



## What is Lung Cancer?

Nearly 170,000 Americans are diagnosed with **lung cancer** each year. While cigarette smoking is the main cause, anyone can develop lung cancer.

The lungs contain many different types of cells. Most cells in the lung are epithelial cells. These cells line the airways and produce mucus, which lubricates and protects the lung. The lung also contains nerve cells, hormone-producing cells, blood cells, and structural or supporting cells.

There are two major types of lung cancer. Non-small cell lung cancer (the most common) is believed to arise from epithelial cells. Small cell lung cancer is believed to arise from nerve cells or hormone-producing cells. The term “small cell” refers to the size and shape of the cancer cells seen under the microscope.

**Lung cancer** begins when cells in the lung grow out of control, and form a tumor. A lung tumor can begin anywhere in the lung. Once a lung tumor begins to grow, it may or may not shed cancer cells. These cells can travel through tiny tubes in the lung called lymphatic vessels, which drain into collecting stations called lymph nodes located in the lungs and the center of the chest. Cancer cells can also travel through blood vessels to distant sites in the body, where they can form other tumors. This process is known as metastasis.

Not all lung tumors metastasize. In general, **small cell lung cancers** are more likely to metastasize than non-small cell lung cancers, so the two types of lung cancer are treated in different ways. Lung cancer is always treatable, no matter the size, location, or if the cancer has spread.

Lung cancer is a malignant tumor that grows in one or both lungs. Lung cancer usually forms from cells that line the airways and nearby glands because these cells are what come in contact with the air we breathe which may contain carcinogens. In lung cancer, the changing of normal cells into cancerous cells usually happens over a period of years.

## What causes lung cancer?

There are several factors that can contribute to the development of lung cancer.

Smoking is the number one cause of lung cancer. While smoking is an important risk factor in developing lung cancer, there are many people with lung cancer who have never smoked. Other factors that contribute to lung cancer include the following:

**Exposure to chemicals in the air** such as asbestos and radon

- **Lung diseases** that can block airflow to the lungs such as chronic obstructive pulmonary disease (COPD) or tuberculosis
- **Genetics** - people with a relative who had lung cancer are at higher risk for developing lung cancer
- **Age** - lung cancer occurs more often in people over 65 years of age

Cigarette smoke contains at least 43 different carcinogens (cancer-causing chemicals). It has been associated with various cancers including lung, esophagus, mouth, stomach, pancreas, and liver, to name just a few. Smoking accounts for at least 30% of all cancer-related deaths and 87% of lung cancer deaths. Approximately 50% of new lung cancers are diagnosed in former smokers. The risk of lung cancer increases with an increase in the total number of cigarettes smoked, referred to as pack-years (number of packs smoked per day times the number of years smoked). The use of cigar and pipe tobacco also increases the risk of developing cancer, but the risk is not as high as with cigarettes.

Secondhand smoke also contains carcinogens, and each year in the US between 5,000 and 10,000 people are diagnosed with lung cancer resulting from breathing secondhand smoke.

Quitting smoking decreases the risk of developing lung cancer. Ten years after quitting, the risk decreases by half. Although smoking cessation lowers this risk of developing lung cancer, the risk never decreases to the level of people who have never smoked. Recent findings for smokers who have been diagnosed with lung cancer suggest that those who quit smoking during their lung cancer treatment may live longer than those who continue to smoke during treatment.

It's never too late to quit smoking! If you currently smoke and would like to quit, talk to your doctor about the different options to help you stop smoking.

## Lung Cancer Symptoms

Some of the symptoms of lung cancer are similar to symptoms of other common illnesses. So, it's important for your doctor to perform a thorough physical examination and to know your medical history. Your doctor will consider your age, smoking history, and diseases or conditions that you and your family members may have. Your doctor will also need to know if you've been exposed to any harmful chemicals. All of these things will help to determine the next steps.

The most common symptom of lung cancer is cough; it occurs in over 50% of people with lung cancer. The tumor causes irritation to the lungs and airway tissue, resulting in cough. Other common symptoms of lung cancer are chest pain, shortness of breath (dyspnea), and wheezing. About 30% of people with lung cancer will cough up blood, called hemoptysis; you should call your doctor immediately if this happens. If the tumor

grows larger, it can press on nearby organs and bones. When this happens, symptoms may include bone pain, chest pain, hoarseness, cough, shortness of breath, swelling of the face or arms, and/or a build up of fluid around the outside of the lungs, also called pleural effusion.

Some symptoms are caused by the cancer spreading to other parts of the body (the lung cancer has metastasized). Symptoms from lung cancer metastases depend on where the cancer has spread. If the lung cancer has spread to the brain or spinal cord, you may experience headaches, nausea, vomiting, weakness, tiredness, or seizures. If the lung cancer has spread to the bones, you may feel bone pain. If the cancer has spread to the liver, you may have right-sided abdominal pain and jaundice. There are also some general symptoms of lung cancer like weight loss, fatigue, and loss of appetite. If you have been diagnosed with lung cancer and you develop any of these or other new symptoms, you should let your doctor know.

## Healthy Cells vs. Cancer Cells

Healthy cells are like a cat. They need structure to determine the size of bones and shape of the body, tail and whiskers. The DNA in genes and chromosomes determine this. They need energy to play and prowl and sustain life. This is derived from chemicals in food. Cats need a system to deliver chemicals (food nutrients like amino acids, carbohydrates, fats, vitamins and minerals) to all parts of their body. These are the blood vessels. Growth factors take a kitten into a lazy old cat, all the while helping it to function normally.

The body and its cells are mostly made up of protein. The building blocks of proteins are substances called amino acids that in the form of enzymes and hormones literally control every chemical reaction within the cells. When these are modified, different messages are sent to a complex control system that can alter their function. There are twenty different kinds of amino acids that are essential to life. Twelve of these can be synthesized within the body however; eight must be supplied by the daily diet.

Structure	
Normal Cells	Cancer Cells
DNA in genes and chromosomes go about their business in a normal way.	Cancer cells develop a different DNA or gene structure or acquire abnormal numbers of chromosomes.
Cells divide in an orderly way to produce more cells only when the body needs them.	Cells continue to be created without control or order. If not needed, a mass of tissue is formed which is called a tumor.
Energy	
Normal Cells	Cancer Cells
Cells derive 70% of their energy from a system called the "Krebs Cycle."	Cells have a defective "Krebs Cycle" and derive little or no energy from it.
Cells derive only 20% of their energy from a system called "Glycolysis."	Cancer cells derive almost all their energy from "Glycolysis."
Cells derive most of their energy with the use of oxygen.	Cells derive most of their energy in the absence of oxygen.
Blood Vessels	
Normal Cells	Cancer Cells

Cells have a built-in blood vessel system.	Cells do not have a built-in blood vessel system. They require more of certain amino acids to grow.
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<b>Growth Factors</b>	
<b>Normal Cells</b>	<b>Cancer Cells</b>
While similar to cancer cells, the amount of them is more in balance to produce a more normal level of activity.	These cells have over produced, require more chemicals (food) and are over active.
<b>Functions</b>	
<b>Normal Cells</b>	<b>Cancer Cells</b>
The enzymes and hormones go about business in a normal balanced manner.	The enzymes and hormones are either over active or under active.
<b>Tumors are Different</b>	
<b>Benign</b>	<b>Malignant</b>
Benign tumors are not cancerous. They do not invade nearby tissues nor spread to other parts of the body. They can be removed and are not a threat to life.	Malignant tumors are cancerous. They can invade and damage nearby tissues and organs and they can break away and enter the blood stream to form new tumors in other parts of the body. The spread of cancer is called metastasis.

## Lung Cancer Staging

Once lung cancer has been diagnosed, your doctor will want to determine the stage or extent of the disease. This involves finding out how large the tumor is and whether the cancer is limited to the lungs or if it has spread to other parts of the body (the presence of metastasis). The tests your doctor performed to diagnose lung cancer, such as a CAT scan and MRI, help determine the stage of disease.

### **Why is it important for your doctor to determine the stage of your lung cancer?**

When you and your doctor know how the cancer is growing and where it is located, you can together choose the best treatment option. The most common system used to describe stages of lung cancer is the TNM staging system, which stands for Tumor, Node, Metastasis. Your doctor will determine the T, N, and M status of the tumor. The first step is assigning a T or tumor stage.

## Lung Cancer Diagnosis

Early diagnosis of lung cancer is difficult because symptoms do not usually occur until the disease is more advanced. You may have felt well and your diagnosis came as a surprise to you and your doctor. Or, you may have had signs or symptoms of lung cancer during a routine physical examination, and your doctor ordered tests that found lung cancer. Certain tests need to be performed for a doctor to be able to diagnose lung cancer. Below is a description of some of the more common tests doctors use.

- **Chest X-Ray:** A chest x-ray is the most common test used when lung cancer is suspected. It uses small amounts of radiation to take a picture of the inside of the chest, including the lungs. Tumors in your lungs can be seen on a chest x-ray. Your doctor may compare old chest x-rays with recent ones to see if the tumor is growing or shrinking.
- **Computed Tomography (CT) Scan:** Computed tomography, also known as a CAT or CT scan, is another test used to help diagnose lung cancer. It's similar to a chest x-ray but it gives a more detailed picture of the lungs. A CAT scan can detect extremely small tumors that may not be seen on a chest x-ray. Also, it may help your doctor determine whether or not the tumor has spread into the surrounding lymph nodes.
- **Magnetic Resonance Imaging (MRI):** An MRI, is similar to a CAT scan, but it uses magnetic fields instead of radiation to create a picture. An MRI produces clear images of your internal body parts, including tissues, muscles, nerves, and bones. Your doctor can use these images to detect the presence of tumors.
- **Positron Emission Tomography (PET) Scan, or PET scan:** A PET scan determines the way the cells in the body act in the presence of sugar. Normal cells take in sugar and use it to make energy. Cancer cells usually take in more sugar than normal cells. If you are going to have a PET scan, your doctor will give you a special type of sugar before the test. The PET scan will detect the presence of tumors by detecting "hot spots," which are bright colored areas on the picture where the sugar has been taken in by cells. The more sugar the tumor takes in, the more likely it is a cancer.

A special type of PET scan is available, which involves the use of a special sugar called fluoro-deoxyglucose (FDG). This PET scan is useful in evaluating the extent of your cancer. More FDG taken up by your lung tissues can mean a more advanced stage of cancer. A PET scan using FDG is more accurate in determining the stage of your cancer compared to a CAT scan.

- **Sputum Cytology:** In this test, your sputum (or mucous that is coughed up) is collected and examined under the microscope to look for cancer cells. The most accurate way to do this test is to collect and analyze early morning mucus for three days.
- **Biopsy:** The techniques that allow the doctor to view the inside of your body do not test the tumor for the presence of cancer cells. So, these tests do not provide absolute proof that you have cancer. To confirm the presence of cancer, a sample of tissue from the tumor is necessary. A biopsy is the removal and examination of a tissue sample from the tumor to determine if it is cancerous (malignant) or non-cancerous (benign). Biopsies can be obtained in several different ways depending on the location and the size of a tumor. Below are different ways a biopsy can be taken.

## Lung Cancer Treatments

### Surgery

Depending on the stage of cancer and your health, lung surgery, which is also known as a thoracotomy, may be used alone or in combination with radiation or chemotherapy.

Surgery is usually used to treat cancer that is diagnosed early, such as Stage I or II. If your cancer is located only in the lungs and has not spread to the lymph nodes or outside the chest cavity, your doctor may perform surgery to remove the tumor. If your cancer has spread to other parts of your body, surgery is not generally an option.

Other factors that may play a role in deciding whether or not surgery is the best option are the size and location of the tumor and your general health. If your cancer is near your vital organs such as the heart, windpipe, or major blood vessels, your doctor may recommend other treatment options, because surgery too close to these organs may be complicated. Also, if you have other serious health conditions such as a heart condition or other lung problems, you may not be able to have surgery. Your doctor will know whether or not lung surgery is the right option to treat your lung cancer. A thoracotomy involves opening one side of your chest between your ribs to avoid damaging organs such as the heart or the windpipe. Your ribs are spread apart and a small piece of your ribs may even be removed, so that the surgeon can see into your chest to remove the tumor.

Depending on the location, size, and type of tumor, there are several different types of surgeries that can be performed. A small part of your lung may be removed, a lobe of your lung may be removed, or a whole lung may be removed. Below is a description of these procedures.

### **Wedge resection or segmentectomy**

There are two operations to remove a small section of the lung: a wedge resection and a segmentectomy. A wedge resection involves removal of a smaller part of your lung compared to a segmentectomy. Your doctor may use these types of surgery if you have been diagnosed with an early stage and the cancer is very small.

### **Lobectomy**

You may recall from your earlier reading that the right lung has three lobes and the left lung has two lobes. Your doctor may decide to remove an entire lobe of your lung if he or she believes that the cancer is just in one part of the lung. This process is known as lobectomy.

### **Pneumonectomy**

Is the removal of an entire lung and is used when your doctor believes that cancer is present in only one lung but it may be anywhere in that lung. Although removing a lung can reduce the function of your lungs, you can breathe normally with only one lung. However, if you had breathing problems before, you may continue having those after your surgery.

### **Video-assisted thoracic surgery**

Video-assisted thoracic surgery (VATS) is a recently developed technique, which may be used for several procedures. It can be used to confirm a diagnosis of lung cancer, and to remove cancer in patients who cannot tolerate open-chest surgery or have a small tumor confined to the lungs. VATS is usually done before a thoracotomy. The surgeon makes small incisions on your chest, which allows him or her to look inside and

remove tumors close to the outside edge of the lung. The doctor does not have to open your entire chest to see and remove a tumor. However, it can only be used to treat cancer if it has not spread throughout the lungs or other parts of the body.

## **What should I expect with surgery?**

As with any major surgery, lung cancer surgery is associated with risks such as bleeding, infection, pain, and damage to the heart, lungs and other organs. You will be admitted to the hospital and you may have to stay several days after the surgery. Your remaining lung function, overall health, the type of surgery done, and the amount of pain you are experiencing are some of the factors that will determine how long you will stay in the hospital. Chest tubes may be placed in your chest to help drain fluid, blood, or air present around the lungs after your surgery. These tubes are removed once all the fluid has drained out of your chest. You will be instructed on how to do breathing exercises that will help you recover from the surgery and prevent complications.

## **Radiation**

Radiation or radiotherapy uses high-energy rays to kill lung cancer cells, shrink tumors, and prevent cancer cells from dividing and spreading. Radiation is directed to the area where the tumor is located and injures or destroys the cells by damaging the cells' genetic material. This kills the cells or makes it impossible for them to grow. More than half of all patients with cancer are treated with some type of radiation.

In lung cancer, radiation therapy is most often administered to patients with early stage disease, such as Stage I, who may not be well enough to undergo surgery. It may also be given before or after surgery in early disease (Stage I or II) or in combination with chemotherapy in later stages of the disease (Stage III). Some patients will also receive radiation therapy to relieve some of the symptoms of lung cancer or to treat an area of metastases in Stage IV disease. For example, if the lung cancer has spread to the bones and is causing pain, radiation to the bone may decrease the tumor size and lessen the bone pain.

It is nearly impossible to direct the radiation rays only at the cancer cells. As a result, both cancer cells and nearby healthy cells may be damaged. However, normal cells, unlike cancer cells, may recover from the effects of radiation. In addition, your doctor will try to limit the effect of radiation on normal cells by aiming the radiation toward the tumor, limiting the dose of radiation, and spreading out the treatment over time.

## **How is radiation given?**

There are two ways in which radiation can be given: external beam radiation and a type of internal radiation called brachytherapy. External beam radiation is the most common type of radiation used for the treatment of lung cancer. With external beam radiation, you're positioned under a machine that sends high-energy rays toward the tumor. The radiation only lasts for a few minutes at each session, and is usually given once daily for 5 days a week for up to 6 to 8 weeks. You will probably not receive radiation on the weekend, which allows the normal cells time to recover. Another type of external beam radiation is called hyperfractionated radiation. During hyper-fractionated radiation, the daily dose of radiation is given as smaller doses but more than once a day. You may

receive radiation several times a day separated by 4 to 6 hours.

Internal radiation is also called brachytherapy. During this treatment, your doctor will place the source of radiation inside of your body, near the tumor. The source of radiation is some type of seed or small implant that is placed into the lung. This is done by inserting a tube into the nose, down the trachea, and into the lung. The radioactive seeds are then placed down the tube and positioned near the tumor. The seeds may stay in the lung for a few minutes or permanently, depending on the dose of radiation needed. Your doctor will determine the dose of radiation and how long the seeds need to stay in your lung. Brachytherapy allows a high dose of radiation to be given to a small area of the body, but it's not often used in lung cancer.

## **What are the side effects of radiation?**

Side effects will be different for every patient and they may continue for several months after radiation treatment is over. Most people who undergo radiation experience fatigue. You may feel tired for months after therapy, so you may want to get more rest during this time. Other side effects you may experience include mild skin problems at the radiation site, nausea, and vomiting. If you get radiation to your chest area, you may experience shortness of breath, and cough. Since your esophagus may be exposed to radiation, difficulty with swallowing may occur. Most of these side effects will usually lessen after treatment is completed.

If you have Stage IV disease and the cancer has spread to your brain, you may get radiation to your brain to relieve some of the symptoms that you are experiencing. Radiation to the brain may cause hair loss, memory loss, headache, or difficulty thinking.

Make sure you tell your doctor if you experience any of these side effects.

## **Chemotherapy**

Is the use of powerful drugs to attack cancer cells. The drugs circulate throughout the body in the bloodstream and may kill any rapidly growing cells, including cancer cells and some healthy cells. Chemotherapy drugs are carefully controlled in both dosage and frequency so that cancer cells are destroyed while minimizing the risk to healthy cells.

## **How is chemotherapy given?**

The drugs used for chemotherapy come in many different forms. While some are given directly into a vein (intravenous) or a muscle (intramuscular), others may be taken by mouth. Some of the drugs must be given in the doctor's office or clinic and others can be taken at home. Certain types of chemotherapy need to be given in the hospital because they require special monitoring of both the treatment and its possible side effects. There are many different chemotherapy drugs, each with its own strengths and weaknesses.

Chemotherapy may sometimes be used in combination with surgery or radiation for Stage II disease. It is more commonly used alone or with radiation to treat Stage III and IV disease. When chemotherapy is used before surgery or radiation in earlier stage disease it is called neo-adjuvant therapy. Neo-adjuvant chemotherapy may reduce the size of the tumor so it's easier to remove during surgery or easier to treat with radiation.

When it is used immediately after surgery or radiation in earlier stage disease it's called adjuvant therapy. Adjuvant therapy may kill any cancer cells that may remain in the body after surgery or radiation. The term minimal residual disease (MRD) is used to describe these cancer cells that may remain in the body despite successful surgery or radiation. MRD does not mean that you have metastatic disease. However, the remaining tumor cells may go undetected for years, and they can develop into metastatic disease if they are not treated.

Most often chemotherapy is used to treat advanced stages of lung cancer (Stages IIIb and IV). Usually different chemotherapy drugs are given together to treat advanced lung cancer. Some combinations of chemotherapy can prolong survival, improve the quality of life, and reduce lung cancer symptoms in people with advanced stages of lung cancer. When chemotherapy is used to ease the symptoms of lung cancer but not used to prolong survival, it is called palliative therapy.

Chemotherapy is considered the standard therapy for advanced lung cancer. The first chemotherapy regimen that a person receives to treat the cancer is referred to as first line. Therapies that are used first-line are considered the best way to treat the cancer. If first-line chemotherapy doesn't work or if the disease re-occurs following first-line therapy, second line therapy may be given. Some people with lung cancer go on to receive more than 4 or 5 different chemotherapy regimens. Your doctor will determine what drug or combinations of drugs is the most appropriate for you by considering your type and stage of lung cancer, other illnesses you may have, and the possible side effects of the therapy.

## **What should I expect with chemotherapy?**

Chemotherapy is administered in "cycles." A cycle is usually made up of 21 days in a row and you may not receive chemotherapy on every day of a cycle. For example, you may receive one chemotherapy drug on day 1 of a cycle, while you may get a second chemotherapy drug in combination with the first drug on day 1 and by itself day 8. Chemotherapy regimens for lung cancer can last for up to 6 cycles with each cycle being about 21 days long. Sometimes, after you finish your chemotherapy cycles your doctor may recommend you continue some therapy for a longer period of time in order to keep the cancer from coming back. This type of therapy is called maintenance therapy.

Sometimes chemotherapy is given at a clinic or hospital over a period of several hours, so you will need to make arrangements to get to your scheduled appointments. Depending on the type of chemotherapy that you receive, you may be given "premedications" (medications given before the chemotherapy) in order to prevent certain side effects. You may also have to receive intravenous fluids before or after the chemotherapy.

## **What are the side effects of chemotherapy?**

Chemotherapy drugs circulate throughout the whole body and they can affect both healthy and cancer cells. When healthy cells are affected you may experience side effects. The specific side effects depend upon which drugs and regimens are used. The most common side effects include hair loss, nausea, vomiting, diarrhea, lowered blood counts, reduced ability of the blood to clot, a tingling or numbing sensation of the hands

and feet, and an increased risk of infection. Other side effects may include blisters or sores in the mouth and throat and a feeling of tiredness. Some of these side effects occur only temporarily or are more noticeable when treatment is first started. Many of the side effects disappear when the drugs are stopped. For instance, hair will grow back once chemotherapy is stopped. You should talk to your doctor about what side effects to expect for your therapy and how to manage them if they occur.

## Treatment of Non-small Cell Lung Cancer

In general, **early-stage non-small cell lung cancer** (stage 0-II) is treated with surgery. Surgeons cure many patients with early-stage lung cancer with a single operation.

Radiation therapy can also be used to treat and cure early-stage lung tumors in people who cannot tolerate surgery. Stage III non-small cell lung cancer has spread so much that surgery or radiation alone is either impossible, or not enough to treat the disease.

Patients with stage III disease have a high risk of the cancer returning, either in the same place, or at a distant location, even if surgery or radiation has completely removed the cancer. For this reason, doctors generally do not recommend immediate surgery, and may recommend immediate chemotherapy for patients with stage III disease.

Chemotherapy can shrink a stage IIIA tumor, and make it easier for the surgeon to remove, or easier for the radiation oncologist to irradiate. In theory, since chemotherapy travels throughout the body it can kill cancer cells that have traveled to distant sites.

Because of the high risk of distant and local recurrence, stage IIIB tumors are usually not removed surgically, no matter how effective chemotherapy might be. For these patients, chemotherapy delivered at the same time as radiation has been shown to improve the ability of radiation to shrink the cancer. With these concepts in mind, patients with stage III disease are generally treated with some combination of chemotherapy followed by surgery, or chemotherapy followed by radiation.

Some patients, especially those with stage IIIB disease, are treated with chemotherapy at the same time as radiation.

Treatment of stage III non-small cell lung cancer with combination therapy has resulted in prolonged survival for many patients. Delivering chemotherapy and radiation at the same time may cause greater side effects.

**Advanced Non-small Cell Lung Cancer** Patients with stage IV non-small cell lung cancer or stage IIIB disease due to cancer cells in fluid around the lung (called "advanced" disease) are typically not treated with surgery or radiation. Rarely, a single brain or adrenal metastasis can be removed surgically or radiation can treat a single site of disease. However, patients with advanced disease are at very high risk for their cancer growing in a different location, so most patients with advanced non-small cell lung cancer are treated with chemotherapy alone.

The goal of chemotherapy is to shrink the cancer, relieve discomfort caused by the cancer, and slow the spread of the disease.

Rarely, chemotherapy can cause metastatic lung cancer to disappear completely, but these patients are still at very high risk of cancer returning. Therefore, patients with advanced disease are never considered "cured" of their cancer no matter how well the chemotherapy works. These patients must be followed closely by their doctors, and require chronic or intermittent chemotherapy to control their disease.

In these patients, highly toxic treatment approaches should be avoided in favor of treatments designed to improve both quantity, and quality of life. Chemotherapy has been proven to improve both quantity and quality of life for patients with advanced non-small cell lung cancer.

## **Treatment of Small Cell Lung Cancer**

Small cell lung cancer spreads quickly and rarely responds well to surgery or radiation therapy alone. Patients with limited-stage small cell lung cancer are usually treated with chemotherapy plus radiation to the site of disease. Radiation therapy is given during the first or second month of chemotherapy, with chemotherapy continuing for 3 to 6 months.

Patients with extensive-stage disease are usually treated with chemotherapy only. In patients whose tumors have disappeared after chemotherapy, radiation may help prevent cancer from later attacking the brain. This is called prophylactic cranial irradiation (PCI).

**Source: A.P. John Institute for Cancer Research**

**When considering any type of complementary cancer treatment or alternative cancer treatment, always consult with your physician first, as possible interactions could reduce your treatment protocol's efficacy.**