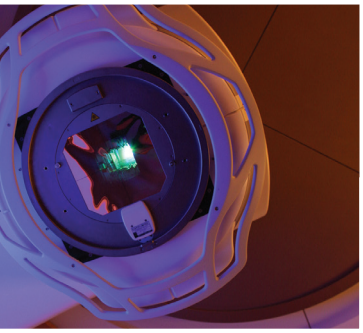
MEDICAL TECHNOLOGY
life changing
innovation



The Value of Radiotherapy:

Transforming cancer care through advanced medical technology

This year more than 1.6 million people in the U.S. will hear their doctor say, "It's cancer."[1] Imagine it's you or a loved one who's diagnosed. You'd want access to the most effective, comprehensive treatment program that would maximize your chance of recovery and preserve your quality of life. In many cases, an essential component of that program is radiotherapy.

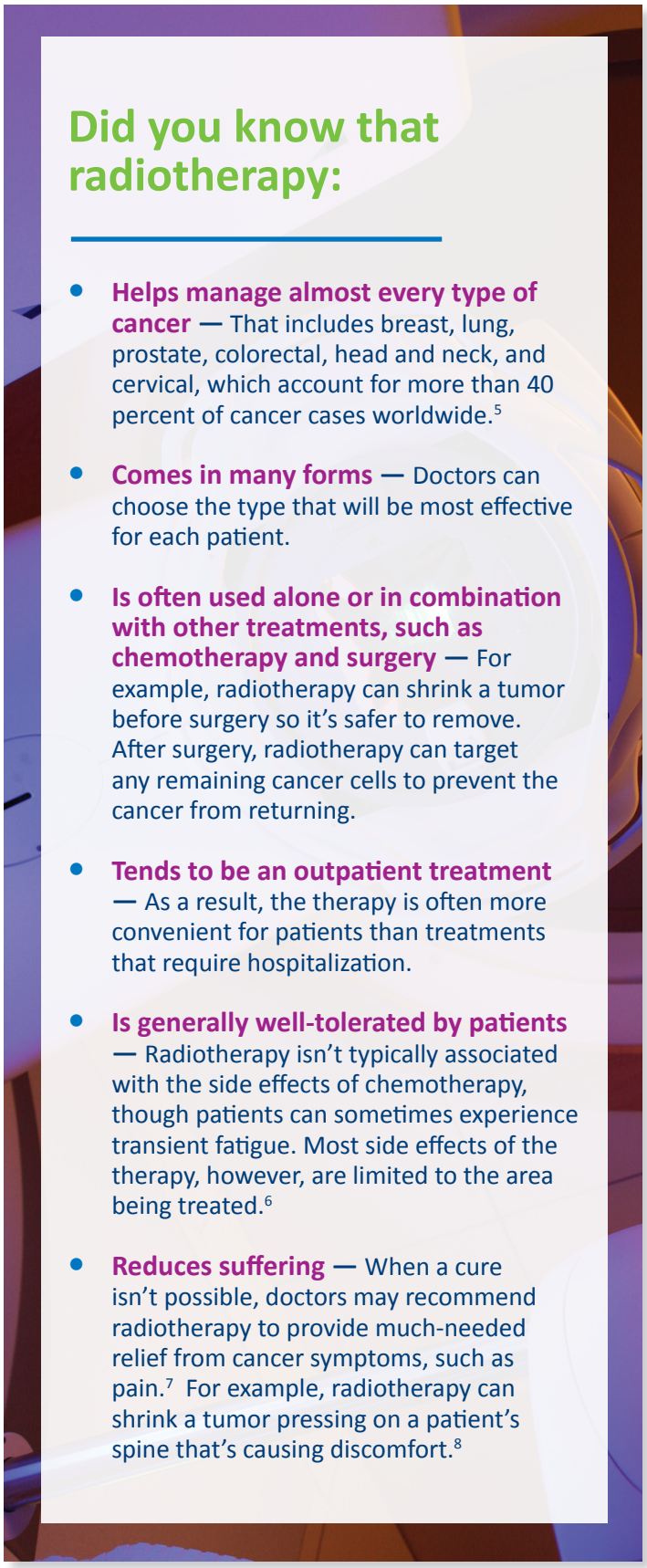
Also called radiation therapy, stereotactic irradiation or X-ray therapy, radiotherapy used today is a cutting-edge cancer treatment proven to be safe and effective. That's why it's one of the most common treatment options[2], with 50 percent to 60 percent of all people with cancer receiving radiotherapy at some point during their care.[3] In fact, newer radiotherapy techniques are so precise that doctors can actually treat in a curative manner. For older patients who cannot tolerate surgery, radiotherapy can be a life-saving intervention.

The Healing Power of Radiation

Think of radiotherapy as the "superhero" of cancer treatment — high-energy radiation blasts rogue cells that are threatening to take over the body. Guided by advances in digital technology and treatment techniques, radiotherapy's powers have grown by leaps and bounds over the past two decades. Radiation oncologists can deliver treatment with previously unimaginable precision, reducing side effects while minimizing the time patients spend undergoing the procedure.[4] As a result, radiotherapy is one of the most effective cancer treatments.

How Radiotherapy Works

The human body is made up of trillions of cells. These cells usually grow and divide in an orderly process to form new cells. These new cells replace damaged or dead ones. But sometimes the process fails and cells start to grow out of control. Those extra, abnormal cells make it hard for normal cells to function properly, and can form a mass called a tumor. A tumor can be benign, which means it's not cancerous, or malignant, which means it is cancerous.



Did you know that radiotherapy:

- **Helps manage almost every type of cancer —** That includes breast, lung, prostate, colorectal, head and neck, and cervical, which account for more than 40 percent of cancer cases worldwide.[5]
- **Comes in many forms —** Doctors can choose the type that will be most effective for each patient.
- **Is often used alone or in combination with other treatments, such as chemotherapy and surgery —** For example, radiotherapy can shrink a tumor before surgery so it's safer to remove. After surgery, radiotherapy can target any remaining cancer cells to prevent the cancer from returning.
- **Tends to be an outpatient treatment —** As a result, the therapy is often more convenient for patients than treatments that require hospitalization.
- **Is generally well-tolerated by patients —** Radiotherapy isn't typically associated with the side effects of chemotherapy, though patients can sometimes experience transient fatigue. Most side effects of the therapy, however, are limited to the area being treated.[6]
- **Reduces suffering —** When a cure isn't possible, doctors may recommend radiotherapy to provide much-needed relief from cancer symptoms, such as pain.[7] For example, radiotherapy can shrink a tumor pressing on a patient's spine that's causing discomfort.[8]

Radiotherapy uses different types of high-energy radiation, such as X-rays, electron beams, protons or gamma rays, to damage or kill cancer cells so they can't reproduce. Different amounts of radiation are used to destroy different types of cancer cells. Patients receive a specific number of treatments over an established period of time.[9]

It's also important to note that radiotherapy can be used to treat non-cancerous conditions, including benign tumors, trigeminal neuralgia, acoustic neuroma, arterial venous malformations, and to treat functional disorders like epilepsy, Parkinson's disease and essential tremor.

The Safety of Radiotherapy

Doctors have been using radiotherapy to treat cancer and other diseases since the early 1900s. The treatment's use grew quickly, even though doctors weren't sure how it worked or what the right doses were. As clear as it was that radiation could damage cancer cells, it soon became just as clear that it could also harm healthy ones. The earliest radiotherapy systems or devices produced low-energy beams that couldn't be precisely steered, shaped, or controlled, so that doses had to be kept low to avoid harming healthy tissues—often compromising treatment effectiveness.[10] But rapid medical technology advances have allowed doctors to quickly harness radiation in a safe, targeted and highly successful way.

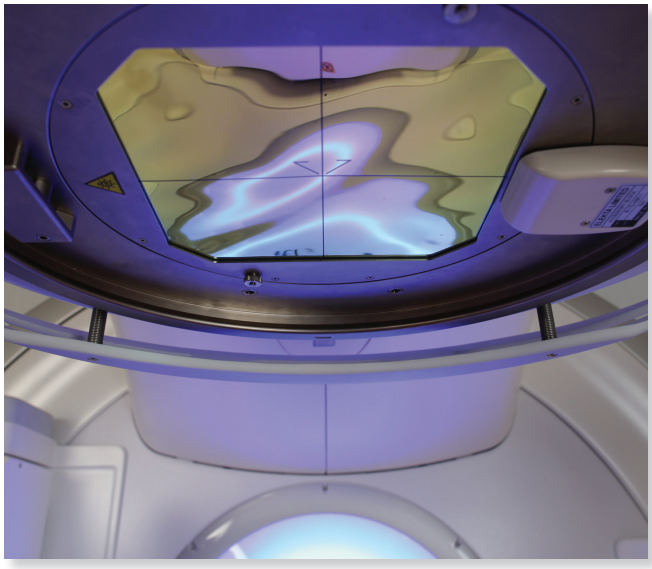
In the 1960s, scientists invented linear accelerators that could deliver radiation beams deep into the body.[11] Then, in the 1970s and 1980s, the development of new imaging technologies, such as computerized tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET) scans, helped doctors better see and target tumors with radiation.[12] From there, machines that use the new diagnostic devices, real-time imaging, and advanced hardware and software to change the size, shape, direction and strength of the treatment beam came into use. As a result, complications are minimized and survival is improved.[13]

*Today, **advanced computer systems** combined with these more sophisticated tools and techniques **help clinicians provide safe treatments** by carefully measuring and precisely delivering radiation to the tumor and avoiding healthy tissue.*

Types of Radiotherapy

There are three types of radiotherapy:

- External beam radiotherapy
- Internal radiotherapy
- Systemic radiotherapy



A radiation oncologist will prescribe a specific radiotherapy type after evaluating many factors, including the cancer's type, size and location; how close the cancer is to healthy tissue that's sensitive to radiation; the patient's health, medical history, and age; and other cancer treatments the patient will have or has had.[14] In some cases, a patient may receive more than one type of radiotherapy.[15]

External Beam Radiotherapy

External beam is the most commonly used type of radiotherapy.[16] The good news is that it's non-invasive and painless.[17] Systems such as linear accelerators, proton beam machines and neutron beam machines, direct high-energy radiation beams through the skin and into the tumor. A patient's radiotherapy team is able to use special computers and planning software, plus sophisticated treatment delivery technologies, to control where and how deep the radiation goes, as well as its strength.

The radiation can be low-energy, which means it doesn't go deep into the body. Low-energy therapy is used mainly to treat surface tumors, such as skin cancer.[18] Alternatively, the radiation can be high-energy, which goes much deeper into the body.[19] External beam radiation is used to treat many types of tumors, including cancers of the head and neck, breast, lung, colon and prostate.[20] The majority of patients can go home between treatments, which are usually given up to five days a week over a period of several weeks.[21] Newer stereotactic techniques enable patients to receive higher doses of radiation over a much shorter period of time, allowing them to often complete treatment in a week or less.

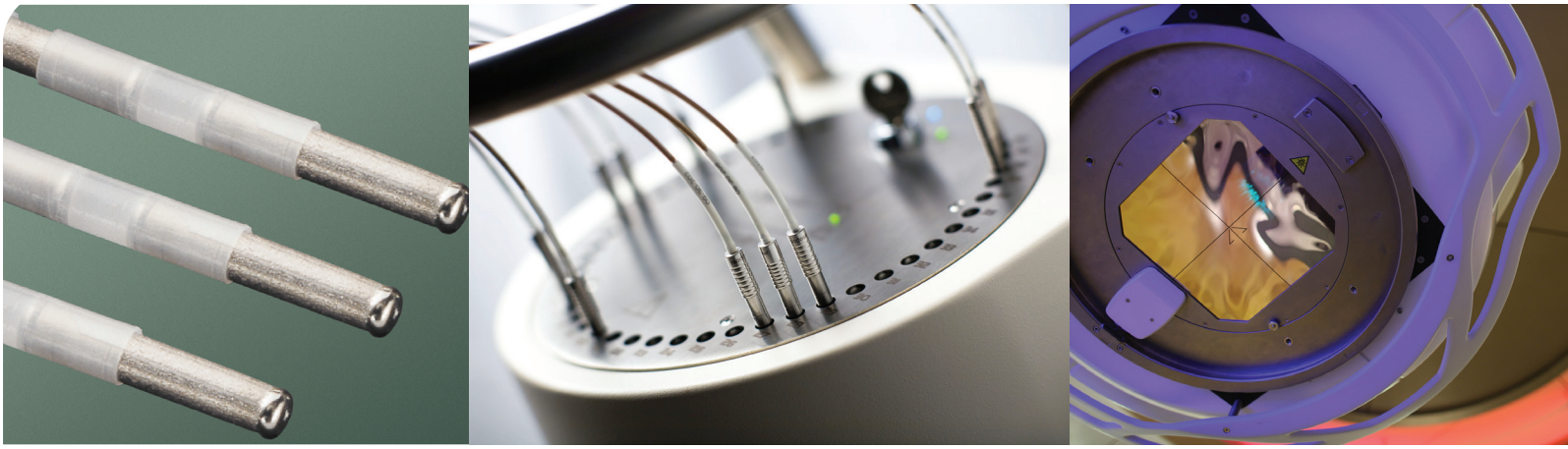
Medical technology companies continue to develop new ways to deliver external beam radiation therapy exactly how and where it's needed while avoiding healthy tissue. Current options include:

- **Three-dimensional conformal radiotherapy (3D-CRT) —** This common therapy uses sophisticated computers and three-dimensional imaging technology to send radiation beams that are shaped to match the patient's tumor directly into the tumor. The radiation is very targeted, and doctors can use a high dose of radiation that's more likely to kill the cancer cells.[22]
- **Intensity modulated radiotherapy (IMRT) —** A specialized type of 3D-CRT, this treatment also uses radiation beams that conform to the tumor. The radiation dose from each beam can be increased or decreased (modulated). IMRT has been shown to be beneficial for many cancers, including prostate, head and neck, brain and gynecologic tumors.[23]
- **Interoperative radiotherapy (IORT) —** During surgery, the surgeon moves normal organs away from a tumor and protects them with special shields. Then radiation can be applied directly to the tumor during the surgery minimizing the impact on those organs.
- **Image-guided radiotherapy (IGRT) —** This treatment uses imaging scans, such as a CT, MRI or PET, right before each treatment to pinpoint the tumor. The radiation oncologist compares each scan to previous scans to see if the size or location of the tumor changed. Then the patient's

position or radiation dose is adjusted accordingly for better targeted treatment. Image-guidance can also be used to detect and then compensate for tumor motion due to breathing and other physiological processes during treatment.

- **Stereotactic radiotherapy —** Like IGRT, stereotactic radiotherapy uses imaging and motion compensation techniques to treat tumors throughout the body with extreme precision. There are two types of this therapy, which are typically used to treat well-defined tumors: stereotactic radiosurgery (SRS) and stereotactic body radiation therapy (SBRT). The radiation dose, which is often given in one to five treatments, can be higher than would be delivered during weekly radiation therapy. SRS is most often used to treat brain or spinal tumors, while SBRT treats tumors outside those areas, such as the lung, liver, and prostate.
- **Proton beam radiotherapy —** Instead of using X-rays, this treatment uses protons. After they enter the body, protons release most of their energy within the tumor region and deliver a minimal dose beyond the tumor boundaries.

A radiation oncologist uses imaging tests, 3D treatment planning, and exact positioning of a patient to accurately target and treat the tumor.



Brachytherapy

Brachytherapy uses radioactive implants placed inside or near the tumor. Doctors use applicators such as needles, balloons, or catheters to place the implants, which contain radioactive isotopes, into the body. The implants range from tiny seeds the size of a grain of rice to capsules, small rods, and wires. Brachytherapy is very effective for breast, cervical, prostate, uterine, vaginal, rectal, eye, and certain head and neck cancers.[24] Treatment requires one to 10 patient visits.

There are three main types of brachytherapy:

- **Intracavitary brachytherapy —** The radioactive source is placed into a body cavity, such as the vagina, chest, uterus, rectum or larynx.
- **Interstitial brachytherapy —** The radioactive source is placed directly into a tumor.
- **Interoperative brachytherapy (IORT) —** During surgery, the surgeon moves normal organs away from a tumor and protects them with special shields. Then brachytherapy can be applied through a specially designed applicator to the tumor site without harming critical organs.

As the isotopes in the implant decay, they give off radiation that harms the nearby cancer cells while protecting healthy tissue from radiation. The implant can be low dose or high dose. Low dose rate (LDR) brachytherapy is when cancer cells continuously receive small doses of radiation from an implant over a certain time period. These implants are permanent and will remain harmlessly in the body even after they no longer give off radiation. High dose rate (HDR) brachytherapy uses a higher dose of radiation, and the implant is removed at the end of each treatment session.

Access to Radiotherapy

Systemic Radiotherapy

During systemic radiotherapy, a radioactive drug goes into the bloodstream to attack cancer cells throughout the body. The doctor may inject the drug through the patient's vein or the patient may swallow it. For example, radioactive iodine, which thyroid cells naturally absorb, is often used to treat certain types of thyroid cancer.[25] For other cancers, the radioactive substance may be bound to a special antibody that binds to cancer cells. Together, the pair moves through the blood, on a search-and-destroy mission for the cells.

A doctor may also recommend systemic radiation therapy to control pain that occurs when cancer spreads to the bone.[26] As with external beam, systemic radiotherapy can be used for palliation.

The rising incidence of cancer worldwide will continue to increase the number of patients that need treatment with radiotherapy. However, despite its proven value, only 40 percent to 60 percent of patients with cancer across the globe have access to radiotherapy.[27] In the U.S., contributing factors include shortages of equipment, trained staff and facilities, particularly in rural areas. Patients also sometimes choose not to seek radiotherapy because of unfounded fears, even though this therapy could save their lives. Most importantly, however, radiotherapy is often not thought of as a front-line cancer treatment, and doctors oftentimes only refer their patients to a radiation oncologist as a last resort or as part of end-of-life care.

Global access to radiotherapy services is even more inconsistent, with a startling 90 percent of the population in low-income countries lacking access to radiotherapy.[28] And global cancer rates are on the rise. By 2035, 12 million patients worldwide will need radiotherapy, but many of them won't be able to get it.[29] While increasing access to radiotherapy services may prove challenging, doing so will provide tangible economic benefits both in the U.S. and abroad. In fact, full access to radiotherapy for all patients in low- and middle-income countries can be achieved with an upfront investment of $97 billion — resulting in estimated cost savings and economic benefits of $278 billion to $365 billion over the next 20 years.[30] More importantly, it can save 27 million life-years. By 2035, if all patients needing radiotherapy had access, cancer in 2.5 million people would be prevented from progressing and 950,000 people would have an overall survival benefit.

About AdvaMed

The Advanced Medical Technology Association (AdvaMed), is a trade association that leads the effort to advance medical technology in order to achieve healthier lives and healthier economies around the world. AdvaMed's membership has reached nearly 300 manufacturers of medical devices, diagnostic products and health information systems, ranging from the largest to the smallest medical technology innovators and companies. About 75 percent of our members are small companies. The Association also has a global presence in countries including Europe, Japan, China, India and Brazil.

For more information, visit **www.AdvaMed.org**.

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