

National Cancer Institute

What You Need
To Know About™

Brain Tumors

U.S. DEPARTMENT OF
HEALTH AND HUMAN SERVICES

National Institutes of Health

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About This Booklet

This National Cancer Institute (NCI) booklet is about *tumors** that begin in the brain (**primary brain tumors**). Each year in the United States, more than 35,000 people are told they have a tumor that started in the brain.

This booklet is only about primary brain tumors. Cancer that spreads to the brain from another part of the body is different from a primary brain tumor.

Lung cancer, breast cancer, kidney cancer, melanoma, and other types of cancer commonly spread to the brain. When this happens, the tumors are called ***metastatic brain tumors***.

People with metastatic brain tumors have different treatment options. Treatment depends mainly on where the cancer started. Instead of this booklet, you may want to read the NCI fact sheet *Metastatic Cancer*. The NCI Contact Center at **1-800-4-CANCER (1-800-422-6237)** can send you this fact sheet, as well as other information about metastatic brain tumors.

This booklet tells about diagnosis, treatment, and *supportive care*. Learning about medical care for brain tumors can help you take an active part in making choices about your care.

*Words in *italics* are in the Dictionary on page 31. The Dictionary explains these terms. It also shows how to pronounce them.

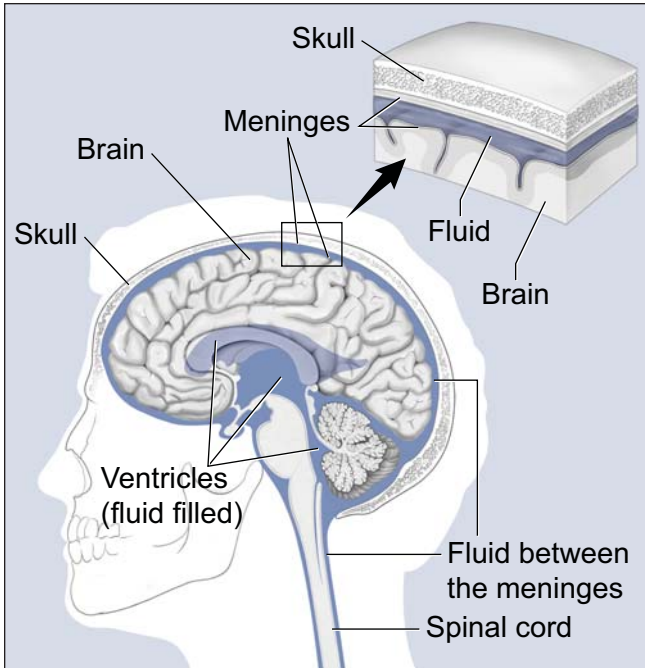
This booklet has lists of questions that you may want to ask your doctor. Many people find it helpful to take a list of questions to a doctor visit. To help remember what your doctor says, you can take notes or ask whether you may use a tape recorder. You may also want to have a family member or friend go with you when you talk with the doctor—to take notes, ask questions, or just listen.

For the latest information about brain tumors, please visit our Web site at <http://www.cancer.gov/cancertopics/types/brain>. Also, the NCI Contact Center can answer your questions about brain tumors. We can also send you NCI booklets and fact sheets. Call **1-800-4-CANCER (1-800-422-6237)** or instant message us through the **LiveHelp** service at <http://www.cancer.gov/help>.

The Brain

The brain is a soft, spongy mass of *tissue*. It is protected by:

- The **bones** of the skull
- Three **thin layers of tissue** (*meninges*)
- **Watery fluid** (*cerebrospinal fluid*) that flows through spaces between the meninges and through spaces (*ventricles*) within the brain



This picture shows the brain and nearby structures.

The brain directs the things we choose to do (like walking and talking) and the things our body does without thinking (like breathing). The brain is also in charge of our senses (sight, hearing, touch, taste, and smell), memory, emotions, and personality.

A network of nerves carries messages back and forth between the brain and the rest of the body. Some nerves go directly from the brain to the eyes, ears, and other parts of the head. Other nerves run through the spinal cord to connect the brain with the other parts of the body.

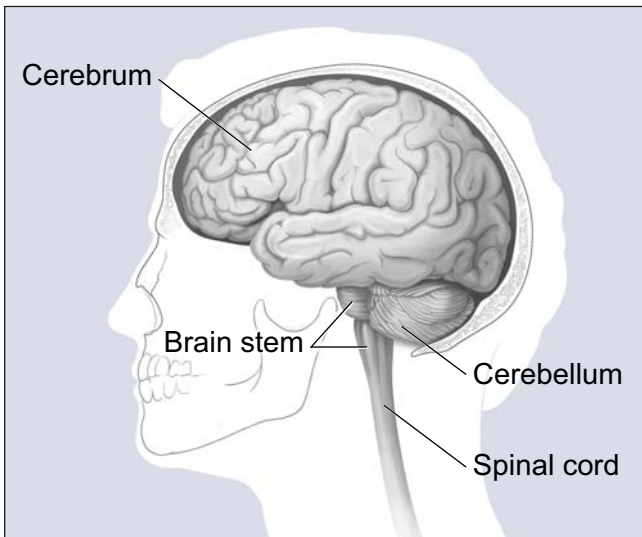
Within the brain and spinal cord, *glial cells* surround *nerve cells* and hold them in place.

The three major parts of the brain control different activities:

- **Cerebrum:** The cerebrum uses information from our senses to tell us what is going on around us and tells our body how to respond. It controls reading, thinking, learning, speech, and emotions.

The cerebrum is divided into the left and right *cerebral hemispheres*. The right hemisphere controls the muscles on the left side of the body. The left hemisphere controls the muscles on the right side of the body.

- **Cerebellum:** The cerebellum controls balance for walking and standing, and other complex actions.
- **Brain stem:** The brain stem connects the brain with the spinal cord. It controls breathing, body temperature, blood pressure, and other basic body functions.



This picture shows the major parts of the brain.

Tumor Grades and Types

When most normal *cells* grow old or get damaged, they die, and new cells take their place. Sometimes, this process goes wrong. New cells form when the body doesn't need them, and old or damaged cells don't die as they should. The buildup of extra cells often forms a mass of tissue called a growth or tumor.

Primary brain tumors can be *benign* or *malignant*:

- **Benign** brain tumors do not contain *cancer* cells:
 - Usually, benign tumors can be removed, and they seldom grow back.
 - Benign brain tumors usually have an obvious border or edge. Cells from benign tumors rarely invade tissues around them. They don't spread to other parts of the body. However, benign tumors can press on sensitive areas of the brain and cause serious health problems.
 - Unlike benign tumors in most other parts of the body, benign brain tumors are sometimes life threatening.
 - Benign brain tumors may become malignant.
- **Malignant** brain tumors (also called **brain cancer**) contain cancer cells:
 - Malignant brain tumors are generally more serious and often are a threat to life.
 - They are likely to grow rapidly and crowd or invade the nearby healthy brain tissue.
 - Cancer cells may break away from malignant brain tumors and spread to other parts of the brain or to the spinal cord. They rarely spread to other parts of the body.

Tumor Grade

Doctors group brain tumors by *grade*. The grade of a tumor refers to the way the cells look under a microscope:

- **Grade I:** The tissue is benign. The cells look nearly like normal brain cells, and they grow slowly.
- **Grade II:** The tissue is malignant. The cells look less like normal cells than do the cells in a Grade I tumor.
- **Grade III:** The malignant tissue has cells that look very different from normal cells. The abnormal cells are actively growing (*anaplastic*).
- **Grade IV:** The malignant tissue has cells that look most abnormal and tend to grow quickly.

Cells from low-grade tumors (grades I and II) look more normal and generally grow more slowly than cells from high-grade tumors (grades III and IV).

Over time, a low-grade tumor may become a high-grade tumor. However, the change to a high-grade tumor happens more often among adults than children.

You may want to read the NCI fact sheet *Tumor Grade*.

Types of Primary Brain Tumors

There are many types of primary brain tumors. Primary brain tumors are named according to the type of cells or the part of the brain in which they begin. For example, most primary brain tumors begin in glial cells. This type of tumor is called a *glioma*.

Among adults, the most common types are:

- **Astrocytoma:** The tumor arises from star-shaped glial cells called *astrocytes*. It can be any grade. In adults, an astrocytoma most often arises in the cerebrum.

- **Grade I or II astrocytoma:** It may be called a low-grade glioma.
- **Grade III astrocytoma:** It's sometimes called a high-grade or an anaplastic astrocytoma.
- **Grade IV astrocytoma:** It may be called a *glioblastoma* or malignant astrocytic glioma.
- **Meningioma:** The tumor arises in the meninges. It can be grade I, II, or III. It's usually benign (grade I) and grows slowly.
- **Oligodendroglioma:** The tumor arises from cells that make the fatty substance that covers and protects nerves. It usually occurs in the cerebrum. It's most common in middle-aged adults. It can be grade II or III.

Among children, the most common types are:

- **Medulloblastoma:** The tumor usually arises in the cerebellum. It's sometimes called a *primitive neuroectodermal tumor*. It is grade IV.
- **Grade I or II astrocytoma:** In children, this low-grade tumor occurs anywhere in the brain. The most common astrocytoma among children is *juvenile pilocytic astrocytoma*. It's grade I.
- **Ependymoma:** The tumor arises from cells that line the ventricles or the central canal of the spinal cord. It's most commonly found in children and young adults. It can be grade I, II, or III.
- **Brain stem glioma:** The tumor occurs in the lowest part of the brain. It can be a low-grade or high-grade tumor. The most common type is *diffuse intrinsic pontine glioma*.

You can find more information about types of brain tumors at <http://www.cancer.gov/cancertopics/types/brain>. Or, you can call the NCI Contact Center at 1-800-4-CANCER (1-800-422-6237).

Risk Factors

When you're told that you have a brain tumor, it's natural to wonder what may have caused your disease. But no one knows the exact causes of brain tumors. Doctors seldom know why one person develops a brain tumor and another doesn't.

Researchers are studying whether people with certain *risk factors* are more likely than others to develop a brain tumor. A risk factor is something that may increase the chance of getting a disease.

Studies have found the following risk factors for brain tumors:

- ***Ionizing radiation:*** Ionizing radiation from high-dose *x-rays* (such as *radiation therapy* from a large machine aimed at the head) and other sources can cause cell damage that leads to a tumor. People exposed to ionizing radiation may have an increased risk of a brain tumor, such as meningioma or glioma.
- **Family history:** It is rare for brain tumors to run in a family. Only a very small number of families have several members with brain tumors.

Researchers are studying whether using cell phones, having had a head injury, or having been exposed to certain chemicals at work or to magnetic fields are important risk factors. Studies have not shown consistent links between these possible risk factors and brain tumors, but additional research is needed.

Symptoms

The symptoms of a brain tumor depend on tumor size, type, and location. Symptoms may be caused when a tumor presses on a nerve or harms a part of the brain. Also, they may be caused when a tumor blocks the fluid that flows through and around the brain, or when the brain swells because of the buildup of fluid.

These are the most common symptoms of brain tumors:

- Headaches (usually worse in the morning)
- Nausea and vomiting
- Changes in speech, vision, or hearing
- Problems balancing or walking
- Changes in mood, personality, or ability to concentrate
- Problems with memory
- Muscle jerking or twitching (*seizures* or convulsions)
- Numbness or tingling in the arms or legs

Most often, these symptoms are not due to a brain tumor. Another health problem could cause them. If you have any of these symptoms, you should tell your doctor so that problems can be diagnosed and treated.

Diagnosis

If you have symptoms that suggest a brain tumor, your doctor will give you a physical exam and ask about your personal and family health history. You may have one or more of the following tests:

- **Neurologic exam:** Your doctor checks your vision, hearing, alertness, muscle strength, coordination, and reflexes. Your doctor also examines your eyes to look for swelling caused by a tumor pressing on the nerve that connects the eye and the brain.
- **MRI:** A large machine with a strong magnet linked to a computer is used to make detailed pictures of areas inside your head. Sometimes a special dye (*contrast material*) is injected into a blood vessel in your arm or hand to help show differences in the tissues of the brain. The pictures can show abnormal areas, such as a tumor.
- **CT scan:** An x-ray machine linked to a computer takes a series of detailed pictures of your head. You may receive contrast material by injection into a blood vessel in your arm or hand. The contrast material makes abnormal areas easier to see.

Your doctor may ask for other tests:

- **Angiogram:** Dye injected into the bloodstream makes blood vessels in the brain show up on an x-ray. If a tumor is present, the x-ray may show the tumor or blood vessels that are feeding into the tumor.



- **Spinal tap:** Your doctor may remove a sample of cerebrospinal fluid (the fluid that fills the spaces in and around the brain and spinal cord). This procedure is performed with *local anesthesia*. The doctor uses a long, thin needle to remove fluid from the lower part of the spinal column. A spinal tap takes about 30 minutes. You must lie flat for several hours afterward to keep from getting a headache. A laboratory checks the fluid for cancer cells or other signs of problems.
- **Biopsy:** The removal of tissue to look for tumor cells is called a biopsy. A *pathologist* looks at the cells under a microscope to check for abnormal cells. A biopsy can show cancer, tissue changes that may lead to cancer, and other conditions. A biopsy is the only sure way to diagnose a brain tumor, learn what grade it is, and plan treatment.

Surgeons can obtain tissue to look for tumor cells in two ways:

- **Biopsy at the same time as treatment:** The surgeon takes a tissue sample when you have *surgery* to remove part or all of the tumor. See the Surgery section on page 16.
- ***Stereotactic biopsy:*** You may get local or *general anesthesia* and wear a rigid head frame for this procedure. The surgeon makes a small *incision* in the scalp and drills a small hole (a *burr hole*) into the skull. CT or MRI is used to guide the needle through the burr hole to the location of the tumor. The surgeon withdraws a sample of tissue with the needle. A needle biopsy may be used when a tumor is deep inside the brain or in a part of the brain that can't be operated on.

However, if the tumor is in the brain stem or certain other areas, the surgeon may not be able to remove tissue from the tumor without harming normal brain tissue. In this case, the doctor uses MRI, CT, or other imaging tests to learn as much as possible about the brain tumor.

A person who needs a biopsy may want to ask the doctor the following questions:

- Why do I need a biopsy? How will the biopsy results affect my treatment plan?
- What kind of biopsy will I have?
- How long will it take? Will I be awake? Will it hurt?
- What are the chances of infection or bleeding after the biopsy? Are there any other risks?
- How soon will I know the results?
- If I do have a brain tumor, who will talk with me about treatment? When?

Treatment

People with brain tumors have several treatment options. The options are *surgery*, *radiation therapy*, and *chemotherapy*. Many people get a combination of treatments.

The choice of treatment depends mainly on the following:

- The type and grade of brain tumor
- Its location in the brain
- Its size
- Your age and general health

For some types of brain cancer, the doctor also needs to know whether cancer cells were found in the cerebrospinal fluid.

Your doctor can describe your treatment choices, the expected results, and the possible *side effects*. Because cancer therapy often damages healthy cells and tissues, side effects are common. Before treatment starts, ask your health care team about possible side effects and how treatment may change your normal activities. You and your health care team can work together to develop a treatment plan that meets your medical and personal needs.

You may want to talk with your doctor about taking part in a *clinical trial*, a research study of new treatment methods. See the Taking Part in Cancer Research section on page 30.

Your doctor may refer you to a specialist, or you may ask for a referral. Specialists who treat brain tumors include *neurologists*, *neurosurgeons*, *neuro-oncologists*, *medical oncologists*, *radiation oncologists*, and *neuroradiologists*.

Your health care team may also include an *oncology nurse*, a *registered dietitian*, a *mental health counselor*, a *social worker*, a *physical therapist*, an *occupational therapist*, a *speech therapist*, and a *physical medicine specialist*. Also, children may need tutors to help with schoolwork. (The Rehabilitation section on page 26 has more information about therapists and tutors.)

You may want to ask your doctor these questions before you begin treatment:

- What type of brain tumor do I have?
- Is it benign or malignant?
- What is the grade of the tumor?
- What are my treatment choices? Which do you recommend for me? Why?
- What are the expected benefits of each kind of treatment?
- What can I do to prepare for treatment?
- Will I need to stay in the hospital? If so, for how long?
- What are the risks and possible side effects of each treatment? How can side effects be managed?
- What is the treatment likely to cost? Will my insurance cover it?
- How will treatment affect my normal activities? What is the chance that I will have to learn how to walk, speak, read, or write after treatment?
- Would a research study (clinical trial) be appropriate for me?
- Can you recommend other doctors who could give me a second opinion about my treatment options?
- How often should I have checkups?

Surgery

Surgery is the usual first treatment for most brain tumors. Before surgery begins, you may be given general anesthesia, and your scalp is shaved. You probably won't need your entire head shaved.

Surgery to open the skull is called a *craniotomy*. The surgeon makes an incision in your scalp and uses a special type of saw to remove a piece of bone from the skull.

You may be awake when the surgeon removes part or all of the brain tumor. The surgeon removes as much tumor as possible. You may be asked to move a leg, count, say the alphabet, or tell a story. Your ability to follow these commands helps the surgeon protect important parts of the brain.

After the tumor is removed, the surgeon covers the opening in the skull with the piece of bone or with a piece of metal or fabric. The surgeon then closes the incision in the scalp.

Sometimes surgery isn't possible. If the tumor is in the brain stem or certain other areas, the surgeon may not be able to remove the tumor without harming normal brain tissue. People who can't have surgery may receive radiation therapy or other treatment.

You may have a headache or be uncomfortable for the first few days after surgery. However, medicine can usually control pain. Before surgery, you should discuss the plan for pain relief with your health care team. After surgery, your team can adjust the plan if you need more relief.

You may also feel tired or weak. The time it takes to heal after surgery is different for everyone. You will probably spend a few days in the hospital.

Other, less common problems may occur after surgery for a brain tumor. The brain may swell or fluid may build up within the skull. The health care team will monitor you for signs of swelling or fluid buildup. You may receive *steroids* to help relieve swelling. A second surgery may be needed to drain the fluid. The surgeon may place a long, thin tube (*shunt*) in a ventricle of the brain. (For some people, the shunt is placed before performing surgery on the brain tumor.) The tube is threaded under the skin to another part of the body, usually the abdomen. Excess fluid is carried from the brain and drained into the abdomen. Sometimes the fluid is drained into the heart instead.

Infection is another problem that may develop after surgery. If this happens, the health care team will give you an *antibiotic*.

Brain surgery may harm normal tissue. Brain damage can be a serious problem. It can cause problems with thinking, seeing, or speaking. It can also cause personality changes or seizures. Most of these problems lessen or disappear with time. But sometimes damage to the brain is permanent. You may need physical therapy, speech therapy, or occupational therapy. See the Rehabilitation section on page 26.

You may want to ask your doctor these questions about surgery:

- Do you suggest surgery for me?
- How will I feel after the operation?
- What will you do for me if I have pain?
- How long will I be in the hospital?
- Will I have any long-term effects? Will my hair grow back? Are there any side effects from using metal or fabric to replace the bone in the skull?
- When can I get back to my normal activities?
- What is my chance of a full recovery?

Radiation Therapy

Radiation therapy kills brain tumor cells with high-energy *x-rays*, *gamma rays*, or *protons*.

Radiation therapy usually follows surgery. The radiation kills tumor cells that may remain in the area. Sometimes, people who can't have surgery have radiation therapy instead.

Doctors use external and internal types of radiation therapy to treat brain tumors:

- ***External radiation therapy***: You'll go to a hospital or clinic for treatment. A large machine outside the body aims beams of radiation at the head. Because cancer cells may invade normal tissue around a tumor, the radiation may be aimed at the tumor and nearby brain tissue, or at the entire brain. Some people need radiation aimed at the spinal cord also.

The treatment schedule depends on your age, and the type and size of the tumor. Fractionated external beam therapy is the most common method of radiation therapy used for people with brain tumors. Giving the total dose of radiation over several weeks helps to protect healthy tissue in the area of the tumor. Treatments are usually 5 days a week for several weeks. A typical visit lasts less than an hour, and each treatment takes only a few minutes.

Some treatment centers are studying other ways of delivering external beam radiation therapy:

— ***Intensity-modulated radiation therapy*** or ***3-dimensional conformal radiation therapy***:

These types of treatment use computers to more closely target the brain tumor to lessen the damage to healthy tissue.

— ***Proton beam radiation therapy***: The source of radiation is protons rather than x-rays. The doctor aims the proton beam at the tumor. The dose of radiation to normal tissue from a proton beam is less than the dose from an x-ray beam.

— ***Stereotactic radiation therapy***: Narrow beams of x-rays or gamma rays are directed at the tumor from different angles. For this procedure, you wear a rigid head frame. The therapy may be given during a single visit (***stereotactic radiosurgery***) or over several visits.

- ***Internal radiation therapy (implant radiation therapy or brachytherapy)***: Internal radiation isn't commonly used for treating brain tumors and is under study. The radiation comes from *radioactive* material usually contained in very small implants called seeds. The seeds are placed inside the brain and give off radiation for months. They don't need to be removed once the radiation is gone.

Some people have no or few side effects after treatment. Rarely, people may have nausea for several hours after external radiation therapy. The health care team can suggest ways to help you cope with this problem. Radiation therapy also may cause you to become very tired with each radiation treatment. Resting is important, but doctors usually advise people to try to stay as active as they can.

Also, external radiation therapy commonly causes hair loss from the part of the head that was treated. Hair usually grows back within a few months. Radiation therapy also may make the skin on the scalp and ears red, dry, and tender. The health care team can suggest ways to relieve these problems.

Sometimes radiation therapy causes brain tissue to swell. You may get a headache or feel pressure. The health care team watches for signs of this problem. They can provide medicine to reduce the discomfort.

Radiation sometimes kills healthy brain tissue. Although rare, this side effect can cause headaches, seizures, or even death.

Radiation may harm the *pituitary gland* and other areas of the brain. For children, this damage could cause learning problems or slow down growth and development. In addition, radiation increases the risk of secondary tumors later in life.

You may find it helpful to read the NCI booklet *Radiation Therapy and You*.

You may want to ask your doctor these questions about radiation therapy:

- Why do I need this treatment?
- When will the treatments begin? When will they end?
- How will I feel during therapy? Are there side effects?
- What can I do to take care of myself during therapy?
- How will we know if the radiation is working?
- Will I be able to continue my normal activities during treatment?

Chemotherapy

Chemotherapy, the use of drugs to kill cancer cells, is sometimes used to treat brain tumors. Drugs may be given in the following ways:

- **By mouth or vein (*intravenous*):** Chemotherapy may be given during and after radiation therapy. The drugs enter the bloodstream and travel throughout the body. They may be given in an outpatient part of the hospital, at the doctor's office, or at home. Rarely, you may need to stay in the hospital.

The side effects of chemotherapy depend mainly on which drugs are given and how much. Common side effects include nausea and vomiting, loss of appetite, headache, fever and chills, and weakness. If the drugs lower the levels of healthy blood cells, you're more likely to get infections, bruise or bleed easily, and feel very weak and tired. Your health care team will check for low levels of blood cells. Some side effects may be relieved with medicine.

- **In wafers that are put into the brain:** For some adults with high-grade glioma, the surgeon implants several wafers into the brain. Each wafer is about the size of a dime. Over several weeks, the wafers dissolve, releasing the drug into the brain. The drug kills cancer cells. It may help prevent the tumor from returning in the brain after surgery to remove the tumor.

People who receive an implant (a wafer) that contains a drug are monitored by the health care team for signs of infection after surgery. An infection can be treated with an antibiotic.

You may wish to read the NCI booklet *Chemotherapy and You*.

You may want to ask your doctor these questions about chemotherapy:

- Why do I need this treatment?
- What will it do?
- Will I have side effects? What can I do about them?
- When will treatment start? When will it end?
- How will treatment affect my normal activities?

Second Opinion

Before starting treatment, you might want a second opinion about your diagnosis and treatment plan. Some people worry that the doctor will be offended if they ask for a second opinion. Usually the opposite is true. Most doctors welcome a second opinion. And many health insurance companies will pay for a second opinion if you or your doctor requests it. Some companies require a second opinion.

If you get a second opinion, the doctor may agree with your first doctor's diagnosis and treatment plan. Or the second doctor may suggest another approach. Either way, you'll have more information and perhaps a greater sense of control. You can feel more confident about the decisions you make, knowing that you've looked at your options.



It may take some time and effort to gather your medical records and see another doctor. In many cases, it's not a problem to take several weeks to get a second opinion. The delay in starting treatment usually won't make treatment less effective. To make sure, you should discuss this delay with your doctor. Some people with a brain tumor need treatment right away.

There are many ways to find a doctor for a second opinion. You can ask your doctor, a local or state medical society, a nearby hospital, or a medical school for names of specialists.

Also, you can request a consultation with specialists at the National Institutes of Health Clinical Center in Bethesda, Maryland.

- **Adults and children with a brain tumor:** Specialists in the NCI Neuro-Oncology Branch provide consultations. The telephone number is 301-594-6767 or 866-251-9686.
- **Children with a brain tumor:** Specialists in the NCI Pediatric Neuro-Oncology Section of the Pediatric Oncology Branch provide consultations. The telephone number is 301-496-8009 or 877-624-4878.

The NCI Contact Center at **1-800-4-CANCER (1-800-422-6237)** can tell you about nearby treatment centers. Other sources can be found in NCI's fact sheet *How To Find a Doctor or Treatment Facility If You Have Cancer*.

Nonprofit groups with an interest in brain tumors may be of help. Many such groups are listed in the NCI fact sheet *National Organizations That Offer Services to People With Cancer and Their Families*.

Nutrition

It's important for you to take care of yourself by eating well. You need the right amount of calories to maintain a good weight. You also need enough protein to keep up your strength. Eating well may help you feel better and have more energy.

Sometimes, especially during or soon after treatment, you may not feel like eating. You may be uncomfortable or tired. You may find that foods don't taste as good as they used to. In addition, the side effects of treatment (such as poor appetite, nausea, vomiting, or mouth blisters) can make it hard to eat well. Your doctor, a registered dietitian, or another health care provider can suggest ways to deal with these problems. Also, the NCI booklet *Eating Hints* has many useful ideas and recipes.

Supportive Care

A brain tumor and its treatment can lead to other health problems. You may receive supportive care to prevent or control these problems.

You can have supportive care before, during, and after cancer treatment. It can improve your comfort and quality of life during treatment.

Your health care team can help you with the following problems:

- **Swelling of the brain:** Many people with brain tumors need steroids to help relieve swelling of the brain.
- **Seizures:** Brain tumors can cause seizures (convulsions). Certain drugs can help prevent or control seizures.

- **Fluid buildup in the skull:** If fluid builds up in the skull, the surgeon may place a shunt to drain the fluid. Information about shunts is in the Surgery part of the Treatment section (page 17).
- **Sadness and other feelings:** It's normal to feel sad, anxious, or confused after a diagnosis of a serious illness. Some people find it helpful to talk about their feelings. See the Sources of Support section on page 28 for more information.

Many people with brain tumors receive supportive care along with treatments intended to slow the progress of the disease. Some decide not to have antitumor treatment and receive only supportive care to manage their symptoms.

You can get information about supportive care at <http://www.cancer.gov/cancerinfo/coping> on the NCI Web site and from the NCI Contact Center at **1-800-4-CANCER (1-800-422-6237)** or **LiveHelp** (<http://www.cancer.gov/help>).

Rehabilitation

Rehabilitation can be a very important part of the treatment plan. The goals of rehabilitation depend on your needs and how the tumor has affected your ability to carry out daily activities.

Some people may never regain all the abilities they had before the brain tumor and its treatment. But your health care team makes every effort to help you return to normal activities as soon as possible.

Several types of therapists can help:

- **Physical therapists:** Brain tumors and their treatment may cause *paralysis*. They may also cause weakness and problems with balance. Physical therapists help people regain strength and balance.
- **Speech therapists:** Speech therapists help people who have trouble speaking, expressing thoughts, or swallowing.
- **Occupational therapists:** Occupational therapists help people learn to manage activities of daily living, such as eating, using the toilet, bathing, and dressing.
- **Physical medicine specialists:** Medical doctors with special training help people with brain tumors stay as active as possible. They can help people recover lost abilities and return to daily activities.

Children with brain tumors may have special needs. Sometimes children have tutors in the hospital or at home. Children who have problems learning or remembering what they learn may need tutors or special classes when they return to school.

Follow-up Care

You'll need regular checkups after treatment for a brain tumor. For example, for certain types of brain tumors, checkups may be every 3 months. Checkups help ensure that any changes in your health are noted and treated if needed. If you have any health problems between checkups, you should contact your doctor.

Your doctor will check for return of the tumor. Also, checkups help detect health problems that can result from cancer treatment.

Checkups may include careful physical and neurologic exams, as well as MRI or CT scans. If you have a shunt, your doctor checks to see that it's working well.

The NCI has publications to help answer questions about follow-up care and other concerns. You may find it helpful to read the NCI booklet *Facing Forward: Life After Cancer Treatment*. You may also want to read the NCI fact sheet *Follow-up Care After Cancer Treatment*.

Sources of Support

Learning you have a brain tumor can change your life and the lives of those close to you. These changes can be hard to handle. It's normal for you, your family, and your friends to need help coping with the feelings that such a diagnosis can bring.

Concerns about treatments and managing side effects, hospital stays, and medical bills are common. You may also worry about caring for your family, keeping your job, or continuing daily activities.

Here's where you can go for support:

- Doctors, nurses, and other members of your health care team can answer questions about treatment, working, or other activities.
- Social workers, counselors, or members of the clergy can be helpful if you want to talk about your feelings or concerns. Often, social workers can suggest resources for financial aid, transportation, home care, or emotional support.



- Support groups also can help. In these groups, people with brain tumors or their family members meet with other patients or their families to share what they have learned about coping with the disease and the effects of treatment. Groups may offer support in person, over the telephone, or on the Internet. You may want to talk with a member of your health care team about finding a support group.
- Information specialists at **1-800-4-CANCER (1-800-422-6237)** and at **LiveHelp (<http://www.cancer.gov/help>)** can help you locate programs, services, and publications. They can send you a list of organizations that offer services to people with cancer.

For tips on coping, you may want to read the NCI booklet *Taking Time: Support for People With Cancer*.

Taking Part in Cancer Research

Cancer research has led to real progress in the detection and treatment of brain tumors. Continuing research offers hope that in the future even more people with brain tumors will be treated successfully.

Doctors all over the country are conducting many types of clinical trials (research studies in which people volunteer to take part). Clinical trials are designed to find out whether new approaches are safe and effective.

Doctors are trying to find better ways to care for adults and children with brain tumors. They are testing new drugs and combining drugs with radiation therapy. They are also studying how drugs may reduce the side effects of treatment.

Even if the people in a trial do not benefit directly, they may still make an important contribution by helping doctors learn more about brain tumors and how to control them. Although clinical trials may pose some risks, doctors do all they can to protect their patients.

If you're interested in being part of a clinical trial, talk with your doctor. You may want to read the NCI booklet *Taking Part in Cancer Treatment Research Studies*. It describes how treatment studies are carried out and explains their possible benefits and risks.

The NCI Web site includes a section on clinical trials at <http://www.cancer.gov/clinicaltrials>. It has general information about clinical trials as well as detailed information about specific ongoing studies of brain tumors. NCI's Information Specialists at **1-800-4-CANCER (1-800-422-6237)** and at **LiveHelp** at <http://www.cancer.gov/help> can answer questions and provide information about clinical trials.

Dictionary

Definitions of thousands of terms are on the NCI Web site in the NCI Dictionary of Cancer Terms. You can access it at <http://www.cancer.gov/dictionary>.

3-Dimensional conformal radiation therapy (3-dih-MEN-shuh-nul kun-FOR-mul RAY-dee-AY-shun THAYR-uh-pee): A procedure that uses a computer to create a 3-dimensional picture of the tumor. This allows doctors to give the highest possible dose of radiation to the tumor, while sparing the normal tissue as much as possible.

Anaplastic (an-ah-PLAS-tik): A term used to describe cancer cells that divide rapidly and have little or no resemblance to normal cells.

Angiogram (AN-jee-oh-gram): An x-ray of blood vessels. The person receives an injection of dye to outline the vessels on the x-ray.

Antibiotic (an-tih-by-AH-tik): A drug used to treat infections caused by bacteria and other microorganisms.

Astrocyte (AS-troh-site): A large, star-shaped cell that holds nerve cells in place and helps them work the way they should. It is a type of glial cell.

Astrocytoma (AS-troh-sy-TOH-muh): A tumor that begins in the brain or spinal cord in small, star-shaped cells called astrocytes.

Benign (beh-NINE): Not cancerous. Benign tumors may grow larger but do not spread to other parts of the body.

Biopsy (BY-op-see): 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.

Brachytherapy (BRAY-kee-THAYR-uh-pee): A type of radiation therapy in which radioactive material sealed in needles, seeds, wires, or catheters is placed directly into or near a tumor. Also called radiation brachytherapy, internal radiation therapy, and implant radiation therapy.

Brain stem: The part of the brain that is connected to the spinal cord.

Brain stem glioma (glee-OH-muh): A tumor located in the part of the brain that connects to the spinal cord (the brain stem). It may grow rapidly or slowly, depending on the grade of the tumor.

Burr hole: A small opening in the skull made with a surgical drill.

Cancer (KAN-ser): A term for diseases in which abnormal cells divide without control. Cancer cells can invade nearby tissues and can spread to other parts of the body through the blood and lymph systems.

Cell: The individual unit that makes up the tissues of the body. All living things are made up of one or more cells.

Cerebellum (ser-uh-BEL-um): The portion of the brain in the back of the head between the cerebrum and the brain stem. The cerebellum controls balance for walking and standing, and other complex motor functions.

Cerebral hemisphere (seh-REE-bral HEM-is-feer): One half of the cerebrum, the part of the brain that controls muscle functions and also controls speech, thought, emotions, reading, writing, and learning. The right hemisphere controls the muscles on the left side of the body, and the left hemisphere controls the muscles on the right side of the body.

Cerebrospinal fluid (seh-REE-broh-SPY-nul): CSF. The fluid that flows in and around the hollow spaces of the brain and spinal cord, and between two of the meninges (the thin layers of tissue that cover and protect the brain and spinal cord). Cerebrospinal fluid is made by tissue called the choroid plexus in the ventricles (hollow spaces) in the brain.

Cerebrum (seh-REE-brum): The largest part of the brain. It is divided into two hemispheres, or halves, called the cerebral hemispheres. Areas within the cerebrum control muscle functions and also control speech, thought, emotions, reading, writing, and learning.

Chemotherapy (KEE-moh-THAYR-uh-pee): Treatment with drugs that kill cancer cells.

Clinical trial: A 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.

Contrast material: A dye or other substance that helps to show abnormal areas inside the body. It is given by injection into a vein, by enema, or by mouth. Contrast material may be used with x-rays, CT scans, MRI, or other imaging tests.

Craniotomy (KRAY-nee-AH-toh-mee): An operation in which an opening is made in the skull.

CT scan: A series of detailed pictures of areas inside the body taken from different angles. The pictures are created by a computer linked to an x-ray machine. Also called CAT scan, computed tomography scan, computerized axial tomography scan, and computerized tomography.

Diffuse intrinsic pontine glioma (dih-FYOOS in-TRIN-sik PON-teen glee-OH-muh): A type of central nervous system tumor that forms from glial (supportive) tissue of the brain and spinal cord. Diffuse intrinsic pontine glioma usually occurs in children. It forms in the brain stem.

Ependymoma (eh-PEN-dih-MOH-muh): A type of brain tumor that begins in cells lining the spinal cord central canal (fluid-filled space down the center) or the ventricles (fluid-filled spaces of the brain). Ependymomas may also form in the choroid plexus (tissue in the ventricles that makes cerebrospinal fluid). Also called ependymal tumor.

External radiation therapy (RAY-dee-AY-shun THAYR-uh-pee): A type of radiation therapy that uses a machine to aim high-energy rays at the cancer from outside of the body. Also called external beam radiation therapy.

Gamma ray: A type of high-energy radiation that is different from an x-ray.

General anesthesia (A-nes-THEE-zhuh): Drugs that cause loss of feeling or awareness and put the person to sleep.

Glial cell (GLEE-ul): Any of the cells that hold nerve cells in place and help them work the way they should. The types of glial cells include oligodendrocytes, astrocytes, microglia, and ependymal cells. Also called neuroglia.

Glioblastoma (GLEE-oh-blas-TOH-muh): A fast-growing type of central nervous system tumor that forms from glial (supportive) tissue of the brain and spinal cord and has cells that look very different from normal cells. Glioblastoma usually occurs in adults and

affects the brain more often than the spinal cord. Also called GBM, glioblastoma multiforme, and grade IV astrocytoma.

Glioma (glee-OH-muh): A cancer of the brain that begins in glial cells (cells that surround and support nerve cells).

Grade: The grade of a tumor depends on how abnormal the cancer cells look under a microscope and how quickly the tumor is likely to grow and spread. Grading systems are different for each type of cancer.

Implant radiation therapy (RAY-dee-AY-shun THAYR-uh-pee): A type of radiation therapy in which radioactive material sealed in needles, seeds, wires, or catheters is placed directly into or near a tumor. Also called brachytherapy, radiation brachytherapy, and internal radiation therapy.

Incision (in-SIH-zhun): A cut made in the body to perform surgery.

Intensity-modulated radiation therapy (in-TEN-sih-tee-MAH-juh-LAY-tid RAY-dee-AY-shun THAYR-uh-pee): A type of 3-dimensional radiation therapy that uses computer-generated images to show the size and shape of the tumor. Thin beams of radiation of different intensities are aimed at the tumor from many angles. This type of radiation therapy reduces the damage to healthy tissue near the tumor.

Internal radiation therapy (in-TER-nul RAY-dee-AY-shun THAYR-uh-pee): A type of radiation therapy in which radioactive material sealed in needles, seeds, wires, or catheters is placed directly into or near a tumor. Also called brachytherapy, radiation brachytherapy, and implant radiation therapy.

Intravenous (IN-truh-VEE-nus): IV. Into or within a vein. Intravenous usually refers to a way of giving a drug or other substance through a needle or tube inserted into a vein.

Ionizing radiation (I-uh-NYZ-ing RAY-dee-AY-shun):

A type of radiation made (or given off) by x-ray procedures, radioactive substances, rays that enter the Earth's atmosphere from outer space, and other sources. At high doses, ionizing radiation increases chemical activity inside cells and can lead to health risks, including cancer.

Juvenile pilocytic astrocytoma (JOO-veh-NILE PY-

loh-SIH-tik AS-troh-sy-TOH-muh): A slow-growing type of central nervous system tumor that forms from glial (supportive) tissue of the brain and spinal cord. Juvenile pilocytic astrocytoma usually occurs in children and young adults. It forms in the brain more often than the spinal cord.

Local anesthesia (A-nes-THEE-zhuh): Drugs that cause a temporary loss of feeling in one part of the body. The patient remains awake but cannot feel the part of the body treated with the anesthetic.

Malignant (muh-LIG-nunt): Cancerous. Malignant tumors can invade and destroy nearby tissue and spread to other parts of the body.

Medical oncologist (MEH-dih-kul on-KAH-loh-jist):

A doctor who specializes in diagnosing and treating cancer using chemotherapy, hormonal therapy, and biological therapy. A medical oncologist often is the main health care provider for someone who has cancer. A medical oncologist also gives supportive care and may coordinate treatment given by other specialists.

Medulloblastoma (MED-yoo-loh-blas-TOH-muh):

A malignant brain tumor that begins in the lower part of the brain and that can spread to the spine or to other parts of the body. Medulloblastomas are a type of primitive neuroectodermal tumor (PNET).

Meninges (meh-NIN-jees): The three thin layers of tissues that cover and protect the brain and spinal cord.

Meningioma (meh-NIN-jee-OH-muh): A type of slow-growing tumor that forms in the meninges (thin layers of tissue that cover and protect the brain and spinal cord). Meningiomas usually occur in adults.

Mental health counselor: A specialist who can talk with patients and their families about emotional and personal matters, and can help them make decisions.

Metastatic (meh-tuh-STA-tik): Having to do with metastasis, which is the spread of cancer from one part of the body to another.

MRI: Magnetic resonance imaging (mag-NEH-tik REH-zuh-nunts IH-muh-jing). A procedure in which radio waves and a powerful magnet linked to a computer are used to create detailed pictures of areas inside the body. These pictures can show the difference between normal and diseased tissue. MRI makes better images of organs and soft tissue than other scanning techniques, such as computed tomography (CT) or x-ray. MRI is especially useful for imaging the brain, the spine, the soft tissue of joints, and the inside of bones. Also called NMRI and nuclear magnetic resonance imaging.

Nerve cell: A type of cell that receives and sends messages from the body to the brain and back to the body. The messages are sent by a weak electrical current. Also called neuron.

Neuro-oncologist (NOOR-oh-on-KAH-loh-jist): A doctor who specializes in diagnosing and treating brain tumors and other tumors of the nervous system.

Neurologic (NOOR-oh-LAH-jik): Having to do with nerves or the nervous system.

Neurologist (noo-RAH-loh-jist): A doctor who specializes in the diagnosis and treatment of disorders of the nervous system.

Neuroradiologist (NOOR-oh-RAY-dee-AH-loh-jist):

A doctor trained in radiology who specializes in creating and interpreting pictures of the nervous system. The pictures are produced using forms of radiation, such as x-rays, sound waves, or other types of energy.

Neurosurgeon (NOOR-oh-SER-jun): A doctor who specializes in surgery on the brain, spine, and other parts of the nervous system.

Occupational therapist: A health professional trained to help people who are ill or disabled learn to manage their daily activities.

Oligodendroglioma (AH-lih-goh-DEN-droh-gee-OH-muh): A rare, slow-growing tumor that begins in oligodendrocytes (cells that cover and protect nerve cells in the brain and spinal cord). Also called oligodendroglial tumor.

Oncology nurse (on-KAH-loh-jee): A nurse who specializes in treating and caring for people who have cancer.

Paralysis (puh-RAL-ih-siss): Loss of ability to move all or part of the body.

Pathologist (puh-THAH-loh-jist): A doctor who identifies diseases by studying cells and tissues under a microscope.

Physical medicine specialist (FIH-zih-kul MEH-dih-sin SPEH-shuh-list): A doctor who specializes in physical medicine (the prevention and treatment of disease or injury with physical methods, such as exercise and machines). Also called physiatrist.

Physical therapist: A health professional who teaches exercises and physical activities that help condition muscles and restore strength and movement.

Pituitary gland (pih-TOO-ih-TAYR-ee): The main endocrine gland. It produces hormones that control other glands and many body functions, especially growth.

Primitive neuroectodermal tumor (PRI-muh-tiv NOOR-oh-EK-toh-DER-mul TOO-mer): PNET. One of a group of cancers that develop from the same type of early cells, and share certain biochemical and genetic features. Some primitive neuroectodermal tumors develop in the brain and central nervous system (CNS-PNET), and others develop in sites outside of the brain such as the limbs, pelvis, and chest wall (peripheral PNET).

Proton (PROH-ton): A small, positively charged particle of matter found in the atoms of all elements. Streams of protons generated by special equipment can be used for radiation treatment.

Proton beam radiation therapy (PROH-ton beam RAY-dee-AY-shun THAYR-uh-pee): A type of high-energy, external radiation therapy that uses streams of protons (small, positively charged particles) that come from a special machine. Proton beam radiation is different from x-ray radiation.

Radiation oncologist (RAY-dee-AY-shun on-KAH-loh-jist): A doctor who specializes in using radiation to treat cancer.

Radiation therapy (RAY-dee-AY-shun THAYR-uh-pee): The use of high-energy radiation from x-rays, gamma rays, neutrons, protons, and other sources to kill cancer cells and shrink tumors. Radiation may come from a machine outside the body (external-beam radiation therapy), or it may come from radioactive material placed in the body near cancer cells (internal radiation therapy). Systemic radiation therapy uses a radioactive substance, such as a radiolabeled

monoclonal antibody, that travels in the blood to tissues throughout the body. Also called irradiation and radiotherapy.

Radioactive (RAY-dee-oh-AK-tiv): Giving off radiation.

Registered dietitian (dy-eh-TIH-shun): A health professional with special training in the use of diet and nutrition to keep the body healthy. A registered dietitian may help the medical team improve the nutritional health of a patient.

Risk factor: Something that may increase the chance of developing a disease. Some examples of risk factors for cancer include age, a family history of certain cancers, use of tobacco products, certain eating habits, obesity, lack of exercise, exposure to radiation or other cancer-causing agents, and certain genetic changes.

Seizure (SEE-zhur): Convulsion; a sudden, involuntary movement of the muscles.

Shunt: In medicine, a passage that is made to allow blood or other fluid to move from one part of the body to another. For example, a surgeon may implant a tube to drain cerebrospinal fluid from the brain to the abdomen. A surgeon may also change normal blood flow by making a passage that leads from one blood vessel to another.

Side effect: A problem that occurs when treatment affects healthy tissues or organs. Some common side effects of cancer treatment are fatigue, pain, nausea, vomiting, decreased blood cell counts, hair loss, and mouth sores.

Social worker: A professional trained to talk with people and their families about emotional or physical needs, and to find them support services.

Speech therapist: A specialist who evaluates and treats people with communication and swallowing problems. Also called a speech pathologist.

Spinal tap (SPY-nul): A procedure in which a thin needle called a spinal needle is put into the lower part of the spinal column to collect cerebrospinal fluid or to give drugs. Also called lumbar puncture.

Stereotactic biopsy (STAYR-ee-oh-TAK-tik BY-op-see): A biopsy procedure that uses a computer and a 3-dimensional scanning device to find a tumor site and guide the removal of tissue for examination under a microscope.

Stereotactic radiation therapy (STAYR-ee-oh-TAK-tik RAY-dee-AY-shun THAYR-uh-pee): A type of external radiation therapy that uses special equipment to position the patient and precisely deliver radiation to a tumor. The total dose of radiation is divided into several smaller doses given over several days. Stereotactic radiation therapy is used to treat brain tumors and other brain disorders. It is also being studied in the treatment of other types of cancer, such as lung cancer. Also called stereotactic external-beam radiation therapy and stereotaxic radiation therapy.

Stereotactic radiosurgery (STAYR-ee-oh-TAK-tik RAY-dee-oh-SER-juh-ree): A type of external radiation therapy that uses special equipment to position the patient and precisely give a single large dose of radiation to a tumor. It is used to treat brain tumors and other brain disorders that cannot be treated by regular surgery. It is also being studied in the treatment of other types of cancer. Also called radiation surgery, radiosurgery, and stereotaxic radiosurgery.

Steroid drug (STAYR-oyd): A type of drug used to relieve swelling and inflammation. Some steroid drugs may also have antitumor effects.

Supportive care: Care given to improve the quality of life of patients who have a serious or life-threatening disease. The goal of supportive care is to prevent or treat as early as possible the symptoms of a disease, side effects caused by treatment of a disease, and psychological, social, and spiritual problems related to a disease or its treatment. Also called comfort care, palliative care, and symptom management.

Surgeon: A doctor who removes or repairs a part of the body by operating on the patient.

Surgery (SER-juh-ree): A procedure to remove or repair a part of the body or to find out whether disease is present. An operation.

Tissue (TISH-oo): A group or layer of cells that work together to perform a specific function.

Tumor (TOO-mer): An abnormal mass of tissue that results when cells divide more than they should or do not die when they should. Tumors may be benign (not cancerous), or malignant (cancerous). Also called neoplasm.

Ventricle (VEN-trih-kul): A fluid-filled cavity in the heart or brain.

X-ray: A type of high-energy radiation. 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.

National Cancer Institute Services

You may want more information for yourself, your family, and your doctor. The NCI offers comprehensive research-based information for patients and their families, health professionals, cancer researchers, advocates, and the public.

- **Call** the NCI Contact Center at **1-800-4-CANCER (1-800-422-6237)**
- **Visit** us at **<http://www.cancer.gov>** or **<http://www.cancer.gov/espanol>**
- **Chat** using **LiveHelp**, NCI's instant messaging service, at **<http://www.cancer.gov/livehelp>**
- **E-mail** us at **cancergovstaff@mail.nih.gov**
- **Order** publications at **<http://www.cancer.gov/publications>** or by calling **1-800-4-CANCER**
- **Get help** with quitting smoking at **1-877-44U-QUIT (1-877-448-7848)**

National Cancer Institute Publications

NCI provides publications about cancer, including the booklets and fact sheets mentioned in this booklet. Many are available in both English and Spanish.

You may order these publications by telephone, on the Internet, or by mail. You may also read them online and print your own copy.

- **By telephone:** People in the United States and its territories may order these and other NCI publications by calling the NCI Contact Center at **1-800-4-CANCER (1-800-422-6237)**.
- **On the Internet:** Many NCI publications may be viewed, downloaded, and ordered from **<http://www.cancer.gov/publications>** on the Internet. People in the United States and its territories may use this Web site to order printed copies. This Web site also explains how people outside the United States can mail or fax their requests for NCI booklets.
- **By mail:** NCI publications may be ordered by writing to the address below:
Publications Ordering Service
National Cancer Institute
P.O. Box 24128
Baltimore, MD 21227

Clinical Trials

- *Taking Part in Cancer Treatment Research Studies*

Finding a Doctor, Support Groups, or Other Organizations

- *How To Find a Doctor or Treatment Facility If You Have Cancer* (also in Spanish)
- *Cancer Support Groups*
- *National Organizations That Offer Services to People With Cancer and Their Families* (also in Spanish)

Diagnosis

- *Tumor Grade*

Cancer Treatment and Supportive Care

- *Radiation Therapy and You* (also in Spanish)
- *Understanding Radiation Therapy: What To Know About External Beam Radiation Therapy* (also in Spanish)
- *Understanding Radiation Therapy: What To Know About Brachytherapy (A Type of Internal Radiation Therapy)* (also in Spanish)
- *Chemotherapy and You* (also in Spanish)
- *Eating Hints for Cancer Patients* (also in Spanish)
- *Pain Control* (also in Spanish)

Coping with Cancer

- *Taking Time: Support for People with Cancer*
- *Managing Radiation Therapy Side Effects: What To Do When You Feel Weak or Tired (Fatigue)* (also in Spanish)

Life After Cancer Treatment

- *Facing Forward: Life After Cancer Treatment* (also in Spanish)
- *Follow-up Care After Cancer Treatment*
- *Facing Forward: Ways You Can Make a Difference in Cancer*

Advanced or Recurrent Cancer

- *Coping With Advanced Cancer*
- *When Cancer Returns*

Complementary Medicine

- *Thinking about Complementary & Alternative Medicine: A guide for people with cancer*
- *Complementary and Alternative Medicine in Cancer Treatment* (also in Spanish)

Caregivers

- *When Someone You Love Is Being Treated for Cancer: Support for Caregivers*
- *When Someone You Love Has Advanced Cancer: Support for Caregivers*
- *Facing Forward: When Someone You Love Has Completed Cancer Treatment*
- *Caring for the Caregiver: Support for Cancer Caregivers*

Possible Risk Factors

- *Cellular Telephone Use and Cancer Risk*
- *Magnetic Field Exposure and Cancer*
- *Secondhand Smoke*

The National Cancer Institute

The National Cancer Institute (NCI), part of the National Institutes of Health, is the Federal Government's principal agency for cancer research and training. NCI conducts and supports basic and clinical research to find better ways to prevent, diagnose, and treat cancer. The Institute also supports education and training for cancer research and treatment programs. In addition, NCI is responsible for communicating its research findings to the medical community and the public.

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