

National Cancer Institute

at the National Institutes of Health

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## Adult Brain Tumors Treatment (PDQ®)

Patient Version

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## General Information About Adult Brain Tumors

### Key Points for This Section

- An adult brain tumor is a disease in which abnormal cells form in the tissues of the brain.
- A brain tumor that starts in another part of the body and spreads to the brain is called a metastatic tumor.
- The brain controls many important body functions.
- The spinal cord connects the brain to nerves in most parts of the body.
- There are different types of brain and spinal cord tumors.
  - Astrocytic Tumors
  - Oligodendroglial Tumors
  - Mixed Gliomas
  - Ependymal Tumors
  - Medulloblastomas
  - Pineal Parenchymal Tumors
  - Meningeal Tumors
  - Germ Cell Tumors
  - Craniopharyngioma (Grade I)
  - Recurrent Brain Tumors
- Having certain genetic syndromes may affect the risk of a brain tumor.
- The cause of most adult brain and spinal cord tumors is unknown.
- The symptoms of adult brain and spinal cord tumors are not the same in every person.
- Tests that examine the brain and spinal cord are used to diagnose adult brain and spinal cord tumors.

- A biopsy is also used to diagnose a brain tumor.
  - Sometimes a biopsy or surgery cannot be done.
- Certain factors affect prognosis (chance of recovery) and treatment options.

## **An adult brain tumor is a disease in which abnormal cells form in the tissues of the brain.**

There are many types of brain and spinal cord tumors. The tumors are formed by the abnormal growth of cells and may begin in different parts of the brain or spinal cord. Together, the brain and spinal cord make up the central nervous system (CNS).

The tumors may be either benign (not cancer) or malignant (cancer):

- Benign brain and spinal cord tumors grow and press on nearby areas of the brain. They rarely spread into other tissues and may recur (come back).
- Malignant brain and spinal cord tumors are likely to grow quickly and spread into other brain tissue.

When a tumor grows into or presses on an area of the brain, it may stop that part of the brain from working the way it should. Both benign and malignant brain tumors cause symptoms and need treatment.

Brain and spinal cord tumors can occur in both adults and children. However, treatment for children may be different than treatment for adults. (See the PDQ summary on Childhood Brain and Spinal Cord Tumors Treatment Overview for more information on the treatment of children.)

For information about lymphoma that begins in the brain, see the PDQ summary on Primary CNS Lymphoma Treatment.

## **A brain tumor that starts in another part of the body and spreads to the brain is called a metastatic tumor.**

Tumors that start in the brain are called primary brain tumors. Primary brain tumors may spread to other parts of the brain or to the spine. They rarely spread to other parts of the body.

Often, tumors found in the brain have started somewhere else in the body and spread to one or more parts of the brain. These are called metastatic brain tumors (or brain metastases). Metastatic brain tumors are more common than primary brain tumors.

About half of metastatic brain tumors are from lung cancer. Other types of cancer that commonly spread to the brain are melanoma and cancer of the breast, colon, kidney, nasopharynx, and unknown primary site. Leukemia, lymphoma, breast cancer, and gastrointestinal cancer may spread to the leptomeninges (the two innermost membranes covering the brain and spinal cord). This is called leptomeningeal carcinomatosis.

See the following for more information from PDQ about cancers that commonly spread to the brain or spinal cord:

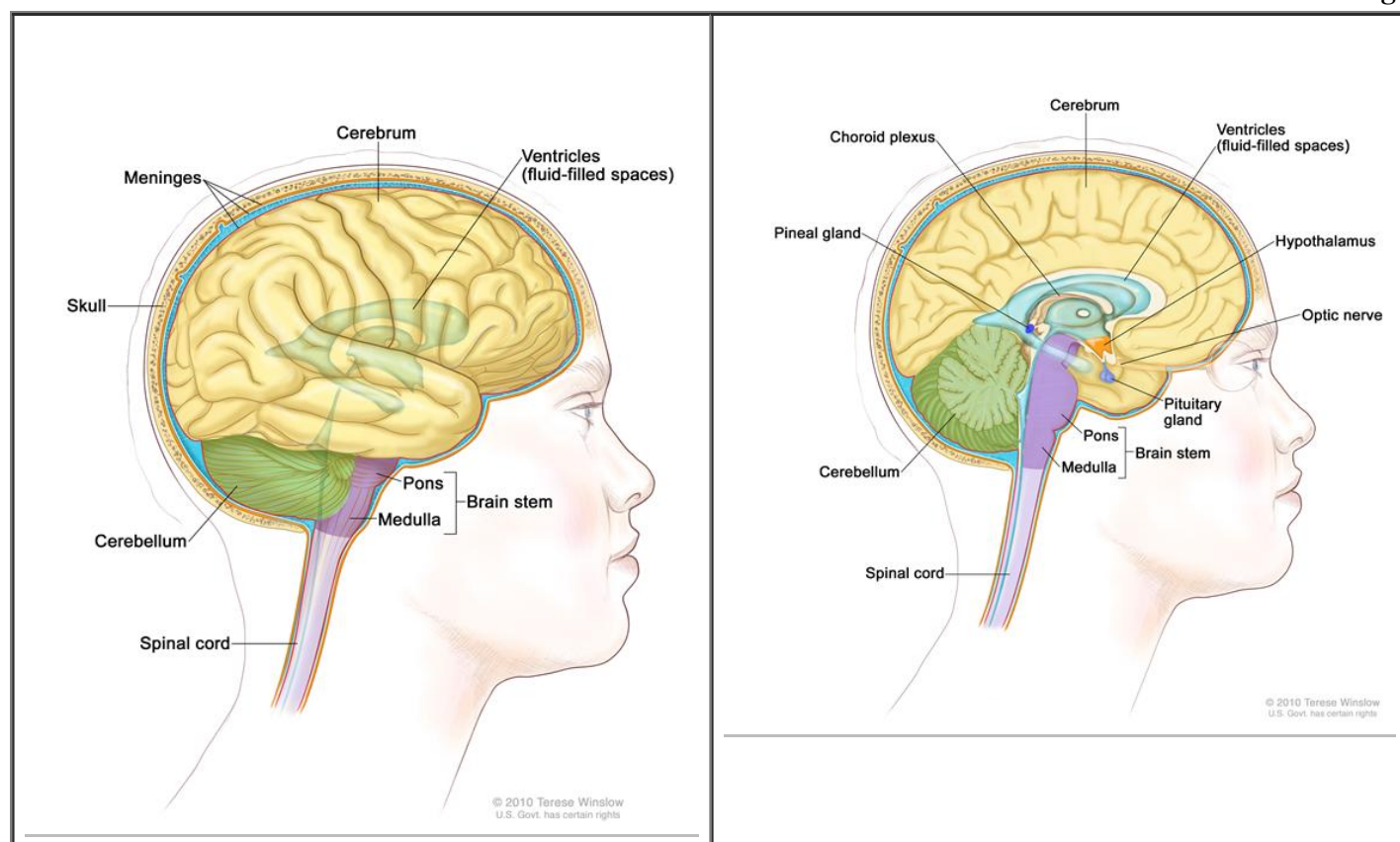
- Adult Hodgkin Lymphoma Treatment
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- Nasopharyngeal Cancer Treatment
- Non-Small Cell Lung Cancer Treatment
- Renal Cell Cancer Treatment
- Small Cell Lung Cancer Treatment

## The brain controls many important body functions.

The brain has three major parts:

- The cerebrum is the largest part of the brain. It is at the top of the head. The cerebrum controls thinking, learning, problem solving, emotions, speech, reading, writing, and voluntary movement.
- The cerebellum is in the lower back of the brain (near the middle of the back of the head). It controls movement, balance, and posture.
- The brain stem connects the brain to the spinal cord. It is in the lowest part of the brain (just above the back of the neck). The brain stem controls breathing, heart rate, and the nerves and muscles used to see, hear, walk, talk, and eat.

Enlarge



Anatomy of the brain, showing the cerebrum, cerebellum, brain stem, and other parts of the brain.

Anatomy of the inside of the brain, showing the pineal and pituitary glands, optic nerve, ventricles (with cerebrospinal fluid)

shown in blue), and other parts of the brain.

## The spinal cord connects the brain to nerves in most parts of the body.

The spinal cord is a column of nerve tissue that runs from the brain stem down the center of the back. It is covered by three thin layers of tissue called membranes. These membranes are surrounded by the vertebrae (back bones). Spinal cord nerves carry messages between the brain and the rest of the body, such as a signal from the brain that makes muscles move or a signal from the skin to the brain that it senses heat.

## There are different types of brain and spinal cord tumors.

Brain and spinal cord tumors are named based on the type of cell they formed in and where the tumor first formed in the CNS. The grade of a tumor may be used to tell the difference between slow-growing and fast-growing types of the tumor. The grade of a tumor is based on how abnormal the cancer cells look under a microscope and how quickly the tumor is likely to grow and spread.

### *Tumor Grading System*

- **Grade I (low-grade)** — The tumor grows slowly, has cells that look a lot like normal cells, and rarely spreads into nearby tissues. Grade I brain tumors may be cured if they are completely removed by surgery.
- **Grade II** — The tumor grows slowly, but may spread into nearby tissue and may recur (come back). Some tumors may become a higher-grade tumor.
- **Grade III** — The tumor grows quickly, is likely to spread into nearby tissue, and the tumor cells look very different from normal cells.
- **Grade IV (high-grade)** — The tumor grows and spreads very quickly and the cells do not look like normal cells. There may be areas of dead cells in the tumor. Grade IV tumors usually cannot be cured.

The following types of tumors can form in the brain or spinal cord:

### **Astrocytic Tumors**

An astrocytic tumor begins in star-shaped brain cells called astrocytes, which help keep nerve cells healthy. An astrocyte is a type of glial cell. Glial cells sometimes form tumors called gliomas. Astrocytic tumors include the following:

- **Brain stem glioma (usually high grade):** A brain stem glioma forms in the brain stem, which is the part of the brain connected to the spinal cord. It is often a high-grade tumor, which spreads widely through the brain stem and is hard to cure. Brain stem gliomas are rare in adults. (See the PDQ summary on Childhood Brain Stem Glioma Treatment for more information.)
- **Pineal astrocytic tumor (any grade):** A pineal astrocytic tumor forms in tissue around the pineal gland and may be any grade. The pineal gland is a tiny organ in the brain that makes melatonin, a hormone that helps control the sleeping and waking cycle.
- **Pilocytic astrocytoma (grade I):** A pilocytic astrocytoma grows slowly in the brain or spinal

cord. It may be in the form of a cyst and rarely spreads into nearby tissues. Pilocytic astrocytomas can often be cured.

- **Diffuse astrocytoma (grade II):** A diffuse astrocytoma grows slowly, but often spreads into nearby tissues. The tumor cells look something like normal cells. In some cases, a diffuse astrocytoma can be cured. It is also called a low-grade diffuse astrocytoma.
- **Anaplastic astrocytoma (grade III):** An anaplastic astrocytoma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually cannot be cured. An anaplastic astrocytoma is also called a malignant astrocytoma or high-grade astrocytoma.
- **Glioblastoma (grade IV):** A glioblastoma grows and spreads very quickly. The tumor cells look very different from normal cells. This type of tumor usually cannot be cured. It is also called glioblastoma multiforme.

See the PDQ summary on Childhood Astrocytomas Treatment for more information about astrocytomas in children.

## Oligodendroglial Tumors

An oligodendroglial tumor begins in brain cells called oligodendrocytes, which help keep nerve cells healthy. An oligodendrocyte is a type of glial cell. Oligodendrocytes sometimes form tumors called oligodendrogliomas. Grades of oligodendroglial tumors include the following:

- **Oligodendroglioma (grade II):** An oligodendroglioma grows slowly, but often spreads into nearby tissues. The tumor cells look something like normal cells. In some cases, an oligodendroglioma can be cured.
- **Anaplastic oligodendroglioma (grade III):** An anaplastic oligodendroglioma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually cannot be cured.

See the PDQ summary on Childhood Astrocytomas Treatment for more information about oligodendroglial tumors in children.

## Mixed Gliomas

A mixed glioma is a brain tumor that has two types of tumor cells in it — oligodendrocytes and astrocytes. This type of mixed tumor is called an oligoastrocytoma.

- **Oligoastrocytoma (grade II):** An oligoastrocytoma is a slow-growing tumor. The tumor cells look something like normal cells. In some cases, an oligoastrocytoma can be cured.
- **Anaplastic oligoastrocytoma (grade III):** An anaplastic oligoastrocytoma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor has a worse prognosis than oligoastrocytoma (grade II).

See the PDQ summary on Childhood Astrocytomas Treatment for more information about mixed gliomas in children.

## Ependymal Tumors

An ependymal tumor usually begins in cells that line the fluid-filled spaces in the brain and around the spinal cord. An ependymal tumor may also be called an ependymoma. Grades of ependymomas include the following:

- **Ependymoma (grade I or II):** A grade I or II ependymoma grows slowly and has cells that look something like normal cells. There are two types of grade I ependymoma — myxopapillary ependymoma and subependymoma. A grade II ependymoma grows in a ventricle (fluid-filled space in the brain) and its connecting paths or in the spinal cord. In some cases, a grade I or II ependymoma can be cured.
- **Anaplastic ependymoma (grade III):** An anaplastic ependymoma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually has a worse prognosis than a grade I or II ependymoma.

See the PDQ summary on Childhood Ependymoma Treatment for more information about ependymoma in children.

## Medulloblastomas

A medulloblastoma is a type of embryonal tumor. Medulloblastomas are most common in children or young adults.

See the PDQ summary on Childhood Central Nervous System Embryonal Tumors Treatment for more information about medulloblastomas in children.

## Pineal Parenchymal Tumors

A pineal parenchymal tumor forms in parenchymal cells or pineocytes, which are the cells that make up most of the pineal gland. These tumors are different from pineal astrocytic tumors. Grades of pineal parenchymal tumors include the following:

- **Pineocytoma (grade II):** A pineocytoma is a slow-growing pineal tumor.
- **Pineoblastoma (grade IV):** A pineoblastoma is a rare tumor that is very likely to spread.

See the PDQ summary on Childhood Central Nervous System Embryonal Tumors Treatment for more information about pineal parenchymal tumors in children.

## Meningeal Tumors

A meningeal tumor, also called a meningioma, forms in the meninges (thin layers of tissue that cover the brain and spinal cord). It can form from different types of brain or spinal cord cells. Meningiomas are most common in adults. Types of meningeal tumors include the following:

- **Meningioma (grade I):** A grade I meningioma is the most common type of meningeal tumor. A grade I meningioma is a slow-growing tumor. It forms most often in the dura mater. A grade I meningioma can be cured if it is completely removed by surgery.
- **Meningioma (grade II and III):** This is a rare meningeal tumor. It grows quickly and is likely to spread within the brain and spinal cord. The prognosis is worse than a grade I meningioma because

the tumor usually cannot be completely removed by surgery.

A hemangiopericytoma is not a meningeal tumor but is treated like a grade II or III meningioma. A hemangiopericytoma usually forms in the dura mater. The prognosis is worse than a grade I meningioma because the tumor usually cannot be completely removed by surgery.

## **Germ Cell Tumors**

A germ cell tumor forms in germ cells, which are the cells that develop into sperm in men or ova (eggs) in women. There are different types of germ cell tumors. These include germinomas, teratomas, embryonal yolk sac carcinomas, and choriocarcinomas. Germ cell tumors can be either benign or malignant.

See the PDQ summary on Childhood Central Nervous System Germ Cell Tumors Treatment for more information about childhood germ cell tumors in the brain.

## **Craniopharyngioma (Grade I)**

A craniopharyngioma is a rare tumor that usually forms just above the pituitary gland (a pea-sized organ at the bottom of the brain that controls other glands). Craniopharyngiomas can form from different types of brain or spinal cord cells. They begin in the center of the brain, just above the back of the nose.

See the PDQ summary on Childhood Craniopharyngioma Treatment for more information about craniopharyngioma in children.

## **Recurrent Brain Tumors**

A recurrent brain tumor is a tumor that has recurred (come back) after it has been treated. Brain tumors often recur, sometimes many years after the first tumor. The tumor may recur at the same place in the brain or in other parts of the central nervous system.

## **Having certain genetic syndromes may affect the risk of a brain tumor.**

Anything that increases your chance of getting a disease is called a risk factor. Having a risk factor does not mean that you will get cancer; not having risk factors doesn't mean that you will not get cancer. Talk with your doctor if you think you may be at risk. There are few known risk factors for brain tumors. The following conditions may increase the risk of certain types of brain tumors:

- Being exposed to vinyl chloride may increase the risk of glioma.
- Infection with the Epstein-Barr virus, having AIDS (acquired immunodeficiency syndrome), or receiving an organ transplant may increase the risk of primary CNS lymphoma. (See the PDQ summary on Primary CNS Lymphoma for more information.)
- Having certain genetic syndromes may increase the risk brain tumors:
  - Neurofibromatosis type 1 (NF1) or 2 (NF2).
  - von Hippel-Lindau disease.
  - Tuberous sclerosis.
  - Li-Fraumeni syndrome.
  - Turcot syndrome type 1 or 2.



- Nevoid basal cell carcinoma syndrome.

## **The cause of most adult brain and spinal cord tumors is unknown.**

## **The symptoms of adult brain and spinal cord tumors are not the same in every person.**

The symptoms caused by a primary brain tumor depend on where the tumor begins in the brain, what that part of the brain controls, and the size of the tumor. Headaches and other symptoms may be caused by brain tumors. Other conditions, including cancer that has spread to the brain, may cause the same symptoms. Check with your doctor if you have any of the following problems:

### ***Brain Tumors***

- Morning headache or headache that goes away after vomiting.
- Frequent nausea and vomiting.
- Loss of appetite.
- Vision, hearing, and speech problems.
- Loss of balance and trouble walking.
- Weakness.
- Unusual sleepiness or change in activity level.
- Changes in personality, mood, ability to focus, or behavior.
- Seizures.

### ***Spinal Cord Tumors***

- Back pain or pain that spreads from the back towards the arms or legs.
- A change in bowel habits or trouble urinating.
- Weakness in the legs.
- Trouble walking.

## **Tests that examine the brain and spinal cord are used to diagnose adult brain and spinal cord tumors.**

The following tests and procedures may be used:

- **Physical exam and history** : An exam of the body to check general signs of health, including checking for signs of disease, such as lumps or anything else that seems unusual. A history of the patient's health habits and past illnesses and treatments will also be taken.
- **Neurological exam** : A series of questions and tests to check the brain, spinal cord, and nerve function. The exam checks a person's mental status, coordination, and ability to walk normally, and how well the muscles, senses, and reflexes work. This may also be called a neuro exam or a neurologic exam.
- **Visual field exam**: An exam to check a person's field of vision (the total area in which objects can be seen). This test measures both central vision (how much a person can see when looking straight

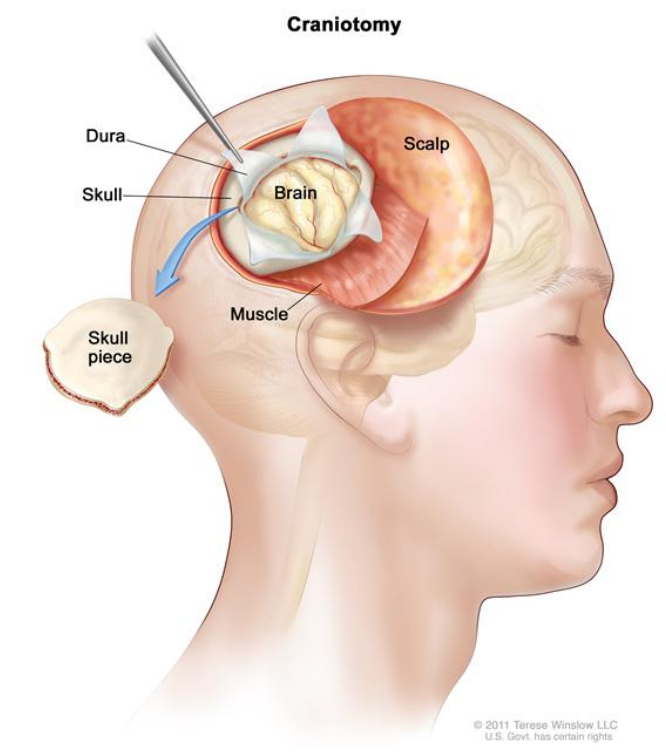
ahead) and peripheral vision (how much a person can see in all other directions while staring straight ahead). Any loss of vision may be a sign of a tumor that has damaged or pressed on the parts of the brain that affect eyesight.

- **Tumor marker test** : A procedure in which a sample of blood, urine, or tissue is checked to measure the amounts of certain substances made by organs, tissues, or tumor cells in the body. Certain substances are linked to specific types of cancer when found in increased levels in the body. These are called tumor markers. This test may be done to diagnose a germ cell tumor.
- **Gene testing** : A laboratory test in which a sample of blood or tissue is tested for changes in a chromosome that has been linked with a certain type of brain tumor. This test may be done to diagnose an inherited syndrome.
- **CT scan (CAT scan)**: A procedure that makes a series of detailed pictures of areas inside the body, taken from different angles. The pictures are made by a computer linked to an x-ray machine. A dye may be injected into a vein or swallowed to help the organs or tissues show up more clearly. This procedure is also called computed tomography, computerized tomography, or computerized axial tomography.
- **MRI (magnetic resonance imaging) with gadolinium** : A procedure that uses a magnet, radio waves, and a computer to make a series of detailed pictures of the brain and spinal cord. A substance called gadolinium is injected into a vein. The gadolinium collects around the cancer cells so they show up brighter in the picture. This procedure is also called nuclear magnetic resonance imaging (NMRI). Sometimes a procedure called magnetic resonance spectroscopy (MRS) is done during the MRI scan. An MRS is used to diagnose tumors, based on their chemical make-up. MRI is often used to diagnose tumors in the spinal cord.
- **SPECT scan (single photon emission computed tomography scan)**: A procedure that uses a special camera linked to a computer to make a 3-dimensional (3-D) picture of the brain. A small amount of a radioactive substance is injected into a vein or inhaled through the nose. As the substance travels through the blood, the camera rotates around the head and takes pictures of the brain. Blood flow and metabolism are higher than normal in areas where cancer cells are growing. These areas will show up brighter in the picture. This procedure may be done just before or after a CT scan. SPECT is used to tell the difference between a primary tumor and a tumor that has spread to the brain from somewhere else in the body.
- **PET scan (positron emission tomography scan)**: A procedure to find malignant tumor cells in the body. A small amount of radioactive glucose (sugar) is injected into a vein. The PET scanner rotates around the body and makes a picture of where glucose is being used in the brain. Malignant tumor cells show up brighter in the picture because they are more active and take up more glucose than normal cells do. PET is used to tell the difference between a primary tumor and a tumor that has spread to the brain from somewhere else in the body.
- **Angiogram** : A procedure to look at blood vessels and the flow of blood in the brain. A contrast dye is injected into the blood vessel. As the contrast dye moves through the blood vessel, x-rays are taken to see if the vessel is blocked.

## A biopsy is also used to diagnose a brain tumor.

If imaging tests show there may be a brain tumor, a biopsy is usually done. One of the following types of biopsies may be used:

- **Stereotactic biopsy** : When imaging tests show there may be a tumor deep in the brain in a hard to reach place, a stereotactic brain biopsy may be done. This kind of biopsy uses a computer and a 3-dimensional scanning device to find the tumor and guide the needle used to remove the tissue. A small incision is made in the scalp and a small hole is drilled through the skull. A biopsy needle is inserted through the hole to remove cells or tissues so they can be viewed under a microscope by a pathologist to check for signs of cancer.
- **Open biopsy** : When imaging tests show that there may be a tumor that can be removed by surgery, an open biopsy may be done. A part of the skull is removed in an operation called a craniotomy. A sample of brain tissue is removed and viewed under a microscope by a pathologist. If cancer cells are found, some or all of the tumor may be removed during the same surgery. Tests are done before surgery to find the areas around the tumor that are important for normal brain function. There are also ways to test brain function during surgery. The doctor will use the results of these tests to remove as much of the tumor as possible with the least damage to normal tissue in the brain.



Craniotomy: An opening is made in the skull and a piece of the skull is removed to show part of the brain.

The pathologist checks the biopsy sample to find out the type and grade of brain tumor. The grade of the tumor is based on how the tumor cells look under a microscope and how quickly the tumor is likely to grow and spread.

The following tests may be done on the tumor tissue that is removed:

- **Immunohistochemistry study:** A laboratory test in which a substance such as an antibody, dye, or radioisotope is added to a sample of cancer tissue to test for certain antigens. This type of study is used to tell the difference between different types of cancer.
- **Light and electron microscopy :** A laboratory test in which cells in a sample of tissue are viewed under regular and high-powered microscopes to look for certain changes in the cells.
- **Cytogenetic analysis :** A laboratory test in which cells in a sample of tissue are viewed under a microscope to look for certain changes in the chromosomes.

### **Sometimes a biopsy or surgery cannot be done.**

For some tumors, a biopsy or surgery cannot be done safely because of where the tumor formed in the brain or spinal cord. These tumors are diagnosed and treated based on the results of imaging tests and other procedures.

Sometimes the results of imaging tests and other procedures show that the tumor is very likely to be benign and a biopsy is not done.

### **Certain factors affect prognosis (chance of recovery) and treatment options.**

The prognosis (chance of recovery) and treatment options for *primary* brain and spinal cord tumors depend on the following:

- The type and grade of the tumor.
- Where the tumor is in the brain or spinal cord.
- Whether the tumor can be removed by surgery.
- Whether cancer cells remain after surgery.
- Whether there are certain changes in the chromosomes.
- Whether the cancer has just been diagnosed or has recurred (come back).
- The patient's general health.

The prognosis and treatment options for *metastatic* brain and spinal cord tumors depend on the following:

- Whether there are more than two tumors in the brain or spinal cord.
- Where the tumor is in the brain or spinal cord.
- How well the tumor responds to treatment.
- Whether the primary tumor continues to grow or spread.

## **Stages of Adult Brain Tumors**

### **Key Points for This Section**

- There is no standard staging system for adult brain and spinal cord tumors.

- Imaging tests may be repeated after surgery to help plan more treatment.

## **There is no standard staging system for adult brain and spinal cord tumors.**

The extent or spread of cancer is usually described as stages. There is no standard staging system for brain and spinal cord tumors. Brain tumors that begin in the brain may spread to other parts of the brain and spinal cord, but they rarely spread to other parts of the body. Treatment of brain and spinal cord tumors is based on the following:

- The type of cell in which the tumor began.
- Where the tumor formed in the brain or spinal cord.
- The amount of cancer left after surgery.
- The grade of the tumor.

Treatment of brain tumors that have spread to the brain from other parts of the body is based on the number of tumors in the brain.

## **Imaging tests may be repeated after surgery to help plan more treatment.**

Some of the tests and procedures used to diagnose a brain or spinal cord tumor may be repeated after treatment to find out how much tumor is left.

## **Treatment Option Overview**

### **Key Points for This Section**

- There are different types of treatment for patients with adult brain and spinal cord tumors.
- Four types of standard treatment are used:
  - Watchful waiting
  - Surgery
  - Radiation therapy
  - Chemotherapy
- New types of treatment are being tested in clinical trials.
  - Proton beam radiation therapy
  - Biologic therapy
  - Targeted therapy
- Supportive care is given to lessen the problems caused by the disease or its treatment.
- Patients may want to think about taking part in a clinical trial.
- Patients can enter clinical trials before, during, or after starting their cancer treatment.
- Follow-up tests may be needed.

## **There are different types of treatment for patients with adult brain and spinal cord tumors.**

Different types of treatment are available for patients with adult brain and spinal cord tumors. Some treatments are standard (the currently used treatment), and some are being tested in clinical trials. A treatment clinical trial is a research study meant to help improve current treatments or obtain information on new treatments for patients with cancer. When clinical trials show that a new treatment is better than the standard treatment, the new treatment may become the standard treatment. Patients may want to think about taking part in a clinical trial. Some clinical trials are open only to patients who have not started treatment.

### **Four types of standard treatment are used:**

#### **Watchful waiting**

Watchful waiting is closely monitoring a patient's condition without giving any treatment until symptoms appear or change.

#### **Surgery**

Surgery may be used to diagnose and treat adult brain and spinal cord tumors. See the General Information section of this summary.

Even if the doctor removes all the cancer that can be seen at the time of the surgery, some patients may be given chemotherapy or radiation therapy after surgery to kill any cancer cells that are left. Treatment given after the surgery, to lower the risk that the cancer will come back, is called adjuvant therapy.

#### **Radiation therapy**

Radiation therapy is a cancer treatment that uses high-energy x-rays or other types of radiation to kill cancer cells or keep them from growing. There are two types of radiation therapy. External radiation therapy uses a machine outside the body to send radiation toward the cancer. Internal radiation therapy uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer. The way the radiation therapy is given depends on the type of tumor and where it is in the brain or spinal cord.

The following ways of giving radiation therapy to the tumor cause less damage to the healthy tissue that is around the tumor:

- **3-dimensional conformal radiation therapy:** A procedure that uses a computer to create a 3-dimensional (3-D) picture of the brain or spinal cord tumor. This allows doctors to give the highest possible dose of radiation to the tumor, with as little damage to normal tissue as possible. This type of radiation therapy is also called 3-dimensional radiation therapy and 3D-CRT.
- **Intensity-modulated radiation therapy (IMRT):** A type of 3-D radiation therapy that uses a computer

to make pictures of the size and shape of the brain or spinal cord tumor. Thin beams of radiation of different intensities (strengths) are aimed at the tumor from many angles. This type of radiation therapy causes less damage to healthy tissue near the tumor.

- **Stereotactic radiosurgery:** A type of radiation therapy that uses a head frame attached to the skull to aim a single large dose of radiation directly to a brain tumor. This causes less damage to nearby healthy tissue. Stereotactic radiosurgery is also called stereotaxic radiosurgery, radiosurgery, and radiation surgery. This procedure does not involve surgery.

## **Chemotherapy**

Chemotherapy is a cancer treatment that uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing. When chemotherapy is taken by mouth or injected into a vein or muscle, the drugs enter the bloodstream and can reach cancer cells throughout the body (systemic chemotherapy). When chemotherapy is placed directly into the cerebrospinal fluid, an organ, or a body cavity such as the abdomen, the drugs mainly affect cancer cells in those areas (regional chemotherapy). Combination chemotherapy is treatment using more than one anticancer drug. To treat brain tumors, a wafer that dissolves may be used to deliver an anticancer drug directly to the brain tumor site after the tumor has been removed by surgery. The way the chemotherapy is given depends on the type of tumor and where it is in the brain.

Anticancer drugs given by mouth or vein to treat brain and spinal cord tumors cannot cross the blood-brain barrier and enter the fluid that surrounds the brain and spinal cord. Instead, an anticancer drug is injected into the fluid-filled space to kill cancer cells there. This is called intrathecal chemotherapy.

See [Drugs Approved for Brain Tumors](#) for more information.

## **New types of treatment are being tested in clinical trials.**

This summary section refers to new treatments being studied in clinical trials, but it may not mention every new treatment being studied. Information about clinical trials is available from the NCI Web site.

## **Proton beam radiation therapy**

Proton beam radiation therapy is a type of high-energy, external radiation therapy that uses streams of protons (small, positively-charged pieces of matter) to make radiation. This type of radiation kills tumor cells with little damage to nearby tissues. It is used to treat cancers of the head, neck, and spine and organs such as the brain, eye, lung, and prostate. Proton beam radiation is different from x-ray radiation.

## **Biologic therapy**

Biologic therapy is a treatment that uses the patient's immune system to fight cancer. Substances made by the body or made in a laboratory are used to boost, direct, or restore the body's natural defenses against cancer. This type of cancer treatment is also called biotherapy or immunotherapy.

Biologic therapy is being studied for the treatment of some types of brain tumors. Treatments may include the following:

- Tyrosine kinase inhibitor therapy.
- Vascular endothelial growth factor (VEGF) therapy.
- Dendritic cell vaccine therapy.
- Gene therapy.

## **Targeted therapy**

Targeted therapy is a type of treatment that uses drugs or other substances to identify and attack specific cancer cells without harming normal cells.

## **Supportive care is given to lessen the problems caused by the disease or its treatment.**

This therapy controls problems or side effects caused by the disease or its treatment and improves quality of life. For brain tumors, supportive care includes drugs to control seizures and fluid buildup or swelling in the brain.

## **Patients may want to think about taking part in a clinical trial.**

For some patients, taking part in a clinical trial may be the best treatment choice. Clinical trials are part of the cancer research process. Clinical trials are done to find out if new cancer treatments are safe and effective or better than the standard treatment.

Many of today's standard treatments for cancer are based on earlier clinical trials. Patients who take part in a clinical trial may receive the standard treatment or be among the first to receive a new treatment.

Patients who take part in clinical trials also help improve the way cancer will be treated in the future. Even when clinical trials do not lead to effective new treatments, they often answer important questions and help move research forward.

## **Patients can enter clinical trials before, during, or after starting their cancer treatment.**

Some clinical trials only include patients who have not yet received treatment. Other trials test treatments for patients whose cancer has not gotten better. There are also clinical trials that test new ways to stop cancer from recurring (coming back) or reduce the side effects of cancer treatment.

Clinical trials are taking place in many parts of the country. See the Treatment Options section that follows for links to current treatment clinical trials. These have been retrieved from NCI's listing of clinical trials.

## **Follow-up tests may be needed.**

Some of the tests that were done to diagnose the cancer or to find out the stage of the cancer may be repeated. Some tests will be repeated in order to see how well the treatment is working. Decisions about whether to continue, change, or stop treatment may be based on the results of these tests. This is sometimes called re-staging.

Some of the tests will continue to be done from time to time after treatment has ended. The results of these



tests can show if your condition has changed or if the cancer has recurred (come back). These tests are sometimes called follow-up tests or check-ups.

The following tests and procedures may be used to check whether a brain tumor has come back after treatment:

- **SPECT scan (single photon emission computed tomography scan):** A procedure that uses a special camera linked to a computer to make a 3-dimensional (3-D) picture of the brain. A small amount of a radioactive substance is injected into a vein or inhaled through the nose. As the substance travels through the blood, the camera rotates around the head and takes pictures of the brain. Blood flow and metabolism are higher than normal in areas where cancer cells are growing. These areas will show up brighter in the picture. This procedure may be done just before or after a CT scan.
- **PET scan (positron emission tomography scan):** A procedure to find malignant tumor cells in the body. A small amount of radioactive glucose (sugar) is injected into a vein. The PET scanner rotates around the body and makes a picture of where glucose is being used in the brain. Malignant tumor cells show up brighter in the picture because they are more active and take up more glucose than normal cells do.

## Treatment Options by Type of Adult Brain Tumor

A link to a list of current clinical trials is included for each treatment section. For some types or stages of cancer, there may not be any trials listed. Check with your doctor for clinical trials that are not listed here but may be right for you.

### Astrocytic Tumors

#### Brain Stem Gliomas

Treatment of brain stem gliomas may include the following:

- Radiation therapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult brain stem glioma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

#### Pineal Astrocytic Tumors

Treatment of pineal astrocytic tumors may include the following:

- Surgery and radiation therapy. For high-grade tumors, chemotherapy may also be given.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult pineal gland astrocytoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

### **Pilocytic Astrocytomas**

Treatment of pilocytic astrocytomas may include the following:

- Surgery to remove the tumor. Radiation therapy may also be given if tumor remains after surgery.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult pilocytic astrocytoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

### **Diffuse Astrocytomas**

Treatment of diffuse astrocytomas may include the following:

- Surgery with or without radiation therapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult diffuse astrocytoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

### **Anaplastic Astrocytomas**

Treatment of anaplastic astrocytomas may include the following:

- Surgery and radiation therapy. Chemotherapy may also be given.
- A clinical trial of chemotherapy placed into the brain during surgery.
- A clinical trial of a new treatment added to standard treatment.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult anaplastic astrocytoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

### **Glioblastomas**

Treatment of glioblastomas may include the following:

- Surgery and radiation therapy. Sometimes chemotherapy is also given.
- Chemotherapy placed into the brain during surgery.
- Radiation therapy given at the same time as chemotherapy.
- A clinical trial of a new treatment added to standard treatment.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult glioblastoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Oligodendroglial Tumors**

Treatment of oligodendrogliomas may include the following:

- Surgery with or without radiation therapy. Chemotherapy may also be given.

Treatment of anaplastic oligodendroglioma may include the following:

- Surgery followed by radiation therapy and/or chemotherapy.
- A clinical trial of a new treatment added to standard treatment.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult oligodendroglial tumors. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Mixed Gliomas**

Treatment of mixed gliomas may include the following:

- Surgery and radiation therapy. Sometimes chemotherapy is also given.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult mixed glioma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Ependymal Tumors**

Treatment of grade I and grade II ependymomas may include the following:

- Surgery to remove the tumor. Radiation therapy may also be given if tumor remains after surgery.

Treatment of grade III anaplastic ependymoma may include the following:

- Surgery and radiation therapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with

adult ependymal tumors. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Medulloblastomas**

Treatment of medulloblastomas may include the following:

- Surgery and radiation therapy to the brain and spine.
- A clinical trial of chemotherapy added to surgery and radiation therapy to the brain and spine

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult medulloblastoma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Pineal Parenchymal Tumors**

Treatment of pineal parenchymal tumors may include the following:

- For pineocytomas, surgery and radiation therapy.
- For pineoblastomas, surgery, radiation therapy, and chemotherapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult pineal parenchymal tumor. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Meningeal Tumors**

Treatment of grade I meningiomas may include the following:

- Watchful waiting for tumors with no symptoms.
- Surgery to remove the tumor. Radiation therapy may also be given if tumor remains after surgery.
- Radiation therapy for tumors that cannot be removed by surgery.

Treatment of grade II and III meningioma and hemangiopericytoma may include the following:

- Surgery and radiation therapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult meningeal tumor. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Germ Cell Tumors**

There is no standard treatment for germ cell tumors (germinoma, embryonal carcinoma, choriocarcinoma,

and teratoma). Treatment depends on what the tumor cells look like under a microscope, the tumor markers, where the tumor is in the brain, and whether it can be removed by surgery.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult central nervous system germ cell tumor. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Craniopharyngiomas**

Treatment of craniopharyngiomas may include the following:

- Surgery to completely remove the tumor.
- Surgery to remove as much of the tumor as possible, followed by radiation therapy.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with adult craniopharyngioma. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Recurrent Brain Tumors**

There is no standard treatment for recurrent brain tumors. Treatment depends on the patient's condition, the expected side effects of the treatment, where the tumor is in the brain, and whether the tumor can be removed by surgery. Treatment may include the following:

- Surgery to remove the tumor.
- Chemotherapy with drugs not used to treat the original tumor.
- Chemotherapy placed into the brain during surgery.
- Radiation therapy.
- A clinical trial of a new treatment.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with recurrent adult brain tumor. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Metastatic Brain Tumors**

Treatment of a single tumor that has spread to the brain from another part of the body may include the following:

- Radiation therapy to the whole brain.
- Stereotactic radiosurgery followed by radiation therapy to the whole brain.

- Surgery followed by radiation therapy to the whole brain. It is not known if surgery improves survival.

Treatment of more than one tumor that has spread to the brain from another part of the body may include the following:

- Radiation therapy to the whole brain.
- Stereotactic radiosurgery.
- Radiation therapy to the whole brain and stereotactic radiosurgery.
- Chemotherapy, if the primary tumor is one that responds to anticancer drugs.

Check for U.S. clinical trials from NCI's list of cancer clinical trials that are now accepting patients with tumors metastatic to brain. For more specific results, refine the search by using other search features, such as the location of the trial, the type of treatment, or the name of the drug. Talk with your doctor about clinical trials that may be right for you. General information about clinical trials is available from the NCI Web site.

## **Treatment Options for Spinal Cord Tumors**

Treatment of spinal cord tumors may include the following:

- Surgery to remove the tumor.
- Radiation therapy.
- Chemotherapy (systemic and/or intrathecal), if the tumor has spread to the leptomeninges (leptomeningeal carcinomatosis). Radiation therapy may also be given.
- Supportive care may be given for leptomeningeal carcinomatosis.
- A clinical trial of a new treatment.

## **To Learn More About Adult Brain Tumors**

For more information from the National Cancer Institute about adult brain tumors, see the following:

- [Brain Tumor Home Page](#)
- [What You Need to Know About™ Brain Tumors](#)
- [Drugs Approved for Brain Tumors](#)

For general cancer information and other resources from the National Cancer Institute, see the following:

- [What You Need to Know About™ Cancer](#)
- [Understanding Cancer Series: Cancer](#)
- [Cancer Staging](#)
- [Chemotherapy and You: Support for People With Cancer](#)
- [Radiation Therapy and You: Support for People With Cancer](#)
- [Coping with Cancer: Supportive and Palliative Care](#)
- [Questions to Ask Your Doctor About Cancer](#)

- Cancer Library
- Information For Survivors/Caregivers/Advocates

## **Changes to This Summary (05/14/2013)**

The PDQ cancer information summaries are reviewed regularly and updated as new information becomes available. This section describes the latest changes made to this summary as of the date above.

Changes were made to this summary to match those made to the health professional version.

## **About This PDQ Summary**

### **About PDQ**

Physician Data Query (PDQ) is the National Cancer Institute's (NCI's) comprehensive cancer information database. The PDQ database contains summaries of the latest published information on cancer prevention, detection, genetics, treatment, supportive care, and complementary and alternative medicine. Most summaries come in two versions. The health professional versions have detailed information written in technical language. The patient versions are written in easy-to-understand, nontechnical language. Both versions have cancer information that is accurate and up to date and most versions are also available in Spanish.

PDQ is a service of the NCI. The NCI is part of the National Institutes of Health (NIH). NIH is the federal government's center of biomedical research. The PDQ summaries are based on an independent review of the medical literature. They are not policy statements of the NCI or the NIH.

### **Purpose of This Summary**

This PDQ cancer information summary has current information about the treatment of adult brain tumors. It is meant to inform and help patients, families, and caregivers. It does not give formal guidelines or recommendations for making decisions about health care.

### **Reviewers and Updates**

Editorial Boards write the PDQ cancer information summaries and keep them up to date. These Boards are made up of experts in cancer treatment and other specialties related to cancer. The summaries are reviewed regularly and changes are made when there is new information. The date on each summary ("Date Last Modified") is the date of the most recent change.

The information in this patient summary was taken from the health professional version, which is reviewed regularly and updated as needed, by the PDQ Adult Treatment Editorial Board.

### **Clinical Trial Information**

A clinical trial is a study to answer a scientific question, such as whether one treatment is better than another. Trials are based on past studies and what has been learned in the laboratory. Each trial answers certain scientific questions in order to find new and better ways to help cancer patients. During treatment clinical trials, information is collected about the effects of a new treatment and how well it works. If a clinical trial shows that a new treatment is better than one currently being used, the new treatment may become "standard." Patients may want to think about taking part in a clinical trial. Some clinical trials are open only to patients who have not started treatment.

Clinical trials are listed in PDQ and can be found online at NCI's Web site. Many cancer doctors who take part in clinical trials are also listed in PDQ. For more information, call the Cancer Information Service 1-800-4-CANCER (1-800-422-6237).

## **Permission to Use This Summary**

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The best way to cite this PDQ summary is:

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## **Disclaimer**

The information in these summaries should not be used to make decisions about insurance reimbursement. More information on insurance coverage is available on Cancer.gov on the Coping with Cancer: Financial, Insurance, and Legal Information page.

## **Contact Us**

More information about contacting us or receiving help with the Cancer.gov Web site can be found on our Contact Us for Help page. Questions can also be submitted to Cancer.gov through the Web site's Contact Form.

## **Get More Information From NCI**



## ***Call 1-800-4-CANCER***

For more information, U.S. residents may call the National Cancer Institute's (NCI's) Cancer Information Service toll-free at 1-800-4-CANCER (1-800-422-6237) Monday through Friday from 8:00 a.m. to 8:00 p.m., Eastern Time. A trained Cancer Information Specialist is available to answer your questions.

## ***Chat online***

The NCI's LiveHelp® online chat service provides Internet users with the ability to chat online with an Information Specialist. The service is available from 8:00 a.m. to 11:00 p.m. Eastern time, Monday through Friday. Information Specialists can help Internet users find information on NCI Web sites and answer questions about cancer.

## ***Write to us***

For more information from the NCI, please write to this address:

NCI Public Inquiries Office  
9609 Medical Center Dr.  
Room 2E532 MSC 9760  
Bethesda, MD 20892-9760

## ***Search the NCI Web site***

The NCI Web site provides online access to information on cancer, clinical trials, and other Web sites and organizations that offer support and resources for cancer patients and their families. For a quick search, use the search box in the upper right corner of each Web page. The results for a wide range of search terms will include a list of "Best Bets," editorially chosen Web pages that are most closely related to the search term entered.

There are also many other places to get materials and information about cancer treatment and services. Hospitals in your area may have information about local and regional agencies that have information on finances, getting to and from treatment, receiving care at home, and dealing with problems related to cancer treatment.

## ***Find Publications***

The NCI has booklets and other materials for patients, health professionals, and the public. These publications discuss types of cancer, methods of cancer treatment, coping with cancer, and clinical trials. Some publications provide information on tests for cancer, cancer causes and prevention, cancer statistics, and NCI research activities. NCI materials on these and other topics may be ordered online or printed directly from the NCI Publications Locator. These materials can also be ordered by telephone from the Cancer Information Service toll-free at 1-800-4-CANCER (1-800-422-6237).