



# Cancer in Children

## What is cancer?

The body is made up of trillions of living cells. Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries.

Cancer begins when cells in a part of the body start to grow out of control. There are many kinds of cancer, but they all start because of out-of-control growth of abnormal cells.

Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells continue to grow and form new, abnormal cells. Cancer cells can also invade (grow into) other tissues, something that normal cells cannot do. Growing out of control and invading other tissues are what makes a cell a cancer cell.

Cells become cancer cells because of damage to DNA. DNA is in every cell and directs all its actions. In a normal cell, when DNA gets damaged the cell either repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, but the cell doesn't die like it should. Instead, this cell goes on making new cells that the body does not need. These new cells will all have the same damaged DNA as the first cell does.

People can inherit damaged DNA, but most DNA damage is caused by mistakes that happen while a normal cell is reproducing or by something in our environment. In adults the cause of the DNA damage may be something obvious, like cigarette smoking. But often no clear cause is found.

In most cases the cancer cells form a tumor. Some cancers, like leukemia, rarely form tumors. Instead, these cancer cells involve the blood and blood-forming organs and circulate through other tissues where they grow.

Cancer cells often travel to other parts of the body, where they begin to grow and form new tumors that replace normal tissue. This process is called metastasis. It happens when the cancer cells get into the bloodstream or lymph vessels of our body.

No matter where a cancer may spread, it is always named for the place where it started. For example, breast cancer that has spread to the liver is still called breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bone is metastatic prostate cancer, not bone cancer.

Different types of cancer can behave very differently. They grow at different rates and respond to different treatments. That is why people with cancer need treatment that is aimed at their particular kind of cancer.

## **What are the differences between cancers in adults and children?**

The types of cancers that develop in children are very different from the types that develop in adults. Childhood cancers are often the result of DNA changes in cells that take place very early in life, sometimes even before birth. Unlike many cancers in adults, childhood cancers are not strongly linked to lifestyle or environmental risk factors.

There are some exceptions, but childhood cancers tend to respond better to treatments such as chemotherapy (also called “chemo”). Children's bodies also tend to handle chemotherapy better than adults' bodies do. But cancer treatments such as chemo and radiation therapy can cause long-term side effects, so children who survive cancer need careful attention for the rest of their lives.

Since the 1960s, most children and teens with cancer have been treated at specialized centers designed for them. Being treated in these centers offers children the advantage of a team of specialists who know the differences between adult and childhood cancers, as well as the unique needs of children with cancers. This team usually includes pediatric oncologists, surgeons, radiation oncologists, pathologists, pediatric oncology nurses, and nurse practitioners.

These centers also have psychologists, social workers, child life specialists, nutritionists, rehabilitation and physical therapists, and educators who can support and educate the entire family.

Most children with cancer in the United States are treated at a center that is a member of the Children's Oncology Group (COG). All of these centers are associated with a university or children's hospital. As we have learned more about treating childhood cancer, it has become even more important that treatment be given by experts in this area.

To find a listing of COG institutions by state, go to their Web site at [www.curesearch.org/resources/cog.aspx](http://www.curesearch.org/resources/cog.aspx)

# What are the key statistics for childhood cancer?

Fortunately, childhood cancers are rare, making up less than 1% of all cancers diagnosed each year. About 12,060 children in the United States under the age of 15 will be diagnosed with cancer in 2012. Childhood cancer rates have been rising slightly for the past few decades.

Because of major treatment advances in recent decades, about 80% of children with cancer now survive 5 years or more (although this rate varies depending on the type of cancer). Overall, this is a huge increase from before the 1970s, when the 5-year survival rate was less than 50%. Survival rates for different cancer types are listed in the section, "Surviving childhood cancer."

Despite its rarity and the major advances in treatment and supportive care, cancer is still the second leading cause of death in children younger than 15 years old (after accidents). About 1,340 children are expected to die from cancer in 2012.

# What are the most common types of childhood cancers?

The types of cancers that occur most often in children are different from those seen in adults. The most common cancers of children are:

- Leukemia
- Brain and other nervous system tumors
- Neuroblastoma
- Wilms tumor
- Lymphoma
- Rhabdomyosarcoma
- Retinoblastoma
- Bone cancer

Other types of cancers are rare in children, but they do happen sometimes. In very rare cases, children may even develop cancers that are much more common in adults.

## Leukemia

Leukemias are the most common childhood cancers. They account for about 34% of all cancers in children. The most common types in children are acute lymphocytic leukemia (ALL) and acute myelogenous leukemia (AML). Leukemia may cause bone and joint pain, weakness, bleeding, fever, weight loss, and other symptoms.

For more information see our document called *Childhood Leukemia*.

## Brain and nervous system tumors

Brain and other nervous system tumors are the second most common cancers in children, and make up about 27% of childhood cancers. There are many types of brain tumors, and the treatment and outlook for each is different. Most brain tumors in children start in the lower parts of the brain, such as the cerebellum or brain stem. They can cause headaches, nausea, vomiting, blurred or double vision, dizziness, and trouble walking or handling objects. Adults are more likely to develop cancers in upper parts of the brain. Spinal cord tumors are less common than brain tumors in both children and adults.

For more information see our document called *Brain and Spinal Cord Tumors in Children*.

## Neuroblastoma

Neuroblastoma is a form of cancer that starts in certain types of nerve cells found in a developing embryo or fetus. It accounts for about 7% of childhood cancers. This type of cancer occurs in infants and young children. It is rarely found in children older than 10. This tumor can start anywhere but is usually in the belly (abdomen) and is noticed as swelling. It can also cause bone pain and fever.

For more information see our document called *Neuroblastoma*.

## Wilms tumor

Wilms tumor is a cancer that starts in one, or rarely, both kidneys. It is most often found in children about 3 years old, and is uncommon in children older than age 6. It can show up as a swelling or lump in the belly (abdomen). Sometimes the child may have other symptoms, like fever, pain, nausea, or poor appetite. Wilms tumor accounts for about 5% of childhood cancers.

For more information see our document called *Wilms Tumor*.

## Lymphoma

These are cancers that start in lymph tissues, like the lymph nodes, tonsils, and thymus. They may spread to bone marrow and other organs, which can cause different symptoms depending on where the cancer is growing. Lymphomas can cause fever, sweats, weakness, and swollen lymph nodes in the neck, armpit, or groin.

There are 2 main types of lymphoma: Hodgkin lymphoma (sometimes called Hodgkin disease) and non-Hodgkin lymphoma. Both types can occur in both children and adults.

Hodgkin lymphoma accounts for about 4% of childhood cancers. It is more common, though, in 2 age groups: early adulthood (age 15 to 40, usually people in their 20s) and late adulthood (after age 55). Hodgkin lymphoma is rare in children younger than 5 years of age. This is one type of cancer that is very similar in children and adults, including which types of treatment work best.

Non-Hodgkin lymphoma also makes up about 4% of childhood cancers. It is more likely to occur in younger children than is Hodgkin lymphoma, but it is still rare in children younger than 3. The most common types of non-Hodgkin lymphoma in children are different from those in adults. These cancers often grow quickly and require intensive treatment, but they also tend to respond better to treatment than most non-Hodgkin lymphomas in adults.

For more information see our documents called *Non-Hodgkin Lymphoma in Children* and *Hodgkin Disease*.

## Rhabdomyosarcoma

Rhabdomyosarcoma starts in cells that normally develop into skeletal muscles. (These are the muscles that we control to move parts of our body.) It can happen in the head and neck, groin, belly (abdomen), pelvis, or in an arms or leg. It may cause pain, swelling (a lump), or both. This is the most common type of soft tissue sarcoma in children. It makes up about 3% of childhood cancers.

For more information see our document called *Rhabdomyosarcoma*.

## Retinoblastoma

Retinoblastoma is a cancer of the eye. It accounts for about 3% of childhood cancers. It usually occurs in children around the age of 2, and is seldom found in children older than 6. Retinoblastomas are usually found because a parent or doctor notices a child's eye looks unusual. Normally when you shine a light in a child's eye, the pupil (the dark spot in the center of the eye) looks red because of the blood in vessels in the back of the eye. In an eye with retinoblastoma, the pupil often looks white or pink. This white glare of the eye may be noticed after a flash picture is taken.

For more information see our document called *Retinoblastoma*.

## Bone cancers

Primary bone cancers (cancers that start in the bones) occur most often in older children and teens, but they can develop at any age.

Primary bone cancer is different from *metastatic* bone cancer, which is cancer that started somewhere else in the body and has spread to the bone. Metastatic bone cancer is more common than primary bone cancer because many types of cancer (including many cancers in adults) can spread to the bone.

Two main types of primary bone cancers occur in children:

**Osteosarcoma** accounts for about 3% of all new childhood cancer cases in the United States. It is most common in teens, and usually develops in areas where the bone is growing quickly, such as near the ends of the long bones in the legs or

arms. It often causes no pain or symptoms until swelling starts, but sometimes there is bone pain that gets worse at night or with activity.

**Ewing sarcoma** is a less common primary bone cancer, which can also cause bone pain. It is most often found in young teens. The most common places for it to start are the bones in the pelvis, the chest wall (such as the ribs or shoulder blades), or in the middle of the long leg bones. Ewing sarcoma accounts for about 1% of childhood cancers.

For more information see our documents called *Osteosarcoma* and *Ewing Family of Tumors*.

## What are the risk factors and causes of childhood cancer?

A risk factor is anything that changes your chance of getting a disease such as cancer. Different cancers have different risk factors. Lifestyle-related risks are thought to be the main factors that affect cancer risk in adults.

Examples include the effect of unhealthy diets, not enough exercise, and habits like smoking and drinking alcohol. But lifestyle factors usually take many years to influence cancer risk, and they are not thought to play much of a role in childhood cancers.

In recent years, scientists have made great progress in understanding how certain changes in our DNA can cause cells to become cancerous. DNA is the chemical in each of our cells that makes up our genes – the instructions for nearly everything our cells do. We usually look like our parents because they are the source of our DNA. However, DNA affects more than how we look. It also influences our risks for developing certain diseases, including some kinds of cancer.

Some genes (parts of our DNA) contain instructions for controlling when our cells grow and divide. Genes that speed up cell growth and division are called *oncogenes*. Others that slow down cell division or cause cells to die at the right time are called *tumor suppressor genes*. Cancers can be caused by DNA changes that turn on oncogenes or turn off tumor suppressor genes.

Some children inherit DNA changes (mutations) from a parent that increase their risk of cancer. These changes are present in every cell of the child's body. This means the changes can often be found by testing the DNA of blood cells or other body cells.

But most cancers are not caused by inherited DNA mutations. They are the result of DNA changes that happened early in the child's life, sometimes even before birth. Every time a cell prepares to divide into 2 new cells, it must copy its DNA. This process is not perfect, and errors sometimes occur, especially when the cells are growing quickly. This kind of gene mutation can happen at any time in life and is called an *acquired mutation*.

Acquired mutations start in one cell of the body, and that cell passes the mutation on to all the cells that come from it. These acquired mutations are present only in the person's cancer cells and will not be passed on to his or her children. The causes of mutations responsible for certain adult cancers are known (such as cancer-causing chemicals in cigarette smoke), but the reasons for DNA changes that cause the vast majority of childhood cancers are not known. Some may have outside causes that have not yet been found, but most are likely to be random events that sometimes happen inside a cell, without having an outside cause.

## **Can childhood cancers be prevented?**

Unlike many cancers of adults, there are no lifestyle-related risk factors (such as smoking) that are known to influence a child's risk of getting cancer. Very few environmental factors, such as radiation exposure, have been linked with childhood cancer risk. Even then, in many cases exposure to radiation may be unavoidable, such as if the child needs radiation therapy to treat another cancer. If your child does develop cancer, it is important to know that it is extremely unlikely there is anything you or your child could have done to prevent it.

In very rare cases, children may inherit gene changes that make them very likely to get a certain kind of cancer. In such cases, doctors may sometimes recommend preventive surgery to remove an organ before cancer has a chance to develop there. Again, this is very rare.

## **Can childhood cancers be found early?**

Cancers in children often are hard to recognize right away because the symptoms can overlap with much more common illnesses or injuries. Children often get sick or have bumps or bruises that might mask the early signs of cancer. Parents should be sure that their children have regular medical check-ups and watch for any unusual signs or symptoms that do not go away. These include:

- An unusual lump or swelling
- Unexplained paleness and loss of energy
- Easy bruising
- An ongoing pain in one area of the body
- Limping
- Unexplained fever or illness that doesn't go away
- Frequent headaches, often with vomiting
- Sudden eye or vision changes

- Sudden unexplained weight loss

More specific information on symptoms is in the "What are the most common types of childhood cancers?" section. Other symptoms are also possible, depending on the type of cancer.

Most of these symptoms are much more likely to be caused by something other than cancer, such as an injury or infection. Still, if your child has any of these symptoms, check with your doctor so that the cause can be evaluated and treated, if needed.

Some children may have a higher chance of developing a specific type of cancer because of certain gene changes they inherit from a parent. These children may need careful, regular medical check-ups that include special tests to look for early signs of cancer.

## How are childhood cancers treated?

Treatments are chosen for childhood cancers based mainly on the type and stage (extent) of the cancer. Treatment options may include chemotherapy, surgery, radiation therapy, and/or other types of treatment. In many cases, more than one of these treatments is used.

There are exceptions, but childhood cancers usually respond well to chemotherapy because they tend to be cancers that grow fast. (Most forms of chemotherapy affect cells that are growing quickly.) Children's bodies are also generally able to recover from higher doses of chemotherapy than are adults' bodies. Using more intensive treatments gives doctors a better chance of treating the cancer effectively, but it can also lead to more short- and long-term side effects. Doctors do their best to balance the need for intensive treatment with the desire to limit side effects as much as possible.

For detailed information on how a certain type of childhood cancer is treated, see our document on that specific type of cancer.

## The cancer treatment team

Children with cancer and their families have special needs that can be best met by children's cancer centers. Treatment of childhood cancer in specialized centers is coordinated by a team of experts who know the differences between adult and childhood cancers, as well as the unique needs of children with cancer. This team usually includes:

- Pediatric oncologists: doctors who specialize in using medicines to treat children with cancer
- Pediatric surgeons: doctors who specialize in performing surgery in children
- Radiation oncologists: doctors who specialize in using radiation to treat cancer
- Pediatric oncology nurses: nurses who specialize in caring for children with cancer
- Nurse practitioners

Childhood cancer treatment involves many professionals other than nurses and doctors, too. Children's cancer centers have psychologists, social workers, child life specialists, nutritionists, rehabilitation and physical therapists, and educators who can support and care for the entire family.

## Getting the best treatment possible

Treating children is different from treating adults. It is best for a child to get treatment at a hospital or treatment center where many children have been treated for cancer. Today, most children with cancer are treated at specialized centers designed for children. These children's cancer centers are often members of the Children's Oncology Group (COG). All of these centers are linked to a university and most are connected with a children's hospital. Going to a hospital that specializes in treating childhood cancer means that a child gets the best available cancer treatment.

These centers offer the most up-to-date-treatment by conducting clinical trials (studies of promising new therapies). If your child qualifies for a clinical trial, you will have to decide whether or not to enter (enroll) the child into it. Older children, who can understand more, usually must also agree to take part in the clinical trial before the parents' consent is accepted.

Clinical trials are one way to get state-of-the art cancer care for your child. They may be the only way to get access to certain treatments. They are also the only way for doctors to learn better methods to treat cancer. Still, they may not be right for every child. Talk to your child's cancer care team to learn about possible clinical trials for your child, and ask about the pros and cons of enrolling in one of them.

## Surviving childhood cancer

Much progress has been made in treating childhood cancers in recent decades, and many of these cancers can now be cured. Still, the progress in some cancers has been greater than in others.

### Five-year survival rates

The 5-year survival rate refers to the percentage of patients who live *at least* 5 years after their cancer is diagnosed. Doctors use five-year rates as a standard way of discussing and comparing the prognosis (outlook for recovery) for different cancers. Of course, many children live much longer than 5 years, and many are cured. Keep in mind that 5-year survival rates are based on patients who were diagnosed and treated more than 5 years ago. Improvements in treatment often result in a better outlook for patients diagnosed more recently.

The 5-year survival rates for the most recent time period (1999-2006) for the more common childhood cancers are:

- Leukemias: 82%

- Brain and other nervous system tumors: 71%
- Wilms tumors (kidney cancers): 89%
- Hodgkin lymphomas: 95%
- Non-Hodgkin lymphomas: 85%
- Rhabdomyosarcomas: 66%
- Neuroblastomas: 73%
- Osteosarcomas (bone cancers): 70%

Survival rates are often based on previous outcomes of large numbers of children who had the disease, but they are at best rough estimates and cannot predict what will happen in any particular child's case. The type of cancer is important in estimating a child's outlook. But many other factors may also be important, such as the child's age, the location and extent of the tumor, and how well the cancer responds to treatment. If your child has cancer, your child's doctor can tell you how well the numbers above may apply, as he or she is familiar with the aspects of your child's situation.

## Long-term outcomes

Because of major advances in treatment, more children treated for cancer are now surviving into adulthood. Doctors have learned that the treatment may affect children's health later in life, so watching for health effects as they get older has become more of a concern in recent years.

Treating childhood cancer requires a very specialized approach, and so does the care and follow-up after treatment. The earlier any problems can be recognized, the more likely it is they can be treated effectively.

Childhood cancer survivors are at risk, to some degree, for several possible late effects of their cancer treatment. This risk depends on a number of factors, such as the type of cancer, the specific cancer treatments they received, doses of cancer treatment, and age when receiving the cancer treatment. Late effects of cancer treatment can include:

- Heart or lung problems (due to certain chemotherapy drugs or radiation therapy)
- Slowed or decreased growth and development (in the bones or overall)
- Changes in sexual development and ability to have children
- Changes in intellectual function with learning problems
- Development of second cancers later in life

To help increase awareness of late effects and improve follow-up care of childhood cancer survivors throughout their lives, the Children's Oncology Group (COG) has developed long-term follow-up guidelines for survivors of childhood cancers. These guidelines, written for doctors and other health care professionals, describe in detail the suggested long-term follow-up care based on the treatments the child has received.

It is very important to discuss possible long-term complications with your child's health care team, and to make sure there is a plan in place to watch for these problems and treat them, if needed. To learn more, ask your child's doctors about the COG survivor guidelines, or visit the COG Web site at [www.survivorshipguidelines.org](http://www.survivorshipguidelines.org). The guidelines themselves are written for health professionals, so you may want to go over the information with the child's treatment team. Information based on some of the guidelines, written for families of children with cancer, is also available on the site.

## **Additional resources for cancer in children**

### **More information from your American Cancer Society**

We have some related information that may also be helpful to you. These materials may be ordered from our toll-free number, 1-800-227-2345.

After Diagnosis: A Guide for Patients and Families (also available in Spanish)

Children Diagnosed With Cancer: Dealing With Diagnosis (also available in Spanish)

Children Diagnosed With Cancer: Understanding the Health Care System (also available in Spanish)

Children Diagnosed With Cancer: Financial and Insurance Issues

Pediatric Cancer Centers

Understanding Chemotherapy: A Guide for Patients and Families (also available in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also available in Spanish)

Surgery (also available in Spanish)

Fertility and Cancer: What Are My Options?

Health Professionals Associated With Cancer Care

Nutrition for Children With Cancer (also available in Spanish)

When Your Child's Treatment Ends: A Guide for Families

Children Diagnosed With Cancer: Returning to School

Childhood Cancer: Late Effects of Cancer Treatment

Family and Medical Leave Act (FMLA)

Americans With Disabilities Act: Information for People Facing Cancer

What Happened to You Happened to Me (booklet for about age 6 and up -- teen appropriate)

When Your Brother or Sister Has Cancer (booklet for about age 6 and up -- teen appropriate)

Anxiety, Fear, and Depression (also available in Spanish)

## **Books from your American Cancer Society**

The following books are available from the American Cancer Society. Call us to ask about costs or to place your order:

*Because...Someone I Love Has Cancer* (workbook for kids age 6-12 who have a loved one with cancer)

*Jacob Has Cancer: His Friends Want to Help* (coloring book for friends and classmates of children with cancer)

*Let My Colors Out* (picture book for young children)

*The Long and the Short of It: A Tale About Hair*

*Imagine What's Possible*

*Caregiving: A Step-by-Step Approach for Caring for the Person With Cancer at Home*

*Cancer in the Family* (for adults)

*What to Eat During Cancer Treatment* (cookbook)

## **National organizations and Web sites\***

Along with the American Cancer Society, other sources of information and support include:

### **American Childhood Cancer Organization (ACCO)**

Toll-free number: 1-800-366-2223

Web site: [www.acco.org](http://www.acco.org)

Provides information on cancer; insurance and legal guidance to families of children with cancer and adult survivors of childhood cancer; information on comprehensive survivor follow-up care, late-effects of cancer treatment, and second malignancies; and books for children, caregivers, and teachers. Also offers parent support groups in most states.

### **National Cancer Institute**

Toll-free number: 1-800-422-6237

Web site: [www.cancer.gov](http://www.cancer.gov)

Provides accurate, up-to-date information about cancer to patients and their families, including clinical trials information for patients. Offers a special booklet for teen siblings of a child with cancer at: [www.cancer.gov/cancertopics/when-your-sibling-has-cancer](http://www.cancer.gov/cancertopics/when-your-sibling-has-cancer)

### **CureSearch for Children's Cancer**

(a combined effort of National Childhood Cancer Foundation and Children's Oncology Group)

Toll-free number: 1-800-458-6223

Web site: [www.curesearch.org](http://www.curesearch.org)

Information from some of the world's best pediatric cancer specialists is available on their Web site. Also can help you find a Children's Oncology Group in your area. Special information for childhood cancer survivors is available at: [www.survivorshipguidelines.org](http://www.survivorshipguidelines.org)

### **Starlight Children's Foundation**

Toll-free number: 1-800-315-2580

Web site: [www.starlight.org](http://www.starlight.org)

Web site has videos, animated stories, and interactive programs to teach kids about cancer and the procedures that may be done in the hospital; also provides a safe, monitored, online support group for teens with cancer.

### **National Dissemination Center for Children with Disabilities (NICHCY)**

Toll-free number: 1-800-695-0285 (also for TTY)

Web site: [www.nichcy.org](http://www.nichcy.org)

Provides information on disability-related issues, such as fact sheets about specific disabilities, state resource sheets, parent guides, and information about educational rights. Also can refer you to state and national disability organizations, parent groups, and professional associations.

*\*Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit [www.cancer.org](http://www.cancer.org).

## **References: Cancer in children detailed guide**

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For additional assistance please contact your American Cancer Society  
1 · 800 · ACS-2345 or [www.cancer.org](http://www.cancer.org)