

FREE take one

Understanding
**Radiation
Therapy**

A GUIDE FOR PATIENTS AND THEIR FAMILIES

WHERE
INFORMATION
EQUALS HOPE

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MEDICAL ADVISORY BOARD

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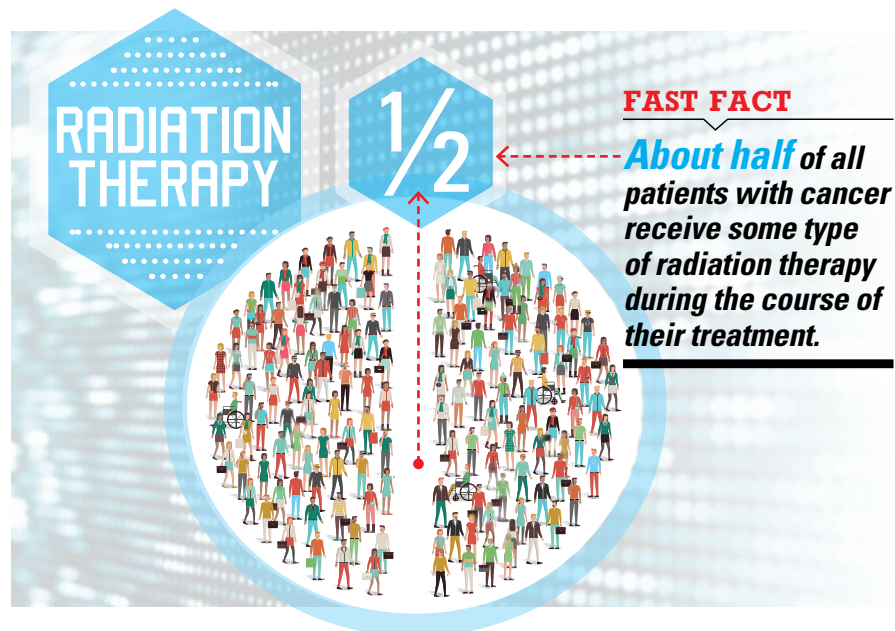
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OVERVIEW

▲ **Radiation therapy is one of the** most common treatments for cancer, with about half of all patients with cancer receiving some type of radiation therapy during the course of their treatment. The goal of this type of treatment is to destroy cancer cells and slow or stop tumor growth with limited or no impact on nearby healthy tissue.

Radiation therapy uses high-energy particles or waves, such as X-rays, electron beams or protons, to kill cancer cells and shrink tumors. These particles or waves damage the DNA, the molecules inside the cancer cells that carry genetic information and pass it from one generation to the next. Radiation therapy can either damage DNA directly or can create charged particles (free radicals) within the cells that can damage the DNA. Cancer cells with DNA that is damaged beyond repair stop dividing or die. Radiation therapy does not kill cancer cells immediately. The targeted cancer cells can take days or weeks before they start to die and will continue to die for weeks or months after therapy ends. As the cells die, they are broken down and eliminated by the body's natural processes. Normal tissues have a greater capacity to repair this DNA damage.

Most types of radiation therapy are considered local treatments because the radiation is aimed at the tumor in a specific area of the



body. Only cells in that area are affected. Most forms of radiation therapy can't reach all parts of the body, which means they're not helpful in treating cancer that has spread to distant areas. In some cases, most notably leukemia, total body radiation therapy may be given in preparation for bone marrow or stem cell transplantation.

To limit the severe side effects that may occur if a large dose of radiation is given all at once, a specific number of radiation doses is usually given over a set period of time. On average, the course of treatment for radiation therapy takes three to seven weeks. There are some forms of radiation therapy that can now be delivered in fewer sessions.

Used alone or in combination with other treatments, such as surgery, chemotherapy or targeted systemic therapy, radiation therapy is typically used in the following ways:

1 To cure or shrink early-stage cancer. To make the cancer shrink or disappear completely, radiation therapy is often used along with chemotherapy. Sometimes, a few cycles of chemotherapy are given first. Certain chemotherapy drugs act as radiosensitizers, meaning they make the cancer cells more sensitive to radiation and therefore, more likely to die. Although these drugs make the radiation therapy more effective, sometimes giving chemotherapy and radiation together results in more severe side effects. If needed, radiation therapy can be used after surgery to kill any remaining cancer cells and help prevent the cancer from coming back. This is known as adjuvant therapy.

When radiation is used along with other forms of therapy, the treatment is planned by the surgeon, medical oncologist and radiation oncologist, as well as the patient.

For certain cancers that can be cured either by radiation or by surgery, radiation may be preferable because it can sometimes preserve the organ's function (such as that of the larynx or the anus). Be sure to talk with your treatment team about temporary and potentially permanent side effects for each form of treatment.

2 To stop cancer from metastasizing. If a type of cancer is known to spread (metastasize) to a certain area, doctors may assume that cancer cells might already have spread there. Even when tumors are

TYPES OF RADIATION THERAPY TO TREAT SOME SPECIFIC CANCERS*

TYPES OF RADIATION THERAPY	TYPES OF CANCER COMMONLY TREATED
3D conformal radiation therapy	Bladder, breast, colon, lung, lymphoma
Brachytherapy	Breast, cervix, colon and rectum, prostate, skin, uterus/endometrial
Image-guided radiation therapy	Breast, head and neck, lung, prostate
Intensity-modulated radiation therapy	Central nervous system, gastrointestinal, head and neck, lung, lymphoma, prostate
Proton therapy	Brain, head and neck, liver, lung, pediatric tumors, prostate
Radioactive iodine	Thyroid
Radiopharmaceuticals	Bone metastases
Stereotactic body radiation therapy	Liver, lung, prostate
Stereotactic radiosurgery	Brain, spine

*Many of the options listed here are used to treat several kinds of cancer. The lists of cancer types are not all-inclusive.

not detected on imaging tests, your doctor may recommend treating the area to keep these cells from growing into tumors. For example, patients with some types of lung cancer may get preventive radiation (also referred to as prophylactic radiation) to the head because lung cancer often spreads to the brain. Sometimes, radiation therapy to prevent future cancer can be given at the same time it is given to treat existing cancer, especially if the prevention area is close to the tumor itself. In breast cancer, preventive radiation is sometimes used to treat regional lymph nodes.

3 To treat symptoms caused by advanced cancer. Sometimes cancer is no longer considered curable, but radiation treatment can still be used to reduce the size of tumors to make the patient feel better. Radiation therapy might help relieve symptoms such as pain, difficulty swallowing or breathing or bowel blockages that can be caused by advanced cancer. This is often called palliative radiation.

In addition to treating cancer, radiation therapy is used to treat other conditions, including Graves ophthalmopathy (the bulging eyes typically seen in certain thyroid conditions) and life-threatening hemangiomas. Radiation therapy also may be used to prevent conditions such as keloid formation, heterotopic bone formation and coronary artery restenosis. New uses for radiation therapy are constantly being researched.

IS RADIATION RIGHT FOR ME?

Radiation therapy can be more beneficial for treating certain kinds of cancer than others. Different types are known to be more sensitive to the effects of radiation, and some tumors develop in areas that are easier to treat with radiation and will cause less damage to healthy tissue. When deciding if radiation therapy is right for you, you must weigh the potential benefits of treatment against the risks. If your treatment team has suggested radiation as a treatment option, it means they believe that the benefits are likely to outweigh the risks.

It is important to know that there are lifetime dose limits of radiation that you can have in any one specific area. There is an amount of radiation to normal tissue that is considered safe. If an area of your body has been previously treated with radiation, you may not be able to get radiation to that area a second time. However, even if one area of tissue has already been exposed to



RADIATION THERAPY AS PAIN RELIEF

Pain relief has many benefits beyond the obvious one of being more comfortable. Studies show that when people with cancer get their pain under control, they are much more likely to finish their treatment on schedule, be more active and enjoy better emotional well-being. Some evidence even suggests that survival is longer when pain is managed effectively. Palliative radiation therapy is effective for treating acute and chronic cancer-related pain that has not been relieved by other methods.

Cancer-related pain is caused by several different factors. In many cases it is directly related to the cancer itself and the location of the tumor(s). A growing tumor can press on internal organs, tissues and joints, creating pressure that ultimately leads to pain in that area. Pain also can be caused by cancer that has spread, or metastasized, to bone. This pain is typically felt in the back, pelvis and hips, as these bones are the most common sites of cancer metastasis. Cancer-related pain may be felt in parts of the body other than where the primary tumor is located, especially in advanced disease.

External-beam radiation therapy (EBRT) is the type of radiation most commonly used to treat pain from cancer that has spread. With EBRT, high-energy X-rays are used to deliver radiation from outside the body. Recent research has shown that this palliative treatment can be given over a shorter period of time than in the past. In some cases, only one treatment is required while in other cases 5 or 6 or 10 to 12 are needed. Another type of radiation therapy used for pain relief is internal, with radiation delivered directly to a tumor through either radioactive medications (known as radiopharmaceuticals) or small radioactive seeds. Radiopharmaceuticals travel through the body and target cancer that has spread to bone. Radioactive seeds are implanted in a tumor and are used more commonly as curative treatment.

Radiation therapy may cause a skin reaction in the area being treated. The skin may absorb small amounts of radiation, causing redness and irritation similar to that with a mild sunburn. These reactions are usually minor and will resolve on their own after treatment. Your doctor can prescribe a cream if the reaction is more severe. Other side effects may relate to the part of the body being treated.

If your pain isn't being relieved, ask your medical team about exploring additional treatment options or for a referral to a pain specialist.

the maximum safe lifetime dose of radiation, you might still be able to get radiation to another area of the body if there is enough distance between the two areas. The safety of your dose is important when considering your treatment options throughout the entire course of your cancer care.

Talk to your medical team about the benefits and risks of receiving radiation therapy,

and also ask about the potential outcome if you refuse treatment. Knowing as much as possible can help you to be sure that radiation therapy is the right decision for you. ■

- ADDITIONAL RESOURCES**
- ▶ **American Cancer Society:** www.cancer.org
A Guide to Radiation Therapy
 - ▶ **National Cancer Institute:** www.cancer.gov

“The message I want to convey is that if radiation therapy is an option for you, make sure you are at a cancer center that is using the latest technology because it can make a huge difference.”

SECOND OPINIONS SAVE LIVES

Dr. Henry Farkas worked much of his life as an emergency room physician and hospice physician. He was familiar with the impact cancer can have on the body so, when he had a metastatic lung cancer recurrence in 2008, he accepted his terminal illness and he and his wife moved out to California to be close to their daughters during what he believed would be the last few months of his life. A visit to a local oncologist, however, led him to life-saving treatment with a newer type of radiation therapy that had recently become available at the facility. He continues to have clear follow-up scans to date.



I had oligometastatic Stage IV lung cancer with tumors in both lungs, two places in the base of my neck, and one place in my brain. I was originally diagnosed in 2006 and treated surgically to remove the lower lobe of my left lung. The tumor had developed behind my heart, against the aorta, but the surgeon was able to remove it all, and my post-treatment CT was clean.

Then, in 2008, a follow-up CT showed three new tumors in each of my lungs and a metastatic tumor in my brain. I underwent highly focused radiosurgery to treat the brain tumor. I began taking erlotinib (Tarceva) as palliative therapy. It was designed to give me a few extra months of life without causing serious side effects. I was also offered palliative radiation therapy to my lungs but declined because the radiation could cause significant damage to my heart.

My wife and I decided to spend my last few months in California closer to our two daughters and six grandchildren. We rented an apartment in Los Angeles near one of our daughters, and I was able to find a lung oncologist near our new home.

He kept me on erlotinib (Tarceva) for a few months but, unfortunately, the tumors began to grow again. The drug was causing side effects that had already bothered me so with the new progression, we decided to stop the treatment. We then found two new tumors at the base of my neck, one on each side. That's when the oncologist suggested chemotherapy and radiation therapy, not as palliative care, but with the goal of curing my advanced lung cancer. Normally, you don't treat Stage IV lung cancer with curative intent because the treatment itself is likely to cause side effects that reduce quality of life in what may be the last few months that

a patient has. And you don't want to take that risk if you don't know if therapy will work.

I explained to him that I had already declined palliative radiation because it could lead to congestive heart failure and, from my work in hospice care, I knew I did not want to battle both diseases near the end of my life. He informed me that his center had just installed the next generation of radiotherapy equipment. With the new technology, they could more precisely target the lung tumors, even those very close to my heart, to the point that the risk of damage to healthy tissues was minimal.

I agreed to the treatment with curative intent. Six weeks later, my tumors started to disappear. My last cancer treatment was on September 25, 2008. My scans have been clean ever since.

The message I want to convey is that if radiation therapy is an option for you, make sure you are at a cancer center that is using the latest technology because it can make a huge difference. A second opinion could save your life, no matter what the predicted outcome. ■

▲ When developing your treatment

plan, your radiation oncologist considers many factors to select the best radiation therapy for you. Important factors include the type of cancer, the size of the tumor, the location of the tumor, how close the treatment area is to normal tissues, how far the radiation has to travel, your general health and medical history and any other cancer treatments you may receive. You may have radiation therapy that is intended to help cure your cancer or to help manage the pain caused by your cancer.

High-energy X-rays and charged particles are types of radiation often used for cancer treatment. X-rays for radiation therapy are many times more powerful than X-rays used for diagnostic imaging (such as a chest X-ray).

There are three categories of radiation: external, internal and systemic.

EXTERNAL-BEAM RADIATION THERAPY

External-beam radiation therapy (EBRT) is the most frequently used type of radiation therapy. In EBRT, the radiation comes from a machine outside the body. These machines are called linear accelerators and they direct the radiation, most often photon beams (high-energy X-rays), to the tumor. EBRT can also be delivered with electron beam radiation, which has similar effects as photons but with different dose shaping capabilities. EBRT does not make a patient radioactive.

EBRT can be used to treat large areas of the body and more than one area (for example, the main tumor and lymph nodes near it). Even though the radiation is aimed at the cancer, it can affect the normal tissue it travels through on its way into and out of the body. External-beam radiation therapy can be administered in many ways.

Three-dimensional conformal radiation therapy

Three-dimensional conformal radiation therapy (3D-CRT) is a common form of EBRT. It involves the use of special computer software and treatment machines to create a three-dimensional image of the tumor. The image lets the doctors direct the highest possible dose of radia-

tion to the tumor while affecting the healthy tissue as little as possible.

Intensity-modulated radiation therapy

Intensity-modulated radiation therapy (IMRT) is a sophisticated type of EBRT. Like 3D-CRT, it also involves the use of software to create a precise, three-dimensional image of the tumor. These images are then used to shape the radiation beams to target the tumor more precisely. It is also possible to adjust the strength, or intensity, of the beams. Changing the intensity gives more control of the dose and lets the doctor deliver high amounts of radiation to the tumor while giving less radiation to normal tissue.

Volumetric modulated arc therapy (VMAT) is a kind of IMRT. For VMAT, the treatment machine rotates quickly around the patient at least once, shaping and reshaping the radiation beam continually to match the shape, size, and position of the tumor. This rapid rotation means that each treatment lasts just a few minutes. This type of radiation therapy can be more convenient for the patient because it delivers radiation faster than some other types.

Image-guided radiation therapy

Image-guided radiation therapy (IGRT) is an option on radiation machines with imaging capabilities built into them. The scanners may be used to obtain diagnostic X-rays or computed tomography (CT) images. These built-in scanners let the doctor take pictures of the tumor to track any changes in a tumor's size or location. If necessary, the doctor can then make minor aiming adjustments, which may make radiation delivery even more precise.

Because machines with IGRT technology can create an image of the tumor right before

treatment sessions, they can target the tumor precisely, while sparing healthy tissue.

Stereotactic radiosurgery

Stereotactic radiosurgery (SRS) uses thin beams of radiation given from many angles to provide a large dose of radiation to a small tumor area very quickly (often in a single session). Even though it is called surgery, it is a kind of radiation therapy and is non-invasive because no scalpel is used.

SRS uses the exact location of the tumor as shown on CT or MRI scans and requires that the patient is positioned precisely. Because of this, SRS can deliver radiation without excess damage to normal cells nearby. It is used to treat small tumors of the brain or spine, including brain metastases. A head frame or shell may be used to keep the patient's head in place.

Stereotactic body radiation therapy

Stereotactic body radiation therapy (SBRT) is similar to SRS. It precisely delivers radiation to tumors in the body that are not in the brain or spinal cord. Because these tumors are more likely to move with the patient's normal movements, these treatments require special technology for localizing the tumor through imaging and then compensating for any tumor or patient motion. SBRT is used to treat small, isolated tumors, such as those in the lung or liver. A body frame is often used to align the patient for treatment, and organ movement, due to functions such as breathing, may be monitored to ensure that the treatment remains accurate.

Proton therapy

The EBRT techniques already listed deliver radiation by photon beams. Protons are a type of charged particle that can also be used to deliver radiation. The main difference between protons and photon beams is how they deposit energy in living tissue. Photons deposit energy in small amounts along their entire path through the tissue. In contrast, protons deposit a lot of their energy at the end of their path, leaving less along their way through the tissue.

This difference means that protons may reduce the amount of radiation deposited in normal tissue. It also suggests that protons may be able to deliver high doses of radia-



← Linear accelerator

FIGURE 1
TEMPORARY BRACHYTHERAPY

Breast Example

Temporary radioactive source (seeds) is placed in the breast through a catheter into a device.

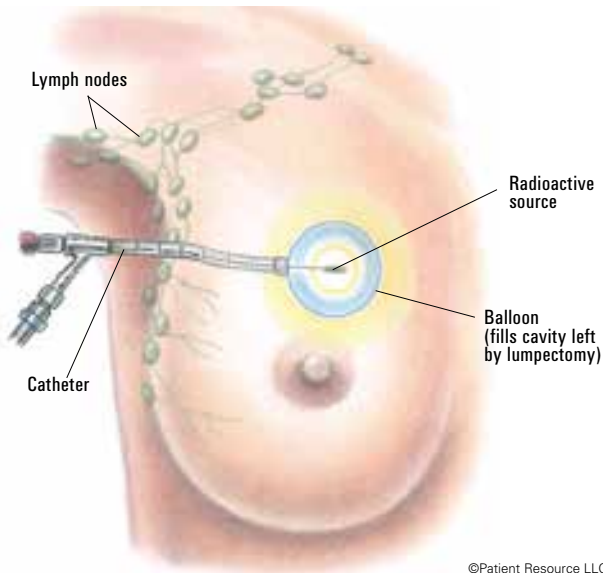
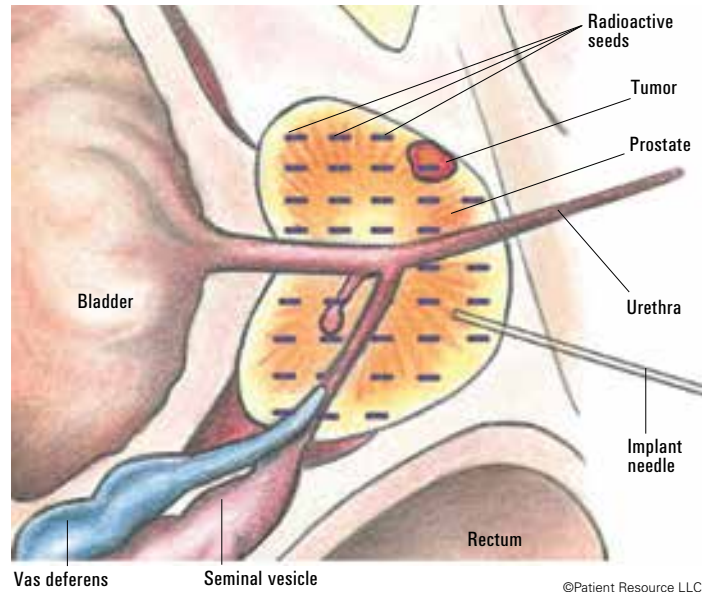


FIGURE 2
PERMANENT BRACHYTHERAPY

Prostate Example

Permanent radioactive seeds are placed in the prostate with a needle.



tion to a tumor. However, more studies are needed to confirm this.

The machine that delivers proton therapy is not yet widely available.

Other charged particle beams

Electron beams can be used to treat superficial tumors, such as skin cancer or tumors near the surface of the body. Electron beams cannot travel far through the tissue, so they cannot treat tumors deeper in the body.

INTERNAL RADIATION THERAPY (BRACHYTHERAPY)

For internal radiation therapy, or brachytherapy, sources of radiation are placed in or near the area to be treated. Because the radiation travels just a short distance, the risk of damaging normal tissue is lower than with EBRT. Brachytherapy can be a good option for tumors that require a high dose of radiation or are near sensitive normal tissues that are easily damaged by radiation.

Depending on where it is placed, brachytherapy may be intracavitary or interstitial. In intracavitary radiation, the radioactive material is placed in a body cavity, such as the rectum, uterus or cervix. The cavity may also be one that results from surgery, such as the space left in the breast after a lumpectomy (see Figure 1). In interstitial radiation, the radioactive source is placed in or near the tumor using needles or catheters, but not in a body cavity.

Brachytherapy placement can be permanent or temporary.

In permanent brachytherapy, seeds or pellets of radioactive material are placed in the tumor with a needle (see Figure 2). The seeds are about the size of a grain of rice. Once in place, they give off radiation for a few weeks or months and are left in place after the radioactive material is used up. During permanent brachytherapy, the patient is temporarily radioactive, but the amount of radiation that reaches the surface of the skin is very low. Still, contact with pregnant women and young children may be restricted for a certain amount of time.

In temporary brachytherapy, cylinders, needles, catheters or balloons are placed in the treatment area. Radioactive materials are placed in these containers, left for a short time and then removed. Temporary brachytherapy can be administered at a high-dose rate (HDR) or a low-dose rate (LDR).

In HDR brachytherapy, the radiation source is placed for a few minutes at a time and then removed. Schedules will vary with treatment plans, but the process can be repeated twice a day for up to a week or once a week for a few weeks. In LDR brachytherapy, the radioactive material stays in place for up to seven days. To keep the radiation source from moving, patients must stay in bed. Because of this, patients receiving LDR therapy stay in the hospital.

During temporary brachytherapy, the patient is radioactive as long as the radioactive material is inside the patient's body. As soon as it is removed, the patient is no longer radioactive. Because of this, patients receiving

temporary brachytherapy usually stay in the hospital in a special room that protects other people from the radiation.

SYSTEMIC RADIATION THERAPY

EBRT and brachytherapy both target the specific location of the tumor. In contrast, systemic radiation treats the entire body. In systemic radiation therapy, a patient swallows a radioactive substance (a pill or a tasteless solution in water) or receives it as an injection.

Radioactive iodine is used to treat some kinds of thyroid cancer. For some other types of cancer, systemic radiation therapy may be administered as a drug with a monoclonal antibody that helps direct the radioactive material to the tumor. For example, ibritumomab tiuxetan (Zevalin) is used to treat certain types of B cell non-Hodgkin lymphoma. Other systemic radiation therapy drugs for other cancer types are being studied in clinical trials.

Some systemic radiation therapy drugs relieve pain caused by cancer that has spread to the bone (bone metastasis). These drugs are called radiopharmaceuticals. Samarium-153 lexidronam (Quadramet) and strontium-89 chloride (Metastron) are two radiopharmaceuticals that treat pain caused by bone metastasis.

Some types of systemic radiation therapy may make a patient's body fluids temporarily give off a low level of radiation. Patients may need to limit contact with others, especially avoiding contact with children younger than 18 years and pregnant women. ■

PARTICIPATING IN A CLINICAL TRIAL

▲ **Radiation therapy has been used** as cancer treatment for more than a hundred years. As radiation technology has improved, delivering radiation has gotten more precise — resulting in fewer side effects for the patient — because of clinical trials.

Before new forms or dose schedules of radiation therapy become available to patients, they are evaluated in clinical trials to evaluate whether the new treatments are safe and effective in humans. In addition, clinical trials help doctors determine a treatment's side effects, dosage and the best way to administer it.

Clinical trials are often sponsored by government agencies such as the National Cancer Institute, independent groups of doctors and health care institutions, or the radiation/imaging companies or pharmaceutical/biotechnology companies that have developed the new treatment. The results of clinical trials help the U.S. Food and Drug Administration (FDA) decide whether to approve a new treatment, which is necessary for the treatment to be used in general practice. You may be eligible to participate in a clinical trial to receive treatment before it is approved by the FDA.

There are several ways that radiation treatment can be included as part of a clinical trial. In addition to studying new ways to deliver radiation to patients, there are trials that study radiation therapy given in combination with other kinds of treatment. Some trials investigate ways to treat side effects of radiation therapy, and still others may look at quality-of-life issues faced by people undergoing radiation therapy. When deciding if a radiation clinical trial is right for you, ask about whether the focus of the study is appropriate for your treatment needs.



SHOULD YOU PARTICIPATE?

You may want to consider participating in a clinical trial for the following reasons:

- 1** Your current treatment may not be working as well as expected, and a clinical trial may be a worthwhile alternative.
- 2** A clinical trial may significantly improve your quality of life. Discuss your personal situation with your medical team.
- 3** You may have a rare type of cancer that hasn't been studied as much as other types.
- 4** By simply participating, you play an integral role in helping refine and improve the way millions of people with all types and stages of cancer are treated. You will not only help identify treatments that do work, you'll help eliminate those that don't.

If you join a trial, you are guaranteed to receive at least the standard of care. There are no placebos involved in these trials. Institutional review boards or ethics committees carefully set up safeguards to make sure that all patients in the clinical trial remain safe throughout the process. Keep in mind that not everyone responds to treatments in the same way, so you cannot expect an identical experience in terms of response to treatment, side effects, etc. Regardless of the

opinions and research you gather, participating in a clinical trial is ultimately your decision.

WHAT TO EXPECT

Clinical trials are all highly strategic and performed in a totally consistent manner so that all patients are treated exactly the same. Whether you're at a small hospital or a large facility in a metropolitan area, your physician will be responsible for diligently following all of the same safety measures for your treatment plan across the board.

When you volunteer to participate in a clinical trial, you will receive specific instructions but you are encouraged to ask questions about anything you don't fully understand. This is the ideal time to talk with your medical team about the many falsehoods that persist about clinical trials. Remember, though there is fear to the contrary, participants are guaranteed to receive at minimum the current standard of care during the trial.

You will be carefully monitored throughout the clinical trial. Even after the treatment ends, you will continue to be in close contact with your medical team.

RISKS AND BENEFITS

Clinical trials present many potential benefits. At the same time, they may also present risks, such as side effects. If you consider volunteering for a clinical trial, talk with your medical team about the expected benefits and risks so you can best manage your expectations.

Fear of the unknown is a common reason people with cancer hesitate to volunteer in clinical trials. It's important to know that if you feel your expectations aren't met or if you experience too many side effects, you can withdraw and return to standard treatment at any time. ■

» FIND A RADIATION CLINICAL TRIAL

Your medical team can give you more information about clinical trials in your area, but they may not be aware of trials available in other locations. Using online tools such as these allow you to search for clinical trials that may apply.

Center for Information and Study on Clinical Research Participation: www.searchclinicaltrials.org

CenterWatch: www.centerwatch.com

City of Hope: www.cityofhope.org/clinical-trials

Coalition of Cancer Cooperative Groups: www.cancertrialshelp.org

Foundation for Women's Cancer: www.foundationforwomenscancer.org
(Search "Clinical Trials")

My Clinical Trial Locator: <http://myclinicaltriallocator.com>

National Cancer Institute: www.cancer.gov/clinicaltrials

National Institutes of Health: www.clinicaltrials.gov

Patient Resource: www.patientresource.com/search_clinical_trials.aspx

Radiation Therapy Oncology Group: www.rtog.org

TrialCheck: www.trialcheck.org

DON'T FORGET TO KEEP LIVING

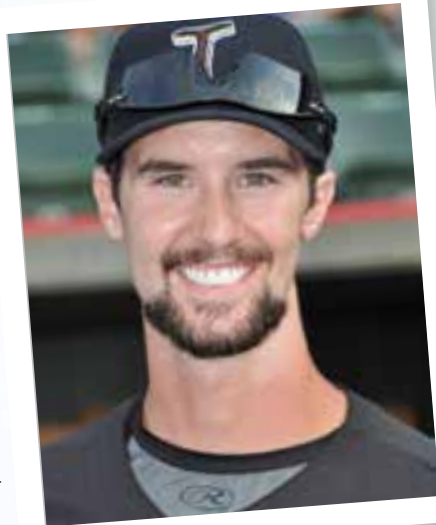


I was diagnosed with early-stage salivary

gland cancer, a rare disease usually diagnosed in people older than 60 — I was only 17. Because it was so rare, my parents and I decided we needed a specialist and felt very lucky to find one not far from home. He told us that I could either have surgery first, followed by radiation and possibly chemotherapy, or jump right into radiation. Surgery would allow the doctor to see more clearly if the cancer had spread, determine a more accurate stage, and remove as much of the surrounding tissue as he thought necessary.

My parents and I discussed the options and we decided on surgery. The surgeon removed two-thirds of my parotid gland and 13 lymph nodes from my neck. Thankfully, all the margins came back clear; the cancer had not spread. The surgeon was confident he'd successfully removed all of the cancer and because surgery went so well, radiation therapy became a choice. Radiation would help to ensure there were no remaining cancer cells. I was young and otherwise healthy so I would be able to better tolerate any side effects. The surgeon encouraged me to get the radiation to prevent recurrence and I agreed. I would receive 33 external-beam radiation treatments.

I went for treatment five days a week, Monday through Friday, and had weekends to recover. I would go to the hospital every day after school and then when I was up for it, I would go to evening baseball practice. Every time I went in, I had to be positioned exactly right, so they made a mask with lots of holes in it that covered my head and ears and went down to my Adam's apple. The nurses would set the table up, I'd lie down and they'd place the mask on my face and secure it in place. They moved the machine around my head to hit the cancer from three different angles. Treatment only took about 15 to 20 minutes, and I was always able to drive myself home.



“Cancer is something that I had, something that affected me and changed my life, but it's not who I am.”



I lost a lot of weight after surgery, could no longer produce saliva on the left side of my mouth and lost some feeling for a while on that side of my face. Radiation caused mouth sores and blisters, chapped lips and hair loss. I also had what looked like a sunburn but aloe helped, and I made sure to wear sunscreen every day to prevent any additional burns. I did experience fatigue that would hit me suddenly. I remember lying down in my teacher's office for a minute after gym and sleeping for hours.

One of the hardest parts of my cancer journey wasn't the surgery or the radiation or the grueling treatment schedule. It was feeling like people looked at me differently. My friends didn't know what to say, peers didn't want to ask questions, coaches wondered. I still have trouble talking about it sometimes because I feel like knowing I had cancer changes the way people view my life and my story. I joined a support group a few years ago. Everyone else was over 40, so it was a little weird. The support, however, was and is great, and being able to talk about it without feeling that people are looking at me funny has helped me become more comfortable with myself.

Cancer is something that I had, something that affected me and changed my life, but it's not who I am. Remember to still be you, even with cancer. Don't let it get you down; it's so much harder to get yourself back up if you do. And do what you love now while you know you can. There are no guarantees in life, so take advantage of the here and now. I've been cancer-free for six years. I play ball as often as I can, and my family and I have a renewed faith in God. Yes, people can die from cancer, but it doesn't have to be a death sentence. Don't forget to keep living. ■

PERSONAL JOURNEY | JIMMIE WADE

→ Jimmie "Hooty" Wade was diagnosed with salivary gland cancer at the young age of 17. Even radiation therapy treatments every weekday for nearly 7 weeks couldn't keep this sophomore out of school or away from the baseball field. Through everything, he had the support of his parents, teachers and coaches. He stayed involved in the sport and now, seven years cancer-free, he's still playing ball whenever he can as a bullpen pitcher for a local independent professional baseball team.





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Radiation treatments may cause side effects that can vary depending on the part of the body being treated. The most frequent ones are typically temporary and may include, but are not limited to, irritation to the respiratory, digestive, urinary or reproductive systems, fatigue, nausea, skin irritation, and hair loss. In some patients, they can be severe. Radiation treatment is not appropriate for all cancers. See varian.com/use-and-safety for more information.

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with your treatment team

If radiation is dangerous, why is it used to treat cancer?

ANSWER } As with any cancer treatment, it is important to consider the benefits versus the risks of that particular option. If your treatment team recommends radiation, it means they believe that the benefits are anticipated to outweigh the risks.

Radiation works by causing DNA damage within the cells. Healthy tissue has a greater ability to repair this damage compared to most tumor cells. The accumulation of damage within tumor cells eventually becomes lethal. Radiation can cause injury to some of the normal cells, but severe toxicity to normal organs resulting from this injury is unusual. However, some of this damage can be long-lasting so it is very infrequent to receive two courses of radiation to the same area of the body. Your radiation oncologist should help you understand the risks and benefits of radiation treatments so that you can contribute to decisions about your treatment.

Recent advancements in radiation techniques allow for better control of the radiation doses and more precise delivery to the treatment site, which minimizes radiation exposure to healthy tissue. This often means fewer side effects. If side effects are experienced, they are typically limited only to the area of the body being irradiated.

→ WHEN YOU CONSIDER RADIATION THERAPY as part of your treatment plan, it is important to learn as much as you can about all of your options before making a decision. Be honest with your treatment team about any concerns you may have and don't be afraid to ask questions that will help you determine if radiation is right for you. To get you started, here are answers to some of the most commonly asked questions.

If I've already had surgery to remove my cancer, why would radiation be necessary?

ANSWER } The goal of radiation therapy given after primary surgical treatment is typically to destroy any cancer cells that may remain. Even if a surgeon believes the entire tumor and any cancerous lymph nodes have been successfully removed, there is a chance that undetectable cancer cells may still exist and begin to grow again. Radiation to the surgical site can lower the risk of recurrence by destroying those cells that could potentially remain. The type of radiation used will depend on your diagnosis.

Am I a candidate for different types of radiation? Am I being treated with the most advanced technology for my needs?

ANSWER } Several different types of radiation therapy are available. When you consider radiation as a treatment option, it is important to know which types of radiation are appropriate for you and whether your treatment center offers the latest technology. Talk to your doctor about all of your options and look for resources specific to a certain type of therapy. Getting a second opinion may be valuable to help you determine which radiation therapy option has the most potential benefit to you.

When and how will I know if radiation was successful?

ANSWER } Radiation therapy does not kill cancer cells immediately. When a cell is unable to repair the DNA damage caused by the radiation, it dies. It could take days or weeks of treatment before this happens and the tumor begins to shrink. Then, the tumor may continue to shrink for weeks or months after radiation therapy ends. Your doctor may monitor progress with diagnostic testing.

If you are receiving radiation therapy after primary surgical treatment, the radiation is targeted at undetectable cells that may remain in the surgical site. Because you are unable to see or detect the cancer cells to begin with, you may not be able to determine the effectiveness of treatment right away. You will likely receive follow-up care after radiation ends to monitor for recurrence.

Why do radiation oncologists and therapists take so many safety precautions for themselves while giving me my radiation treatments?

ANSWER } If you have chosen radiation as part of your treatment plan, the appropriate radiation dose will be calculated according to several factors and then divided among the appropriate number of treatments. As a patient, you are likely receiving only one series of treatments to a specific area. Radiation specialists, however, work with several patients every single day, often for years. Staff is required to follow specific protocol (such as leaving the room during external-beam radiation or wearing protective gear while providing internal or systemic radiation) when delivering radiation as a safety precaution. These precautions are set in place to protect professionals that work in the radiation clinic.

PREPARING FOR RADIATION

INSIDE THIS SECTION

PAGE	TOPICS
12	Planning Your Treatment
13	Receiving Radiation Therapy
16	Post-Treatment Care
17	Assistance & Financial Resources



PLANNING YOUR TREATMENT

▲ **Before you begin radiation therapy,** you will meet with a radiation oncologist to determine whether radiation is appropriate for you. The doctor will review your medical history and may perform a physical exam. You will likely discuss the potential benefits and risks of radiation therapy, and you'll have the opportunity to ask questions. Once you've decided to include radiation as part of your treatment plan, you'll be asked to sign a consent form.

INFORMED CONSENT

A radiation treatment consent form gives the doctor permission to treat you with radiation and complete the necessary testing for treatment planning. Although the details of the consent form may vary, it generally states that your doctor has explained the potential benefit of radiation therapy for your diagnosis, as well as the possible risks, the type you'll be receiving and any other treatment options you may have. By signing the form, you confirm that you've received and understood this information and that you agree to treatment with radiation and are aware that treatment does not guarantee the intended results.

YOUR RADIATION TEAM

Your radiation treatment team will include several professionals trained in radiation therapy:

- **Radiation oncologist** – treats cancer with radiation and is in charge of managing your radiation treatment plan and working with other treatment team members.
- **Radiation oncology nurse** – cares for patients receiving radiation treatment and is available to answer your questions about radi-

ation and tell you how to monitor your health and manage or prevent possible side effects.

■ **Radiation physicist** – makes sure the radiation equipment works properly, including delivering the correct dose of radiation as prescribed by your radiation oncologist. The radiation physicist also helps develop the treatment plan.

■ **Radiation dosimetrist** – works with the radiation oncologist to plan treatment and calculate the appropriate radiation dose.

■ **Radiation therapist** – delivers the radiation, typically daily, during scheduled treatments, ensures that you are positioned properly for each treatment and operates the radiation equipment.

Your team may also include additional health care professionals, such as a dietitian, physical therapist or social worker, as needed.

SIMULATION

The first radiation therapy session will be a simulation to help with the planning. During the simulation, your treatment team will use imaging scans to determine exactly where the radiation beams need to be directed. This may include the following imaging techniques:

■ **Computed tomography (CT)** – CT is a procedure in which a scanner creates three-dimensional X-ray images of the organs, tissues and bones inside the body and displays cross-sectional pictures of them on a computer screen. CT may also be called a CAT scan. This is the most common imaging for breast cancer treatment.

■ **Magnetic resonance imaging (MRI)** – MRI involves the use of magnetic fields instead of X-rays to create images of structures inside the body.

■ **Positron emission tomography (PET)** – A PET scan involves the use of radioactive substances (tracers) that travel through the blood

stream and collect in areas of fast metabolism (cells that use a lot of energy), such as tumors. The machine then detects those areas and creates images that help the doctor determine where the cancer cells are located. Often, PET may be combined with CT, which is known as a PET/CT scan.

■ **Ultrasound** – Ultrasound uses sound waves to produce images of the organs inside the body and can show where the tumor is located.

Once the treatment team has determined the appropriate position for you on the table, you must be placed in exactly the same position for each treatment session. To make sure this happens, body molds or other immobilizing devices may be necessary. If you are to receive radiation to the head and neck, a special mesh head mask, called a thermoplastic mask, may be created from a mold of your face and head (see Figure 1, page 13). In most cases, semi-permanent marks or permanent tattoos may be placed on your skin to indicate the exact location the radiation beams must hit to reach the tumor.

Your treatment team will want to make you as comfortable as possible, so be sure to talk to them about any anxiety you feel, especially regarding immobilizing devices. They will work with you to find a position you are comfortable with that can be reproduced for each treatment. If necessary, your doctor may prescribe medication to ease anxiety and help you relax for your treatments.

YOUR TREATMENT PLAN

After the simulation is complete, your treatment team will calculate the appropriate dose and finish treatment planning. Different doses of radiation are used to kill different types of cancer cells. The overall dose of radiation necessary to treat your cancer is determined by several factors, including the type of cancer you have, the location of the tumor(s), the goal of treatment and your overall health. To minimize damage to normal tissue and to increase the likelihood that the radiation will kill the most cancer cells, the total dose of radiation is typically divided into several smaller doses and given over a period of time. Researchers continue to study the effects of different dosing schedules in hopes of finding more effective and convenient options for patients. For example, recent research has shown that for most patients treated with a lumpectomy, a shorter course of treatment lasting 3 to 4 weeks rather than 6 weeks is just as safe and effective. ■

FAMILY PLANNING

→ **Radiation therapy can affect fertility, especially if the radiation will target the pituitary gland in the brain or your reproductive organs, including the abdomen, pelvis, lower spine, ovaries or uterus. If you are receiving radiation to an area that could result in infertility but are not ready to rule out the possibility of becoming a parent, consult with a fertility expert (known as a reproductive endocrinologist). There are ways to preserve your fertility and your doctors, oncologists and fertility experts can all help you better understand your options.**



RECEIVING RADIATION THERAPY

▲ **Radiation is delivered externally** (external-beam radiation therapy), internally (brachytherapy) or systemically (radiopharmaceuticals). “Radiation Therapy Options” on pages 4-5 describes each of these options in more detail. Some patients may receive multiple types of radiation to treat their cancer.

WHAT YOU CAN EXPECT

External-beam radiation therapy

Radiation therapy is the use of high-energy X-rays, electrons, or proton beams to destroy or damage cancer cells. External-beam radiation treatments are most commonly delivered with the use of radiation machines known as linear accelerators. The X-rays generated with these machines are much higher energy compared to the X-rays used for diagnostic studies, which permits the radiation beams to kill cancer cells. New techniques, such as intensity-modulated radiation therapy, enable doctors to target the radiation dose directly to the precise site of the tumor, causing less

» QUESTIONS TO ASK YOUR RADIATION ONCOLOGIST



Start planning your questions by reading “Asked & Answered” on page 10.

- ▶ **What is the goal of treatment?**
- ▶ **What are my other treatment options?**
- ▶ **How do I prepare for treatment?**
- ▶ **How often will I receive radiation and for how long?**
- ▶ **What are the short-term side effects and how long will they last?**
- ▶ **What are the long-term side effects?**
- ▶ **Will treatments restrict my normal activity?**
- ▶ **Will I be radioactive after treatment?**
- ▶ **When do I need to call my doctor?**

FIGURE 1
▲ THERMOPLASTIC MASK



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damage to healthy cells in the pathway of the radiation beam.

When you arrive for your treatment appointments, your radiation therapist will instruct you to lie down in the position determined during your radiation simulation session. He or she might use molds or other techniques to position your body and hold it in place or set up shields to block the radiation from reaching certain parts of your body. It may take up to 10 minutes to get you set up for treatment, and most treatments last only a few minutes.

When you are correctly positioned, the radiation therapist will leave the room. He or she will still be able to see and hear you at all times during the treatment, so you can always communicate if you have concerns. When the therapist starts the linear accelerator, it may rotate around your body to reach the targeted area from different angles. It also may make buzzing, whirring, clicking or knocking sounds, but these are normal so don't be alarmed.

The treatment itself is painless, and most patients are treated on an outpatient basis, maintaining the ability to carry on with normal daily activities.

Proton therapy

Proton-beam therapy is a type of EBRT. It uses a type of charged particle called a proton, rather than traditional photon beams (X-rays or gamma rays), to destroy or damage the cancer cells. Protons deposit most of their energy when they reach the targeted area and their dose rapidly stops. This helps avoid treating the normal tissues that are directly behind the targeted region. This difference means that protons may reduce damage to normal tissue, often causing fewer side effects and potentially allowing for higher doses of radiation per treatment.

This process is similar to getting an X-ray. The entire process of setting up the equipment and putting you into the proper position usually takes about 15 to 30 minutes.

When you arrive, you'll lie on a table or sit in a chair next to the radiation machine. A member of your care team will get you into your treatment position, which was determined during your radiation simulation session. This may include using immobilizing devices to hold the treatment area in place or setting up shields to block the radiation from reaching certain parts of your body.

Once you are ready, the machine will deliver the radiation to the tumor site. The machine has an arm that can be positioned around you but will not touch you. It will likely make loud clicking and whirring noises. Although the radiation therapist will control the machine from a separate room, he or she will be able to see and hear you at all times during the treatment. If at any point you are uncomfortable or feel ill, let the radiation therapist know.

Treatment should be painless and most patients are treated on an outpatient basis, maintaining the ability to carry on with normal daily activities.

Brachytherapy

If your treatment plan includes brachytherapy, the radioactive materials will probably be implanted in you in a hospital operating or procedure room. The doctor will likely use either a general anesthetic (meaning you will be asleep) or a local anesthetic to numb a specific area so that you do not feel pain during the procedure. The radioactive substance will be implanted using an applicator, which is usually a metal tube or a plastic catheter.

If you are receiving several temporary treatments, the applicator may remain in place until the final treatment, and you will need to stay in the hospital while receiving treatment. Other brachytherapy applications are given as outpatient procedures, delivered several times per week. If your internal radiation therapy is permanent, the applicator will be removed at the time of the procedure.

The dose and amount of time you are exposed internally to the radioactive substance will be determined by your radiation treatment team. Permanent radioactive seeds will eventually stop giving off radiation after weeks or months. They will stay inside your body but will not be active and will not cause harm.

Radiopharmaceuticals

Systemic radiation is delivered through radioactive drugs called radiopharmaceuticals. They may be given in a vein or taken orally. You will likely receive treatment in a hospital room designed to contain radiation. Because you will have radiation in your body for a couple of days following treatment, you may need to stay in the hospital. It is important that you follow any precautions recommended by your cancer care team to protect the people around you for a certain amount of time after you receive systemic radiation treatment.

It is important that you avoid pregnancy while receiving any type of radiation therapy. For women, radiation can cause harm to the baby. For men, there is very little information

available about the effect of radiation therapy on children of men receiving radiation at the time of conception. Talk to your doctor about birth control options during and for a short time after radiation therapy.

TAKING CARE OF YOURSELF

During treatment, it is important to take care of yourself. You need to get plenty of rest, eat a healthy diet and manage side effects.

In addition to killing cancer cells, radiation may also cause damage to normal tissues. This damage can lead to unintended side effects. Which side effects you experience will depend on the area of the body being treated, the dose and treatment schedule, your overall health and whether you are receiving any other treatment during radiation. The side effects of radiation treatment can vary. Not all people will have the same side effects, even if they have the same type of radiation therapy for the same type of cancer.

Side effects that occur during treatment are called short-term side effects, and they usually disappear when treatment ends or within one to two weeks after treatment.

In contrast, long-term side effects may not completely disappear until months or years after treatment ends, and late effects may emerge years later. Other side effects vary according to the part of the body being treated and may be short-term, long-term or occur long after treatment ends.

Some side effects are a minor inconvenience, while others may cause discomfort, pain and/or emotional distress. Knowing what to expect and how you can prevent or manage some of the most common side effects may help you get through treatment successfully. If you feel better, you're more likely to complete treatment on schedule.

Fatigue

Fatigue is one of the most common side effects of radiation treatment. Most patients experience some degree of fatigue regardless of the area being treated. Everyone knows what exhaustion feels like, but the fatigue that can come with cancer and its treatment is different. It's stronger and lasts longer. For some patients receiving radiation, fatigue persists even when they get enough sleep.

Radiation therapy typically takes a while to cause fatigue; a feeling of being tired and weak usually starts a few weeks after treatment begins and gradually diminishes after treatment ends. These strategies may help you manage your fatigue:

- Accept help from others who volunteer to prepare meals, complete chores and perform other tasks.
- Remain active. Regular moderate exercise, especially walking, decreases fatigue.
- Set a routine for sleeping and waking.
- Nap when you can, but not too much. Try to keep naps to about 30 minutes. Longer naps can reduce your energy level. Try to get at least eight hours of sleep per night.
- Don't ignore symptoms like pain, nausea, vomiting or depression, which might be preventing you from sleeping.

Skin problems

Skin reactions caused by radiation therapy often begin about two to three weeks after the first treatment and typically resolve within a few weeks after treatment ends. During your treatment you will likely experience some dryness, itchiness and irritation of the skin, similar to a mild sunburn. The skin and underlying tissues in the area being treated may become sensitive. This sensitivity is typically short-term and usually resolves gradually within two months after treatment stops.

POTENTIAL SIDE EFFECTS

Listed here are the most common side effects based on the part of body treated.

BRAIN

- ▶ Headaches
- ▶ Hair loss
- ▶ Nausea, vomiting
- ▶ Fatigue
- ▶ Hearing loss
- ▶ Skin changes
- ▶ Problems with memory or speech
- ▶ Seizures

BREAST

- ▶ Heart problems, such as hardening of the arteries, heart valve damage or irregular heartbeat
- ▶ Trouble swallowing
- ▶ Cough
- ▶ Shortness of breath
- ▶ Breast soreness, tenderness or tightening
- ▶ Skin changes, irritation
- ▶ Lymphedema (swelling, fluid buildup)

CHEST

- ▶ Heart problems, such as hardening of the arteries, heart valve damage or irregular heartbeat
- ▶ Trouble swallowing
- ▶ Cough
- ▶ Shortness of breath

HEAD AND NECK

- ▶ Soreness in the mouth or throat
- ▶ Dry mouth
- ▶ Trouble swallowing
- ▶ Changes in taste
- ▶ Nausea
- ▶ Earaches
- ▶ Tooth decay
- ▶ Swelling of the gums, throat or neck
- ▶ Hair loss
- ▶ Skin changes, irritation
- ▶ Stiffness in the jaw

STOMACH AND ABDOMEN

- ▶ Nausea, vomiting
- ▶ Cramping
- ▶ Diarrhea

PELVIS

- ▶ Nausea, vomiting
- ▶ Cramping
- ▶ Diarrhea
- ▶ Bladder problems, such as pain or burning sensation during urination, trouble passing urine, blood in the urine or frequent urge to urinate
- ▶ Vaginal itching, burning, dryness
- ▶ Fertility problems
- ▶ Changes in sex drive



WILL I BE RADIOACTIVE?

A COMMON FEAR

→ **Many patients wonder** if receiving radiation therapy will make them radioactive. It is important to know that the majority of patients do not emit any radioactive material during or following radiation therapy. Only the small number of patients receiving internal or systemic radiation are at risk of emitting radioactive substance surrounding treatment. Internal radiation therapy may emit small amounts of radiation, depending on the dose and whether you receive temporary or permanent implants. Permanent implants give off only very small doses over a period of a few weeks or months so the risk that others could be exposed to radiation from your treatment is minimal. Still, it is important to take precautions, such as limiting visitors while receiving temporary treatment and staying away from small children and pregnant women immediately after permanent radiation implantation. However, neither your bodily fluids nor the surfaces you touch will be radioactive during internal radiation therapy. Systemic radiation does involve a radioactive substance that circulates throughout your entire body so, for a time after receiving therapy, your bodily fluids (including urine, saliva and sweat) may emit radioactive material. For the first few days after systemic radiation therapy, you can reduce the risk of radiation exposure to family and friends by following some simple tips.

Because there is no internal source of radiation in your body, external-beam radiation does not cause you to become radioactive during or after treatment.

SAFETY TIPS FOR PATIENTS RECEIVING INTERNAL OR SYSTEMIC RADIATION

- ▶ Wash your hands thoroughly after using the toilet
- ▶ Flush twice after using the restroom
- ▶ Do not share utensils or towels
- ▶ Wash your laundry separately
- ▶ Drink plenty of fluids to help rid your body of radioactive material
- ▶ Avoid sexual contact for at least a week, including kissing
- ▶ Limit contact with infants, young children, pregnant women and pets
- ▶ Consider sleeping alone for the first week



▲ Wash hands thoroughly



▲ Flush toilets twice and keep clean for others



▲ Drink plenty of fluids

Short-term or long-term swelling or scarring of the tissues may occur, and the scarred tissues may become firm or contracted.

Talk to your doctor about using creams or lotions to alleviate short-term discomfort caused by radiation. And stay covered or wear sunscreen when outdoors to prevent further damage or sensitivity to the treatment area.

Nausea and vomiting

Nausea and vomiting are most commonly caused by radiation to the abdomen or pelvis and sometimes the brain. This can cause severe dehydration and interrupt your treatment plan. Talk to your treatment team about prescribing antiemetics or anti-nausea drugs to help keep you comfortable throughout treatment. Also try eating smaller meals throughout the day and drinking plenty of fluids.

Diarrhea

Radiation to the abdomen or pelvis can damage the cells that line the intestines, making them unable to absorb water. This can affect your body's ability to have regular bowel movements. If left untreated, diarrhea can

become severe and even life-threatening, so talk to your doctor if you are experiencing problems. To manage diarrhea at home, try these tips:

- Drink plenty of fluids every day, including water and other clear liquids such as broth.
- Eat several small meals throughout the day rather than three big meals.
- Eat bland, low-fiber foods such as boiled white rice, boiled chicken, white bread, cottage cheese and small servings of smooth peanut butter.
- Eat foods that have potassium such as boiled or mashed potatoes and bananas.
- Avoid alcohol, caffeine and fatty foods.
- Talk with your radiation oncologist about using over-the-counter anti-diarrheal medications such as loperamide (Imodium).

Dry mouth

Radiation therapy to the head and neck or face can cause dry mouth. It can take six months or longer after treatment ends for saliva production to return to normal again, especially if radiation was directed at the salivary glands. It is important to

visit your dentist before starting treatment to help prevent dental problems. Also try brushing with fluoride toothpaste and a soft-bristle toothbrush, flossing gently and rinsing your mouth regularly. Avoid mouthwashes that contain alcohol and use a cool mist humidifier. ■

ADDITIONAL RESOURCES

- ▶ **American Cancer Society:** www.cancer.org
A Guide to Radiation Therapy
- ▶ **American Society of Clinical Oncology:** www.cancer.net
Long-term Side Effects of Cancer Treatment
- ▶ **LUNgevity:** www.lungevity.org
Radiation Therapy
- ▶ **National Breast Cancer Foundation:** www.nationalbreastcancer.org
Radiation Therapy
- ▶ **National Cancer Institute:** www.cancer.gov
Radiation Therapy for Cancer
- ▶ **The Oral Cancer Foundation:** www.oralcancerfoundation.org
Side Effects of Radiation Treatment
- ▶ **Prostate Cancer Foundation:** www.pcf.org
Radiopharmaceutical Therapy
- ▶ **RadiologyInfo.org For Patients:** www.radiologyinfo.org
- ▶ **RT Answers – American Society for Radiation Oncology:** www.ranswers.org

POST-TREATMENT CARE

▲ **After you complete radiation**, your treatment team will establish a follow-up care plan to check your progress. Because radiation does not immediately kill cancer cells, follow-up is especially important to monitor the tumor and determine the effectiveness of treatment. You may also need to watch for any long-term or late effects of treatment.

If you are receiving radiation therapy after you've finished primary surgical treatment and/or chemotherapy, the goal is to kill any microscopic cancer cells that may remain. Monitoring progress during treatment may not be an option because there will be no physical evidence of how remaining cancer cells are responding to treatment. Because of this, it is important that you complete your entire radiation schedule.

POST-TREATMENT SIDE EFFECTS

Long-term effects are those that last beyond the end of treatment for weeks or even months. Late effects are side effects that develop after treatment has ended, months or even years later. Make sure you talk to your doctor about the possible long-term and late effects of radiation treatment as well as any side effects that could be permanent. Consider the possibility of these effects when making a decision about whether radiation treatment is right for you.

Possible long-term and late effects include damage to other organs, and a risk of a second cancer developing. In nearly all cases, these risks are small.

Damage to other organs

Some patients who require radiation to lymph node regions have a risk of developing arm swelling after treatment. Radiation can also cause damage to nearby structures; for example, radiation to the chest may affect the heart. Damage to the heart can lead to hardening of the arteries, which may increase your risk of having a heart attack later in life; or damage to the heart valves.

The most common radiation side effects associated with breast cancer treatments involve the skin within the treatment field and the soft tissues of the breast or chest wall.

External-beam radiation therapy can cause inflammation of the lungs from six weeks to six months after treatment ends; this inflammation is called radiation pneu-

monitis. Whether radiation pneumonitis develops will depend on the radiation area, your history of radiation treatment and any treatments you are receiving at the same time as radiation. You may or may not experience any symptoms, which can include cough, fever, shortness of breath or pink-tinged sputum (saliva and mucus from the respiratory tract). Steroids are typically used to reduce the inflammation.

Radiation to the pelvis can cause bowel alteration, such as diarrhea, gas and cramping. These bowel changes may be managed by following a low fiber diet during the radiation treatment course and by taking over the counter medications, such as loperamide (Imodium) or simethicone (Alka-Seltzer Anti-Gas, Gas-X, Mylanta Gas, Maalox Anti-Gas). Pelvic radiation may also cause hemorrhoidal irritation, which may cause pain with bowel movements and blood streaked stools. A sitz bath and steroid rectal cream may be very helpful. Most patients recover from these within 1 to 3 months after treatment ends, although a small proportion of patients do experience lasting bowel alteration over several years.

Less commonly, radiation to the pelvis may cause bladder inflammation, which leads to pain or burning during urination, trouble passing urine, an urge to urinate frequently, and/or blood in the urine or incontinence (inability to control the flow of urine). Most bladder issues are resolved over time but in some cases, damage to the lining of the bladder can be permanent. This damage can cause radiation cystitis, resulting in pain and bleeding during urination.

Radiation to the head and neck can cause long-term swallowing and dental issues. Good dental hygiene and regular dental exams are important for patients who receive radiation to the mouth area. Patients who receive radiation to the neck may also need to have periodic blood tests because radiation can affect levels of thyroid hormone. In some cases oral thyroid medication may be needed.

Risk of second cancers

Although rare, radiation damage to healthy tissues may increase your risk of a second cancer developing many years later. Tissues closest to the radiation site are at the greatest risk for the development of cancer. For example, patients who receive radiation to the chest may be at an increased risk of breast cancer. This increased risk, however, appears to be limited to women treated at a young age. There does not appear to be an

MYTH vs FACT

[MYTH] Radiation therapy is painful.

[FACT] Radiation therapy does not typically cause pain. Receiving external-beam radiation therapy is like getting an X-ray and will likely be painless. If you are receiving internal radiation, the process of implantation may cause discomfort, but the radiation itself should not be painful. Ask your treatment team about other side effects you may experience and how you can prevent or manage them.

[MYTH] Radiation causes hair loss.

[FACT] You may lose body hair at the site of treatment but radiation will not cause you to lose the hair on your head, as chemotherapy sometimes does. The only time you may lose hair from your head is if you receive radiation to the brain or head and neck.

[MYTH] Radiation increases my risk of recurrence.

[FACT] Treating a specific cancer with radiation will not increase your risk of that same cancer recurring (developing again). For example, radiation to the breast to treat breast cancer will not increase your risk of breast cancer in the other breast. There is a very rare risk, however, of a second type of cancer developing several years later. Talk to your doctor about any concerns you have before deciding whether radiation is right for you.

[MYTH] Radiation will cause me to be radioactive.

[FACT] External-beam radiation therapy, the most common type of radiation treatment, will not cause you to be radioactive. Only certain kinds of radiation therapy will cause you to emit small amounts of radiation following treatment. Talk to your doctor about what precautions to take when receiving internal or systemic radiation.

increased risk in women who are age 40 or older at the time of chest radiation. Cancers that result from past radiation exposure usually don't develop until 10 or even 15 years after treatment ends. Talk to your doctor about your concerns when deciding if radiation is right for you. ■

ADDITIONAL RESOURCES

- ▶ **American Society of Clinical Oncology:** www.cancer.net
Long-term Side Effects of Cancer Treatment
- ▶ **RT Answers – American Society for Radiation Oncology:** www.ranswers.org

ASSISTANCE & FINANCIAL RESOURCES

BASIC LIVING EXPENSES

American Childhood Cancer Organization.....www.acco.org, 855-858-2226
 The Bone Marrow Foundation.....www.bonemarrow.org, 800-365-1336
 Brenda Mehling Cancer Fund (patients 18-40).....www.bmcf.net, 661-310-7940
 Bringing Hope Home.....www.bringinghopehome.org, 484-580-8395
 Candlelighters Childhood Cancer Family Alliance.....www.candle.org, 713-270-4700
 The CHAIN Fund Inc.....www.thechainfund.com, 203-691-5955
 Children's Cancer Recovery Foundation.....www.childrenscancerrecovery.org, 800-238-6479
 Cleaning for a Reason (free house cleaning service).....www.cleaningforareason.org, 877-337-3348
 Family Reach Foundation.....www.familyreach.org, 973-394-1411
 Hugs and Kisses.....www.hugsandkissesinc.org, 561-819-9471
 Life Beyond Cancer Foundation.....www.needhelpayingbills.com, 281-791-7549
 Mission4Maureen (brain cancer).....www.mission4maureen.org, 440-840-6497
 The National Children's Cancer Society.....www.thencs.org, 314-241-1600
 Rise Above It (youth, young adults).....www.raibenefit.org
 The Simple Dollar.....www.thesimpledollar.com/category/insurance
 Stupid Cancer.....www.stupidcancer.org, 877-735-4673
 Team Continuum.....www.teamcontinuum.net, 646-569-5621
 Zichron Shlome Refuah Fund.....www.zsrf.org, 718-GET-WELL

CAREGIVERS & SUPPORT

4th Angel Patient & Caregiver Mentoring Program.....www.4thangel.org
 Bloch Cancer Hotline.....800-433-0464
 CanCare.....www.cancare.org
 CANCER101.....www.cancer101.org
 Cancer Action.....www.canceractionkc.org
 Cancer and Careers.....www.cancerandcareers.org
 CancerCare.....www.cancercare.org
 Cancer Connection.....www.cancer-connection.org
 Cancer Hope Network.....www.cancerhopenetwork.org
 Cancer Information and Counseling Line.....800-525-3777
 Cancer Really Sucks!.....www.cancerreallysucks.org
 Cancer Support Community.....www.cancersupportcommunity.org
 Cancer Support Community Open to Options (counseling program).....888-793-9355
 Cancer Survivors Network.....http://csn.cancer.org
 Cancer Wellness Center.....www.cancerwellness.org
 Caregiver Action Network.....www.caregiveraction.org
 CaringBridge.....www.caringbridge.org
 Center to Advance Palliative Care.....www.capc.org
 The Children's Treehouse Foundation.....www.childrenstreehousefdn.org
 Cleaning For A Reason.....www.cleaningforareason.org
 Colorectal CareLine (Patient Advocate Foundation).....www.colorectalcareline.org
 Cooking with Cancer.....www.cookingwithcancer.org
 Cuddle My Kids.....www.cuddlemykids.org
 Family Caregiver Alliance.....www.caregiver.org
 Fighting Chance.....www.fightingchance.org
 Friend for Life Cancer Support Network.....www.friend4life.org
 The Gathering Place.....www.touchedbycancer.org
 Guide Posts of Strength, Inc.....www.cancergps.org
 The Hope Light Foundation.....www.hopelightproject.com
 I Can Cope.....www.cancer.org/icancope
 Imerman Angels.....www.imermanangels.org
 The LGBT Cancer Project – Out With Cancer.....www.lgbtcancer.org
 LIVESTRONG Foundation.....www.livestrong.org
 LivingWell Cancer Resource Center.....www.livingwellcrc.org
 Lotsa Helping Hands.....www.lotsahelpinghands.com
 LUNgevity Caregiver Resource Center.....www.lungevity.org/caregiver
 MyLifeLine.org Cancer Foundation.....www.mylifeline.org
 PearlPoint Cancer Support.....www.pearlpoint.org
 SHARE Caregiver Circle for Family and Friends.....www.sharecancersupport.org/support
 Strike Out Cancer.....www.strikeoutcancer.com
 Stronghold Ministry.....www.mystronghold.org
 Support Groups.....www.supportgroups.com
 Triage Cancer.....www.triagecancer.org
 Turning Point.....www.turningpointkc.org
 Visiting Nurse Associations of America.....www.vnaa.org
 Vital Options International.....www.vitaloptions.org
 Walk With Sally.....www.walkwithsally.org
 Well Spouse Association.....www.wellspouse.org

weSPARK Cancer Support Center.....www.wespark.org
 Wonders & Worries.....www.wondersandworries.org

INSURANCE PREMIUM EXPENSES

American Cancer Society Health Insurance Assistance Service.....www.cancer.org, 800-227-2345
 The Bone Marrow Foundation.....www.bonemarrow.org, 800-365-1336
 CancerCare Co-Payment Assistance Foundation.....www.cancercarecopay.org, 866-552-6729
 The CHAIN Fund Inc.....www.thechainfund.com, 203-691-5955
 Foundation for Health Coverage Education.....www.coverageforall.org
 HealthWell Foundation (diagnosis-specific).....www.healthwellfoundation.org, 800-675-8416
 Kaiser Family Foundation.....http://kff.org/health-costs/report/a-consumer-guide-to-handling-disputes-with-your-employer-or-private-health-plan
 The National Children's Cancer Society.....www.thencs.org, 314-241-1600
 NeedyMeds (links to assistance programs).....www.needymeds.org, 800-503-6897
 Patient Advocate Foundation Co-Pay Relief.....www.copays.org, 866-512-3861
 Patient Services, Inc.....www.patientservicesinc.org, 800-366-7741
 Stupid Cancer.....www.stupidcancer.org, 877-735-4673

LEGAL ISSUES

Administration on Aging (search for "legal assistance").....www.aoa.gov, 202-401-4634
 American Bar Association.....www.americanbar.org, 800-285-2221
 Cancer and Careers.....www.cancerandcareers.org, 636-929-8032
 Disability Rights Legal Center.....www.disabilityrightslegalcenter.org, 866-999-3752
 LawHelp.org.....www.lawhelp.org
 Legal Services Corporation.....www.lsc.gov, 202-295-1500
 National Coalition for Cancer Survivorship.....www.canceradvocacy.org, 877-NCCS-YES
 National Health Law Program (links to assistance programs).....www.healthlaw.org, 202-289-7661
 Patient Advocate Foundation.....www.patientadvocate.org, 800-532-5274
 Social Security Disability Resource Center.....www.ssdrc.com

MEDICAL CARE EXPENSES

American Cancer Society (local chapters).....www.cancer.org, 800-227-2345
 Be the Match.....www.bethematch.org, 800-627-7692
 The Bone Marrow Foundation.....www.bonemarrow.org, 800-365-1336
 CancerCare.....www.cancercare.org, 800-813-HOPE
 Cancer Survivors' Fund (young adults, children).....www.cancersurvivorsfund.org, 281-437-7142
 Cancer Warrior, Inc.....www.cancervarriorinc.org, 323-578-5083
 Children's Leukemia Research Association.....www.childrensleukemia.org, 516-222-1944
 Foundation for Health Coverage Education.....www.coverageforall.org
 Jake Owen Raborn Foundation (pediatric only).....888-356-JAKE
 Linking ARMS Program (breast cancer).....www.cancercare.org, 800-813-HOPE
 The National Children's Cancer Society.....www.thencs.org, 314-241-1600
 NeedyMeds (links to assistance programs).....www.needymeds.org, 800-503-6897
 Patient Access Network Foundation.....www.panfoundation.org, 866-316-7263
 Patient Advocate Foundation.....www.patientadvocate.org, 800-532-5274
 The Pins for Pauly Foundation Inc.....www.pinsforpauly.org, 516-379-8885
 Rise Above It (youth, young adults).....www.raibenefit.org
 Sarcoma Alliance.....www.sarcomaalliance.org, 415-381-7236
 Stupid Cancer.....www.stupidcancer.org, 877-735-4673
 UnitedHealthcare Children's Foundation.....www.uhccf.org, 855-698-4223
 Verna's Purse.....www.vernapurse.org, 888-489-8944
 Zichron Shlome Refuah Fund.....www.zsrf.org, 718-GET-WELL

MENTAL HEALTH SERVICES

American Psychosocial Oncology Society Helpline.....866-276-7443

NUTRITION

American Cancer Society.....www.cancer.org
 CancerCare.....www.cancercare.org
 LIVESTRONG Foundation.....www.livestrong.org
 OncoLink.....www.oncolink.org
 PearlPoint Cancer Support.....www.pearlpoint.org
 Physicians Committee for Responsible Medicine.....www.pcrm.org/health/cancer-resources

PAIN MANAGEMENT

American Chronic Pain Association.....www.theacpa.org
 Cancer Pain Research Consortium.....www.cancerpainresearchconsortium.org
 The Resource Center of the Alliance of State Pain Initiatives.....www.trc.wisc.edu
 U.S. Pain Foundation.....http://uspainfoundation.org

RADIATION ONCOLOGY

American Society for Radiation Oncology.....www.astro.org
 National Association for Proton Therapy.....www.proton-therapy.org
 RadiologyInfo.org.....www.radiologyinfo.org
 RT Answers.....www.rtanswers.org
 Society of Interventional Radiology.....www.sirweb.org

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