
X-rays, Gamma Rays, and Cancer Risk

There are many types of radiation. But when talking about radiation and cancer risk, it is often x-rays and gamma rays that people are concerned about.

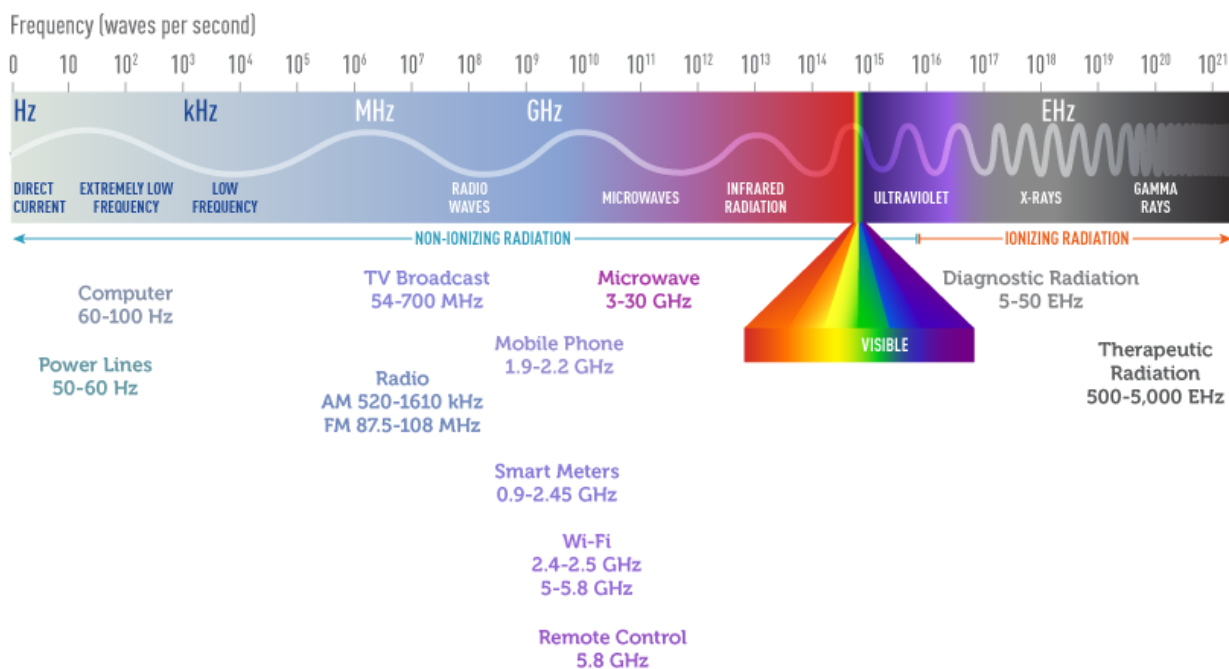
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What Are X-rays and Gamma Rays?

There are many types of radiation – from the light that comes from the sun to the heat that our bodies constantly give off. But when it comes to cancer risk, people are most often concerned about x-rays and gamma rays.

- [Doses of radiation](#)

ELECTROMAGNETIC SPECTRUM



X-rays and gamma rays can come from natural sources, such as [radon gas](#)¹, radioactive elements in the earth, and cosmic rays that hit the earth from outer space. But this type of radiation can also be man-made. X-rays and gamma rays are created in nuclear power plants, and are also used in smaller amounts for things like medical imaging tests, cancer treatment, and food irradiation.

X-rays and gamma rays are in packets of energy known as **photons**. Because X-rays and gamma rays have the same properties and health effects, they are grouped together here.

Both x-rays and gamma rays are forms of high-frequency (high-energy) **ionizing radiation**, which means they have enough energy to remove an electron from (ionize) an atom or molecule. Ionizing radiation can damage the DNA (genes) inside a cell. Sometimes this can lead to cancer later on.

Gamma rays and x-rays aren't the only kinds of ionizing radiation. Some higher energy [ultraviolet \(UV\) rays](#)² are also ionizing. Ionizing radiation can also exist in particle form, such as protons, neutrons, and alpha and beta particles.

Doses of radiation

Radiation exposure dose can be expressed in different ways.

- The **absorbed dose** is the amount of energy deposited per unit of mass. Most often this is measured in grays (Gy). A milligray (mGy), which is 1/1000th of a Gy, may also be used.
- The **equivalent dose** is the absorbed dose multiplied by a converting factor based on the medical effects of the type of radiation. It is often expressed in sieverts (Sv) or millisieverts (mSv), which is 1/1000th of a Sv.

For x-rays and gamma rays (and beta particles), the equivalent dose in Sv is the same as the absorbed dose in Gy.

Less common radiation dose units include rads, rems, and roentgens.

Hyperlinks

1. www.cancer.org/cancer/risk-prevention/radiation-exposure/radon.html
2. www.cancer.org/cancer/risk-prevention/sun-and-uv/uv-radiation.html

References

National Toxicology Program. Ionizing radiation: x-radiation and gamma radiation. *Rep Carcinog*. 2011;12:237-240.

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How Are People Exposed to X-rays and Gamma Rays?

- [Natural background radiation](#)
- [Medical radiation](#)
- [Non-medical sources of man-made radiation](#)

People can be exposed to x-rays and gamma rays from 3 main sources:

- **Natural background radiation** from cosmic rays from outer space and from radioactive elements normally in rocks and soil. This is the major contributor to worldwide radiation exposure.
- **Medical radiation** used for imaging tests such as x-rays, CT scans, and PET scans, as well as for radiation therapy. Radiation therapy is used to treat some types of cancer, and it generally uses doses much higher than those used in imaging tests.
- **Non-medical, man-made radiation** exposure can happen in certain workplaces, or in communities as a result of above ground nuclear weapons testing or nuclear accidents. Radiation is also used in small amounts in some consumer products, as well as in food irradiation.

Natural background radiation

We are all exposed to some amount of radiation just from being on this planet. This is known as **background radiation**. In the United States this averages about 3 millisieverts (mSv) per year. For most people, background radiation is most of their exposure to ionizing radiation during the year. It comes from several sources.

Cosmic rays

Cosmic rays are radioactive particles that hit the earth from outer space. They come from the sun and from other stars. The earth's atmosphere blocks a portion of these rays, but some of them reach the ground.

Because the atmosphere blocks some cosmic rays, exposure is greater at higher altitudes. For example, people who live in Denver, Colorado, which is at a high elevation, are exposed to slightly more cosmic rays than people living at sea level.

People are also exposed to higher levels of cosmic rays during airplane flights. Airline pilots and flight attendants, who spend many hours at high elevations, are exposed to more of these rays, but it is not clear if they have an increased risk of cancer because of

it.

Radiation in the earth

People are also exposed to small amounts of radiation from radioactive elements that occur naturally in rocks and soil. Some of these may end up in building materials used in houses and other structures. Tiny amounts of radiation may even be found in drinking water and in some plant-based foods as a result of being in contact with the soil. For people who smoke, [tobacco](#)¹ can account for a significant portion of the yearly radiation they receive.

Radon

The largest source of natural background radiation for most people is radon. This is an odorless, colorless gas that is formed from the breakdown of radioactive elements in the ground. Radon levels are usually higher inside buildings and homes, especially in levels closer to the ground such as basements. Radon levels can vary a great deal, depending on where you live. Some people, such as people who work in mines, are exposed to higher radon levels at work.

For more on radon and its possible health effects, see [Radon and Cancer](#)².

Medical radiation

X-rays, gamma rays, and other forms of ionizing radiation are used to diagnose and treat some medical conditions. The radiation can be directed at your body from a machine, or radioactive particles can be swallowed or put into your body.

Imaging tests

Certain types of [imaging tests](#)³, such as x-rays, CT scans, and nuclear medicine tests (such as PET scans and bone scans) expose people to low levels of radiation to create pictures of the inside of the body. (Some imaging tests, such as MRI and ultrasound, do not expose people to ionizing radiation.)

In adults: The amount of radiation a person is exposed to varies depending on the test, as well as on a person's size. For example, the exposure for an averaged-sized adult from a 2-view chest x-ray is about 0.1 mSv, while exposure from a CT scan of the chest is about 6 mSv. The exposure from a PET/CT scan (which combines a PET scan of the body with a CT scan) is typically about 23 mSv. Fluoroscopy, which uses x-rays to make real-time moving images, exposes people to different amounts of radiation

depending on how long it is used. The amount of radiation used in many imaging tests has gone down over time as technology has improved.

In children: Exposure levels for a child can be higher than they would be for an adult when using the same amount of radiation, so the settings on the scanner need to be adjusted to account for body size.

For children, exposure to radiation from imaging tests is of particular concern, because:

- Children (especially younger children) are much more sensitive to radiation than adults.
- Children are expected to live longer than adults, so they have more time to develop problems from radiation exposure.
- With tests like CT scans, children might get a higher radiation dose than necessary if the CT scanner settings are not adjusted for their smaller body size.

These factors mean that for a young child, the risk of developing a radiation-related cancer could be several times higher than for an adult exposed to the same imaging test.

The risks from these tests aren't known for sure, but to be safe, most doctors recommend that children only get these tests when they're absolutely needed, and that when such tests are done, they use only the minimum amount of radiation needed to get the image.

To learn more, see [Understanding Radiation Risk from Imaging Tests⁴](#).

Radiation therapy

X-rays, gamma rays, and other forms of ionizing radiation are an effective way to treat some types of cancer. During [radiation therapy⁵](#), high doses of ionizing radiation (much higher than those used for imaging tests) are directed at the cancer, resulting in the death of the cancer cells. However, this can sometimes lead to DNA changes (mutations) in other cells that survive the radiation, which may eventually lead to the development of a second cancer. Radiation therapy is also sometimes used to treat serious medical conditions besides cancer.

For more information about cancer risks from radiation therapy for cancer, see [Second Cancers Related to Treatment⁶](#).

Non-medical sources of man-made radiation

People may also be exposed to ionizing radiation from non-medical man-made sources.

Nuclear weapons

The atomic bombs dropped on Nagasaki and Hiroshima, Japan, exposed many people to radiation from x-rays, gamma rays, and neutrons. Some people died fairly quickly as a result of burns and radiation sickness, but many survived. The survivors were exposed to different amounts of radiation, depending largely on how far they were from the explosions. Much of the information that we have about radiation and cancer risk comes from studies of these survivors.

The United States government conducted above-ground nuclear tests in the South Pacific and in the state of Nevada between 1945 and 1962. Other countries have also conducted above-ground tests. Many people in the military at the time were part of training exercises in the area and were exposed to ionizing radiation from these tests. Others were exposed to radiation while working at facilities making the bombs or at other nuclear sites.

Non-military people living near or downwind of nuclear test sites may have also been exposed to radioactive byproducts. Levels of radiation are likely to be higher near these sites, but some radioactive particles from the tests entered the atmosphere and traveled great distances, landing thousands of miles away from the original site. While exposure levels were likely to be higher at the time of testing, some radiation in the soil today is the result of these tests.

Government programs have been set up to give financial support to people who were exposed to nuclear weapons testing and developed cancer.

Nuclear power plants

Emissions of radiation from nuclear power plants are carefully monitored and controlled. According to the US Environmental Protection Agency (EPA), nuclear power plant operations account for less than 1/100 of 1% of the average American's total radiation exposure.

Nuclear power plant accidents: Accidents at nuclear power plants are rare, but they could possibly expose people to high levels of radiation.

In 1986, an accident at the nuclear power plant at Chernobyl (in Ukraine) exposed

millions of people living in the area to radiation, either directly or from radioactive elements released into the air that ended up deposited on the ground. The emergency clean-up workers were exposed to the highest levels of radiation.

In 2011, an earthquake and tsunami struck the coast of Japan that resulted in damage to the Fukushima Daiichi Nuclear Power Plant in Fukushima Prefecture, Japan. Radiation was released into the air, contaminating soil, food, and water (both fresh and seawater). An area of more than 300 square miles around the plant was found to be contaminated with radiation, although at lower levels than within the plant. Because of high radiation levels, many areas were evacuated. The health effects of this disaster are still being studied.

Workplace exposures

Some people can be exposed to radiation at work. For example:

- People who work in nuclear power plants may be exposed to higher levels of radiation than the general public, although their exposure levels are monitored carefully.
- People who work in uranium mines are monitored because of their exposure to radiation in the form of radon.
- People who work in health or dental care, particularly those who work with x-ray (or other imaging test) equipment or who work with radioactive isotopes, may also be exposed to radiation at work. Radiation exposure may also occur at some research labs.

In the United States, people who are likely to be exposed to radiation in the workplace are monitored carefully. Exposure is limited to an effective dose of 100 mSv over 5 years, with a maximum of 50 mSv in any single year.

Consumer products

Some consumer products contain small amounts of ionizing radiation.

For example, **tobacco products** contain low levels of radiation, which may come from the soil it's grown in or the fertilizer used to help it grow. Tobacco may account for a significant portion of the yearly radiation exposure for people who smoke.

Some **building materials** used in the home or other structures may contain low levels of naturally occurring radiation, which can be given off in the form of radon gas. The

amount of radiation can vary depending on what they're made of, but the levels are unlikely to contribute much to a person's overall exposure to radiation, according to the EPA. To learn more, see [Radon and Cancer](#)⁷.

Many **smoke detectors** contain a small amount of a very low-level radioactive material that helps detect the smoke. This material is sealed in a container and does not pose a significant risk of radiation exposure.

Food irradiation

Ionizing radiation can be used to kill bacteria and other germs on certain foods, which may make them safer to eat and help them last longer. Some people may be concerned that irradiated food may itself contain radiation.

It's important to understand that the radiation does not stay in the food. According to the US Food and Drug Administration (FDA), irradiating food does **not** make it radioactive and does **not** change its nutritional value, nor does it noticeably change the taste, texture, or appearance of the food.

Hyperlinks

1. www.cancer.org/cancer/risk-prevention/tobacco.html
2. www.cancer.org/cancer/risk-prevention/radiation-exposure/radon.html
3. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html
4. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/understanding-radiation-risk-from-imaging-tests.html
5. www.cancer.org/cancer/managing-cancer/treatment-types/radiation/basics.html
6. www.cancer.org/cancer/survivorship/long-term-health-concerns/second-cancers-in-adults/treatment-risks.html
7. www.cancer.org/cancer/risk-prevention/radiation-exposure/radon.html

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Do X-rays and Gamma Rays Cause Cancer?

X-rays and gamma rays are known human **carcinogens** (cancer-causing agents). The evidence they can cause cancer comes from many different sources, including studies of atomic bomb survivors in Japan, people exposed during the Chernobyl nuclear accident, people treated with high doses of radiation for cancer and other conditions, and people exposed to high levels of radiation at work, such as uranium miners. Most studies on radiation and cancer risk have looked at people exposed to high doses of radiation in these settings.

- [What do studies show?](#)
- [What do expert agencies say?](#)

It is harder to measure the much smaller increase in cancer risk that might come from much lower levels of radiation exposure. Most studies have not been able to detect an increased risk of cancer among people exposed to low levels of x-rays or gamma rays. For example, people living at high altitudes, who are exposed to more [natural background radiation](#) from cosmic rays than people living at sea level, do not have noticeably higher cancer rates.

Still, most scientists and regulatory agencies agree that even small doses of gamma and x-radiation can increase cancer risk, although most likely by a very small amount. In general, the lower the exposure dose is, the smaller the increase in risk. But there is no threshold below which this kind of radiation is thought to be totally safe.

What do studies show?

Atomic bomb survivors

Much of what we know about cancer risks from radiation is based on studies of the survivors of the atomic bombs in Nagasaki and Hiroshima. These people had higher risks of some, but not all cancers. Studies have found an increased risk of the following cancers (from higher to lower risk):

- Most types of leukemia (although not chronic lymphocytic leukemia)
- Multiple myeloma
- Thyroid cancer
- Bladder cancer
- Breast cancer
- Lung cancer
- Ovarian cancer
- Colon cancer (but not rectal cancer)
- Esophageal cancer
- Stomach cancer
- Liver cancer
- Lymphoma
- Skin cancer (besides melanoma)

For most of these cancers, the risk was found to be highest for those exposed as children, and was lower as the age at exposure increased. Those exposed while still in the womb (in utero) had lower risks than those exposed during childhood.

Exposure to higher doses of radiation exposure was linked to higher risk of cancer, but even low amounts of radiation were linked to an increased risk of getting and dying from cancer. There was no clear cut-off for a safe level of radiation exposure.

These cancers took years to develop, but some cancers appeared sooner than others. Deaths from leukemia started to go up about 2 to 3 years after exposure, with the number of cases peaking after about 10 years and going down after that. Solid tumors took longer to develop. For example, excess deaths from lung cancer began to be seen about 20 years after exposure.

Chernobyl accident

Children and teens living near the Chernobyl plant at the time of the accident had an increased risk of thyroid cancer linked to exposure to radioactive iodine. This increased risk was not seen in adults living in the area.

Workers in cleanup operations from 1986 to 1990 had an increased risk of leukemia (all types). These people had higher and more prolonged radiation exposures than the people living near the plant.

Nuclear weapons testing

Studies suggest that some people who were children when above-ground nuclear testing was being done in the US may develop thyroid cancer as a result of exposure to radioactive iodine in milk.

Radiation therapy

To treat benign conditions

Radiation therapy is now used mainly to treat cancer. But in the past, before the risks of radiation were clearer, it was also used to treat some benign (non-cancerous) diseases. Studies of people treated for these conditions have helped us learn about how radiation affects cancer risk.

For example, some studies have suggested links between:

- The use of radiation to treat **peptic ulcer disease** and a higher risk of cancers of the stomach and pancreas.
- The use of radiation to treat **ringworm of the scalp** (a fungal infection, also called tinea capitis) and an increased risk of basal cell skin cancers.
- The injection of radium to treat **ankylosing spondylitis** (an autoimmune disease) and an increased risk of leukemia, bone sarcoma, and possibly some other cancers.
- The use of radiation to treat some benign **head and neck conditions** and a higher risk of cancers of the salivary gland, brain and spinal cord tumors, and thyroid cancer.

To treat cancer

Studies have linked [radiation therapy to treat cancer](#)¹ with an increased risk of leukemia, thyroid cancer, early-onset breast cancer, and some other cancers later in life. The increase in risk depends on a number of factors, including:

- The dose of radiation
- The part of the body being treated
- The person's age (younger people are generally at greater risk)
- The use of other treatments such as chemotherapy at or around the same time

Other factors might also play a role in how likely it is that a person exposed to radiation will develop cancer. For example, some genetic conditions can make a person's cells more vulnerable to radiation damage, which might in turn raise their risk more than in someone without these gene changes.

Cancers after radiation therapy don't happen right away

If cancer does develop after radiation therapy, it doesn't happen right away. Most leukemias develop within about 5 to 9 years after exposure. In contrast, most other cancers are not seen for at least 10 years after radiation therapy, and some are diagnosed more than 15 years later.

When considering getting radiation therapy to treat cancer, the benefits generally outweigh the risks. Overall, radiation therapy alone does not appear to be a very strong cause of second cancers. This is probably because doctors focus the radiation on the cancer cells as much as possible, while limiting the exposure of nearby normal cells.

Doctors do their best to ensure the treatment destroys the cancer while limiting the risk that a second cancer will develop later on.

For more information, see [Second Cancers Related to Treatment](#)².

Imaging tests

Some studies have estimated the risk of radiation exposure from [imaging tests](#)³ based on the risks from similar amounts of radiation exposure in the studies of the atomic bomb survivors. Based on these studies, the US Food and Drug Administration (FDA) estimates that exposure to 10 millisieverts (mSv) from an imaging test would be expected to increase the risk of death from cancer by about 1 chance in 2,000.

It can be hard to study cancer risks from imaging tests that use radiation. In order to find a small increase in risk (such as 1 in 2,000), a study would have to look at tens of thousands, or even hundreds of thousands of people. For each person, information about other exposures that could affect cancer risk would need to be collected, to help ensure any increase in cancer risk came from the radiation exposure and not something else. And because cancers caused by radiation take many years to develop, the study would need to follow people for decades.

Often, scientists use other types of studies that can be done more quickly and require fewer resources, but the conclusions from these types of studies often are not as strong.

For example, researchers might use questionnaire studies to look for possible causes of cancer. These studies compare exposures among people who have a certain cancer to those who don't. Or they may compare people who had a certain exposure (like radiation) to those who didn't. However, this is hard to do for radiation exposure from imaging tests, because people often can't accurately recall information about things that happened many years before (such as in childhood), and information about all the imaging tests they've had is often not available. There is also a concern that people with cancer are more likely to report exposures that they think might have affected their cancer risk than people who do not have cancer, which can affect study results.

Studies that have found an increased risk of cancer after imaging tests that use radiation often involve people who have had many imaging tests or high-dose procedures. For example:

- Studies of women who had been imaged many times with **fluoroscopy** as a teen or young woman during treatment for tuberculosis have found an increased risk of

breast cancer years later.

- Teens and young women who had many **x-rays of the spine** to monitor scoliosis have been found to have an increased risk of breast cancer later on.
- People with meningioma (a brain tumor that is most often benign) have been found to be more likely to have had certain types of **dental x-rays** every year.
- Some studies have suggested a link between higher doses of radiation from **CT scans** in children to increased risks of leukemia and brain tumors, although the overall risk was still low.

What do expert agencies say?

Several national and international agencies study different exposures in the environment to determine if they can cause cancer. (An exposure that causes cancer or helps cancer grow is called a carcinogen.) **The American Cancer Society looks to these organizations to evaluate the risks, based on the available evidence.**

Based on studies done on people and studies done in the lab, several expert agencies have evaluated the cancer-causing nature of x-rays and gamma rays.

The **International Agency for Research on Cancer (IARC)** is part of the World Health Organization (WHO). One of its major goals is to identify causes of cancer. Based on the data available, IARC classifies x- and gamma radiation as a “known human carcinogen.”

The **National Toxicology Program (NTP)** is an interagency program of different US government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The NTP has classified x- and gamma radiation as “known to be a human carcinogen.”

The US **Environmental Protection Agency (EPA)** sets limits for exposure to x-rays and gamma rays in part because it recognizes that this form of radiation can cause cancer.

For more information on the classification systems used by these agencies, see [Determining if Something Is a Carcinogen⁴](#) and [Known and Probable Human Carcinogens⁵](#).

Hyperlinks

1. www.cancer.org/cancer/managing-cancer/treatment-types/radiation.html
2. www.cancer.org/cancer/survivorship/long-term-health-concerns/second-cancers-in-adults/treatment-risks.html
3. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html
4. www.cancer.org/cancer/risk-prevention/understanding-cancer-risk/determining-if-something-is-a-carcinogen.html
5. www.cancer.org/cancer/risk-prevention/understanding-cancer-risk/known-and-probable-human-carcinogens.html

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Do X-rays and Gamma Rays Cause Health Problems Other than Cancer?

X-rays and gamma rays can cause a number of other problems besides cancer. What problems occur depends on factors such as the radiation dose, the timing of the exposure, and what areas of the body are exposed.

Exposure to high doses of radiation over a short period of time can cause **radiation sickness** (sometimes called **radiation poisoning** or **acuteradiation syndrome**) and even death. Some of the symptoms of radiation sickness include fainting, confusion, nausea and vomiting, diarrhea, hair loss, skin and mouth sores, and bleeding. The atomic bomb blasts in Hiroshima and Nagasaki led to many cases of radiation sickness. Some cases have also resulted from nuclear power plant accidents, such as the one in Chernobyl.

Doses of radiation such as those given in radiation therapy also cause side effects.

Short-term side effects depend on the area being treated but might include skin changes (ranging from mild reddening to something like a severe burn), nausea, vomiting, diarrhea, and low blood cell counts.

There is also a risk of **long-term side effects**, which again vary depending on the area being treated. For example:

- Radiation to the head and neck area can lead to problems with dry mouth and trouble swallowing.
- Radiation can weaken bones, making them more likely to break later on.
- Radiation to the bone marrow (where new blood cells are made) can lead to long-

- term problems with blood cell counts and even a disease called **aplastic anemia**.
- Radiation to the pelvic area might lead to infertility (problems getting pregnant or fathering children).

Lower doses of radiation, such as from [imaging tests](#)¹, are not known to cause short-term health problems.

Hyperlinks

1. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html

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Can I Avoid or Limit My Exposure to X-rays and Gamma Rays?

We are all [exposed to some amount of radiation](#) just from being on this planet. You can, however, limit your exposure to some sources of radiation, such as x-rays from imaging tests, radiation in the workplace, and radon in your home.

- [Radiation from imaging tests](#)

- [Radiation in the workplace](#)
- [Radon](#)

We are all [exposed to some amount of radiation](#) just from being on this planet. You can, however, limit your exposure to some sources of radiation, such as x-rays from imaging tests, radiation in the workplace, and radon in your home.

Radiation from imaging tests

The increased risk of cancer from exposure to any single [imaging test](#)¹ is likely to be very small. But radiation exposure from all sources can add up over one's lifetime, so imaging tests that use radiation should only be done if there is a good medical reason to do so. The usefulness of the test must always be balanced against the possible risks from exposure to the radiation.

Sometimes, other imaging tests that don't use radiation such as ultrasound or MRI might be an option. But if there is a reason to believe that an x-ray or CT scan is the best way to look for cancer or other diseases, a person will most likely be helped more than the small dose of radiation can hurt.

If you do need a test that will expose you to some radiation, ask if there are ways to shield the parts of your body that aren't being imaged from being exposed. For example, a lead apron can sometimes be used to protect parts of your chest or abdomen from getting radiation, and a lead collar (known as a thyroid shield or thyroid collar) can be used to protect your thyroid gland.

For more detailed information about radiation doses from imaging tests in adults, see [Understanding Radiation Risk from Imaging Tests](#)².

For children

Exposure to radiation from imaging tests is of particular concern in children because their bodies are smaller and more sensitive to radiation. It's important for parents to ask questions before the child has a test such as an x-ray or CT scan, to make sure that the test is really needed and, if it is, that the facility is experienced in adjusting radiation doses for children.

Radiation in the workplace

In the US, several federal agencies are charged with protecting workers from radiation

exposure, including the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission, and the Department of Energy. Each agency is responsible for a different set of workplaces, but all follow the same general principles. If you work someplace where radiation exposure is likely, your employer can tell you which agency sets the standards for your workplace.

In general, employers cannot allow employees to be exposed to levels of radiation over a certain (low) limit without telling them of the risks. They also must take steps to monitor the level of exposure and make sure that it stays below certain limits. Workers can do their part by learning about the risks and following safety procedures, which may include using protective clothing and equipment.

Radon

For most people, the largest potential source of radon exposure is in the home. You can check radon levels in your home, either with do-it-yourself kits or by hiring a professional. If the levels are high, there are steps you can take to lower them.

For more information, see [Radon and Cancer](#)³.

Hyperlinks

1. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/imaging-radiology-tests-for-cancer.html
2. www.cancer.org/cancer/diagnosis-staging/tests/imaging-tests/understanding-radiation-risk-from-imaging-tests.html
3. www.cancer.org/cancer/risk-prevention/radiation-exposure/radon.html

References

Environmental Protection Agency. Radiation Protection: Frequent Questions about Radiation Protection. 2022. Accessed at <https://www.epa.gov/radiation/frequent-questions-about-radiation-protection> on November 4, 2022.

National Cancer Institute. Radiation Risks and Pediatric Computed Tomography (CT): A Guide for Health Care Providers. 2018. Accessed at <https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/pediatric-ct-scans> on November 4, 2022.

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