

# **Radiation Therapy**

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## A HANDBOOK FOR FAMILIES

### **Author**

Aimee Carlson, MSN RN CNP CPHON®

### **Content Reviewers**

Steering Council

### **Family Reviewer**

Lyn Goldsworthy

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## ■ WHAT IS RADIATION THERAPY?

Radiation therapy (sometimes called radiotherapy) is a cancer treatment that uses high doses of radiation to kill cancer cells. Radiation therapy works by damaging the DNA (genetic makeup) of cancer cells. Cancer cells are then unable to repair themselves and subsequently die.

Radiation therapy can be used to treat many different types of cancer. About 40%–60% of all patients with cancer will receive radiation therapy during the course of their illness. It is used for treating solid tumors (including tumors of the brain, spinal cord, bone, and liver) as well as for cancers of the blood and lymph systems, such as leukemia and lymphoma.

Radiation therapy can be used alone or in combination with surgery and/or chemotherapy. In certain cases, it also is used in preparation for bone marrow transplant. Radiation therapy may be used to cure cancer or as a palliative therapy when the goals of treatment are to improve quality of life and relieve symptoms such as pain, bleeding, and shortness of breath.



## ■ WILL MY CHILD BEGIN RADIATION THE FIRST DAY WE SEE THE RADIATION ONCOLOGIST?

A series of steps has to be completed before starting the radiation treatment.

### **Step One: Consultation**

A *radiation oncologist* is a doctor who specializes in taking care of patients who need radiation therapy. During the initial consultation, you also may meet other members of the radiation oncology team. The radiation oncologist will examine your child and review his or her medical history, including X rays, lab tests, and pathology reports. The radiation oncology team will consult with your child's other medical specialists (such as oncologists or surgeons) about the best plan for treating your child.

During this visit, you will discuss the plan for treatment, including how long therapy will last and any potential side effects your child may experience. The amount of radiation needed and the duration of treatment will be determined by the radiation oncologist and reviewed with you. For many types of cancer, the radiation dose is based on previous research. If your child is participating in a clinical trial, the dose will be based on the recommendations of the protocol. The frequency of treatments can range from 1 day to several weeks. After you and your child have had an opportunity to ask questions, a plan for treatment will be developed. In most instances, you will be asked to give written permission for your child to begin treatment.

### **Step Two: Simulation**

Radiation therapy requires a planning session before treatment can begin. The initial planning session is called a *CT simulation* or *simulation*. The simulation usually is performed in the radiation oncology department using computed tomography (CT), positron emission tomography (PET), or magnetic resonance imaging (MRI) scans of the area to be treated. During the scan, special immobilization equipment may be used to help your child

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remain still and in the same position throughout the simulation. Immobilization equipment and devices also ensure that the subsequent radiation treatment is delivered only to the intended area. Depending on the area to be treated, immobilization equipment may include plastic mesh masks that fit over the face; molds of the upper body, arm, or leg; bite blocks; or chin supports. Some children need sedation or anesthesia to help them remain still during the simulation and daily treatments. (Sedation or anesthesia also helps to reduce fear or anxiety during the process.) The simulation process can last 1–2 hours.

### **Step Three: Planning**

The radiation oncologist creates a treatment plan that will administer the maximum amount of radiation to the tumor while protecting normal surrounding tissues. Planning can take several days from the time of the simulation to the day your child returns for treatment verification (see the next section). During that time, the radiation oncology team is creating an individualized treatment plan based on your child's disease and specific requirements.

### **Step Four: Treatment Verification**

After the treatment plan has been created, your child will need to visit the radiation oncology department for treatment verification, also called *simulation*. During treatment verification, your child will be placed in the proper treatment position with any necessary immobilization equipment or devices. The machine that delivers the radiation beam, called a linear accelerator, will go through a final test to confirm the treatment plan is correct, and X rays will be taken to verify the treatment position. Treatment verification usually lasts less than an hour. When this process is complete, your child will be ready to begin radiation therapy.

## **■ WHO ARE THE MEMBERS OF THE RADIATION ONCOLOGY TEAM?**

Your child's radiation treatment is planned, administered, and monitored by a multidisciplinary team of healthcare providers.

### **Radiation Oncologist**

Radiation oncologists are doctors who have completed an additional 4 years of training in radiation oncology and 1 year of medical or surgical internship after medical school. Radiation oncologists have specialized training and knowledge related to the planning and delivery of all forms of radiation therapy. Most are certified by the American Board of Radiology. Make certain your doctor is board-certified in radiation oncology.



### **Nurse Practitioner**

Nurse practitioners are registered nurses who have completed advanced education in nursing and are certified and licensed to practice as nurse practitioners in their state of employment. The nurse practitioner has additional training in radiation oncology and is able to help you and your child manage the side effects of radiation therapy.

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## **Medical Physicist**

Medical physicists work with the radiation oncologist to develop and plan the arrangement of radiation beams. The medical physicist makes sure that the procedures and machines all work properly and meet safety standards.

## **Dosimetrist**

Dosimetrists work with the radiation oncologist and medical physicist to develop the radiation therapy plan. The dosimetrist produces the planned arrangement of radiation beams from the radiation oncologist's specifications. The plan is reviewed and checked for accuracy and feasibility by the medical physicist.

## **Radiation Therapist**

Radiation therapists are licensed professionals who operate the radiation machine (also known as a linear accelerator) and deliver the correct dose of radiation as prescribed by the radiation oncologist. The radiation therapist works under the supervision of the radiation oncologist.

## **Radiation Oncology Nurse**

Radiation oncology nurses work with all members of the treatment team to develop a plan of care for your child. They provide care to your child and help manage the side effects of treatment. They educate you and your child about the treatment regimen and possible side effects. Radiation oncology nurses may refer you to a nutritionist or social worker, if needed, during treatment.

## **Child Life Specialist**

Child life specialists may work with the treatment team to help your child and family cope with treatment. They develop and provide interventions such as procedure preparation, therapeutic play, and education to reduce fear and anxiety and help manage the side effects of therapy.

## **Nutritionist**

Nutritionists, or dieticians, provide information on the effects radiation therapy may have on your child's diet. They also will give you suggestions and guidance to help your child maintain his or her weight before, during, and after therapy.

## **Social Worker**

Social workers provide support to you and your child during treatment. This can include information about healthcare benefits, transportation, and counseling as well as community and cancer support services.

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## ■ HOW WILL RADIATION THERAPY BE DELIVERED TO MY CHILD?

There are several types of radiation therapy. Radiation may be given as external beam radiation therapy (from outside the body), brachytherapy (when radioactive material is placed inside the body near the tumor), or systemically (when radioactive material is taken by mouth or through a vein).

### External Beam Radiation Therapy (EBRT)

EBRT is radiation treatment delivered to a specific area of the body (such as the leg, chest, or brain). Multiple beams of radiation are produced in the radiation machine and then directed at the tumor. The beams are focused to deliver most of the radiation dose to the cancer cells while sparing the normal surrounding tissue. During EBRT, the machine used to deliver radiation does not touch your child. The treatment usually is painless and similar to the way X rays are taken. Side effects generally are limited to the area of the body being treated.

EBRT typically is administered in small daily doses called *fractions*, Monday through Friday, over a course of several weeks. The length of therapy depends on the number of fractions needed to deliver the total radiation dose. In some cases, the radiation dose may be delivered on a different schedule. Your child's medical team will discuss the treatment schedule with you.



#### TYPES OF EBRT

**Three-Dimensional Conformal Radiation Therapy (3D-CRT)** incorporates images from CT scans to make 3D pictures of the tumor and the areas around it. This allows the radiation oncologist and team to make the radiation beams match the shape of the tumor. When the beams are more precise, less normal tissue receives radiation, leading to fewer side effects.

**Intensity-modulated radiation therapy (IMRT)** divides radiation beams into many smaller beams. These beams can vary in intensity, and this enables the radiation oncologist to deliver different doses of radiation to specific areas of tumor and surrounding tissues. The goal of IMRT is to deliver a stronger dose of radiation to the tumor while reducing damage done to healthy surrounding tissues.

**Image-guided radiation therapy (IGRT)** uses imaging technology such as X rays, ultrasounds, and CT scans to direct the delivery of radiation. IGRT is most appropriate for tumors that can move during treatment, such as tumors in the lung or liver. Small markers, called *fiducials*, are placed in or near the tumor before the planning CT scan to track the tumor's movement. IGRT uses imaging such as CT scans, X rays, and ultrasounds taken just before daily treatments to check for any changes in the condition of the patient or the tumor. These images are compared with CT scans taken during planning. The radiation is directed at the tumor in the most current images, if there is a difference between the planning images and daily image.

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**Stereotactic radiation therapy**, or stereotactic radiosurgery (SRS), delivers large doses of radiation in one single fraction or in multiple smaller doses to a small area. The radiation beams are very precise, and this enables the radiation oncologist to protect more healthy tissue than other forms of EBRT. This treatment is appropriate only for certain types of cancer and is most commonly used for brain and spinal cord tumors. Stereotactic radiation therapy usually requires special equipment to help your child stay in the right position for the treatment.

**Intraoperative radiation therapy** involves delivery of radiation in the operating room directly to the tumor or tumor bed during surgery. This allows the radiation oncologist to clearly see the area to be treated and more precisely define the treatment field. Intraoperative radiation therapy also enables the radiation oncologist to deliver high doses of radiation therapy to the treatment site while protecting the nearby tissues and structures.

**Proton beam therapy** uses protons to deliver most of their energy at the end of their path, resulting in less radiation to normal tissue around the tumor or targeted area. This treatment usually is reserved for situations when tumors are located in areas for which surgery is not an option or when structures near the tumor may not be able to handle other types of radiation therapy. If this treatment is recommended for your child, you may be referred to another treatment center because not all radiation therapy facilities offer proton beam therapy.

**Neutron beam therapy** is another form of EBRT used to treat tumors that do not respond to other types of radiation therapy. Neutron beam therapy also may be used in combination with chemotherapy and/or surgery to reduce the risk that the cancer will return or to remove small amounts of remaining cancer. Neutron therapy often requires fewer treatments than other forms of radiation therapy; however, it is available only at a few centers in the United States.

**Total body irradiation (TBI)** is external beam radiation to the entire body in preparation for bone marrow (stem cell) transplantation. The goal of TBI is to suppress the immune system, kill any remaining cancer cells, and create room for the new bone marrow to grow. TBI usually is performed two or three times each day for several days before the bone marrow transplant. Vital organs that are very sensitive to radiation, such as the lungs, may be protected with lead shielding devices for a portion of the treatment.

## Brachytherapy

Brachytherapy is radiation given from inside the body. Radioactive material is sealed in a small container called an *implant* and placed into the area of the body to be treated. The implant may be permanent or temporary and can be placed in almost any cavity of the body where the tumor is located, in the space left after the tumor is removed (surgical bed), or near the tumor itself. Brachytherapy enables the radiation oncologist to deliver higher doses of radiation to the tumor in a short amount of time. This may be done over several days or weeks.

## Systemic Radiotherapy

Systemic radiotherapy may be given by mouth or intravenously (IV) so that the radioactive material travels throughout the entire body. Some tumors, such as thyroid cancer, may be treated with systemic radiation. Newer treatments, such as radiolabeled antibodies, have radioactive particles attached to an antibody. An antibody is found in the blood or other body fluids and is used to identify and destroy foreign cells in the body. The antibody recognizes the cancer cells, attaches to them, and gives off radiation that causes damage or death to the cancer cells.

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## ■ WHAT CAN BE EXPECTED DURING TREATMENT?

### **Weekly On-Treatment Visits (Status Check)**

When treatment begins, your child will be monitored weekly by the radiation oncologist and/or nurse practitioner. These visits are intended to monitor how well your child is tolerating the treatment and are another opportunity for you to ask questions. During these visits, the area being treated will be examined, any side effects will be discussed, and a plan for managing side effects will be developed.

The radiation oncologist may adjust the treatment schedule or radiation dose based on how the treatment is affecting your child and how well it is being tolerated.



### **Weekly X Rays (Position Verification)**

X rays will likely be taken at least weekly, usually after every five treatments, and sometimes even daily during therapy. The X rays are reviewed by the radiation oncologist and therapist to verify the treatment position. Positioning is very important during radiation therapy because the tumor has been targeted down to the millimeter. Changes in position may affect which part of the tumor is receiving treatment. The X rays only look at position; they do not provide any information about the tumor's response to therapy.

### **Follow-Up After Treatment**

When treatment is completed, your child will have a follow-up appointment with the radiation oncologist to monitor their recovery from treatment. Additional appointments will be scheduled as needed.

## ■ WILL MY CHILD BE RADIOACTIVE DURING TREATMENT?

If your child is receiving EBRT, he or she will not emit radiation following treatments. However, if your child is undergoing brachytherapy or systemic radiotherapy, he or she will emit radiation during treatment. Special precautions related to the care of your child during radiation therapy will be discussed before and after treatments.

## ■ WHAT ARE THE SIDE EFFECTS OF RADIATION THERAPY?

Most patients tolerate radiation therapy well. Side effects usually begin 2–3 weeks after treatment begins. Side effects may be mild at first and progress to moderate or severe. They can last for several weeks after radiation therapy has ended. Late side effects may occur months to years after treatment has ended. Because EBRT is a local treatment, side effects generally are experienced in the area where the radiation was given. Side effects may be more severe when radiation therapy is used in conjunction with chemotherapy or surgery.



<b>Examples of Radiation Therapy Side Effects</b>		
<b>Area Receiving Radiation</b>	<b>Side Effects During Treatment</b> <i>(acute effects)</i>	<b>Side Effects After Treatment</b> <i>(late effects)</i>
Brain	Hair loss, dry scalp, darkening of scalp, nausea and vomiting, headaches	Decreased hormone production, potential for learning deficits, attention difficulties, hair loss
Head and neck	Dry mouth, mouth sores, change in taste, difficulty swallowing and pain on swallowing, weight loss	Dry mouth, cavities, change in taste, decreased thyroid hormone production, cataracts
Chest	Irritation of throat or esophagus (food pipe), heartburn, difficulty swallowing	Inflammation of lung and/or heart, lung fibrosis (stiffness of the lungs)
Abdomen and pelvis	Nausea, vomiting, diarrhea, low blood counts*	Inflammation of the bowel, sterility, bowel obstruction, early signs of menopause
Bones and limbs		Decreased or incomplete bone growth, fractures
Skin	Irritation (similar to a sunburn), dry skin, hair loss	Darkening of the skin, slow wound healing, thickened skin
General	Feeling more tired than usual, sleeping more often	Secondary cancers

\* Low refers to a drop in normal blood counts (the number of red blood cells [RBC], white blood cells [WBC], and platelets.) A low RBC count may be referred to as anemia; a low WBC count may be referred to as neutropenia; and a low platelet count may be referred to as thrombocytopenia.

## ■ SHOULD I DO ANYTHING SPECIAL WHILE MY CHILD RECEIVES RADIATION THERAPY?

### **Skin Care**

Skin changes in the treatment area are very common. Skin may appear to have a mild sunburn, become darker in color, or even blister and peel. Good skin care is very important during radiation therapy. You should check the skin in the radiation area every day and notify your child's doctor or nurse about any changes. Skin in the radiation area should be cleaned with mild soap and warm (not hot) water; avoid scrubbing the skin. Your child's healthcare team will discuss with you how best to care for your child's skin during radiation. Special skin creams may be provided. Skin care products, perfumes, and deodorants should not be used in the radiation area unless your child's radiation team approves of their use.

To prevent further skin breakdown, your child should avoid wearing harsh fabrics, such as wool or denim, tight-fitting clothes over the treatment area, and elastic bands or straps on the treatment area that may cause irritation.

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## Nutrition

Nutrition is extremely important during radiation therapy. Radiation therapy may cause your child to experience nausea and vomiting, mouth sores, or fatigue.

These side effects may limit how much your child is able to eat and drink each day. The radiation oncologist, nurse, or nutritionist will discuss with you various ways to ensure that your child receives enough of both food and fluids. To decrease your child's nausea, the provider may prescribe medications for your child to take at home and prior to treatment.



## Fatigue

Most children do well while on radiation therapy, but some may experience fatigue (feeling overly tired), especially later in treatment. Incorporating rest periods into your child's daily routine may be helpful.

## ■ HOW CAN I HELP MY CHILD DURING AND AFTER TREATMENT?

You have an important role in the care of your child, such as providing emotional support and maintaining your child's routine as much as possible. If your child feels well enough, allow him or her to attend school. Make every attempt to maintain your child's normal routine, but make allowances if he or she feels ill.

Many parents and guardians may find it difficult to see their child experience side effects. As a caregiver, you may need support during these times. Contact members of the treatment team, such as the nurse or social worker, for assistance. Remember to report any side effects to your child's radiation oncologist, nurse, or therapist. Your child's treatment team is there to help.

## IMPORTANT PHONE NUMBERS

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8735 W. Higgins Road, Suite 300  
Chicago, IL 60631  
847.375.4724 • Fax 847.375.6478  
info@aphon.org  
www.aphon.org