancer](#).)

As with other stages, treatment for stage IV lung cancer depends on a person's overall health. For example, some people not in good health might get only 1 chemo drug instead of 2. For people who can't have chemo, radiation therapy is usually the treatment of choice. Local treatments such as laser therapy, PDT, or stent placement may also be used to help relieve symptoms caused by lung tumors.

Because treatment is unlikely to cure these cancers, taking part in a clinical trial of newer treatments may be a good option.

You can also find more information about living with stage IV cancer in [Advanced Cancer](#).

## Cancer that progresses or recurs after treatment

If cancer continues to grow during treatment (progresses) or comes back (recurs), further treatment will depend on the location and extent of the cancer, what treatments have been used, and on the person's health and desire for more treatment. It's important to understand the goal of any further treatment – if it is to try to cure the cancer, to slow its growth, or to help relieve symptoms – as well as the likelihood of benefits and risks.

If cancer continues to grow during initial treatment such as [radiation therapy](#), [chemotherapy](#) (chemo) may be tried. If a cancer continues to grow during chemo as the first treatment, second line treatment most often consists of a single chemo drug such as docetaxel or pemetrexed, the [targeted therapy](#) erlotinib (Tarceva), or chemo plus a targeted drug like ramucirumab (Cyramza). If a targeted drug was the first treatment and is no longer working, another targeted drug or combination chemo might be tried. For some people with certain types of NSCLC, treatment with an immunotherapy drug such as nivolumab (Opdivo), pembrolizumab (Keytruda), or atezolizumab (Tecentriq) might be an option.

Smaller cancers that recur locally in the lungs can sometimes be retreated with surgery or radiation therapy (if it hasn't been used before). Cancers that recur in the lymph nodes between the lungs are usually treated with chemo, possibly along with radiation if it hasn't been used before. For cancers that return at distant sites, chemo, targeted therapies, and/or immunotherapy are often the treatments of choice.

For more on dealing with a recurrence, see [Understanding Recurrence](#)

In some people, the cancer may never go away completely. These people may get regular treatments with chemo, radiation therapy, or other therapies to try to help keep the cancer in check. Learning to live with cancer that does not go away can be difficult and very stressful. It has its own type of uncertainty. [Managing Cancer as a Chronic Illness](#) talks more about this.

*The treatment information here is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.*

- [References](#)

[See all references for Non-Small Cell Lung Cancer](#)

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