RadiologyInfo.org
For patients

Radiation Dose in X-Ray and CT Exams

What are x-rays and what do they do?

X-rays are a form of energy, similar to light and radio waves. X-rays are also called radiation. Unlike light waves, x-rays have enough energy to pass through your body. As the radiation moves through your body, it passes through bones, tissues and organs differently, which allows a radiologist to create images of them. The radiologist is a specially trained physician who can examine these images on a monitor. The monitor is like a computer display. It allows the radiologist to see very fine detail of the structures in your body.

X-ray examinations provide valuable information about your health and help your doctor make an accurate diagnosis. X-rays are sometimes used to help place tubes or other devices in the body or to treat disease.

See "Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures" (http://www.radiologyinfo.org/en/info/safety-radiation) for more information.

Measuring radiation dosage

When radiation passes through the body, some of it gets absorbed. The x-rays that are not absorbed are used to create the image. The amount that is absorbed contributes to the patient's radiation dose. The radiation that passes through the body does not. The scientific unit of measurement for whole body radiation dose, called "effective dose," is the millisievert (mSv). Other radiation dose measurement units include rad, rem, roentgen, sievert, and gray.

Doctors use "effective dose" when they talk about the risk of radiation to the entire body. Risk refers to possible side effects, such as the chance of developing a cancer later in life. Effective dose takes into account how sensitive different tissues are to radiation. If you have an x-ray exam that includes tissues or organs that are more sensitive to radiation, your effective dose will be higher. Effective dose allows your doctor to evaluate your risk and compare it to common, everyday sources of exposure, such as natural background radiation.

Naturally-occurring "background" radiation

We are exposed to natural sources of radiation all the time. According to recent estimates, the average person in the U.S. receives an effective dose of about 3 mSv per year from natural radiation, which includes cosmic radiation from outer space. These natural "background doses" vary according to where you live.

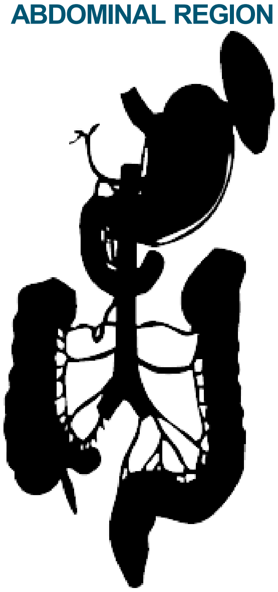
People living at high altitudes such as Colorado or New Mexico receive about 1.5 mSv more per year than those living near sea level. A coast-to-coast round trip airline flight is about 0.03 mSv due to exposure to cosmic rays. The largest source of background radiation comes from radon gas in our homes (about 2 mSv per year). Like other sources of background radiation, the amount of radon exposure varies widely depending on where you live.

To put it simply, the amount of radiation from one adult chest x-ray (0.1 mSv) is about the same as 10 days of natural background radiation that we are all exposed to as part of our daily living.

Effective radiation dose in adults

Here are some approximate comparisons of background radiation and effective radiation dose in adults for several radiology procedures described on this website.

ABDOMINAL REGION



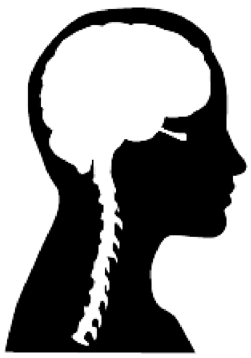
Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Computed Tomography (CT)–Abdomen and Pelvis	7.7 mSv	2.6 years
Computed Tomography (CT)–Abdomen and Pelvis, repeated with and without contrast material	15.4 mSv	5.1 years
Computed Tomography (CT)–Colonography	6 mSv	2 years
Intravenous Urography (IVU)	3 mSv	1 year
Barium Enema (Lower GI X-ray)	6 mSv	2 years
Upper GI Study with Barium	6 mSv	2 years

BONE

Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Lumbar Spine	1.4 mSv	6 months
Extremity (hand, foot, etc.) X-ray	Less than 0.001 mSv	Less than 3 hours

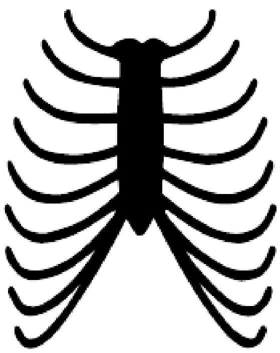
CENTRAL NERVOUS SYSTEM

Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Computed Tomography (CT)–Brain	1.6 mSv	7 months
Computed Tomography (CT)–Brain, repeated with and without contrast material	3.2 mSv	13 months



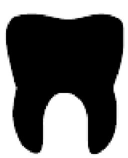
Computed Tomography (CT)–Head and Neck	1.2 mSv	5 Months
Computed Tomography (CT)–Spine	8.8 mSv	3 years

CHEST



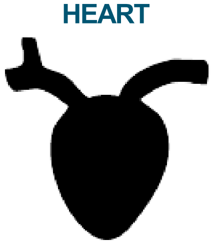
Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Computed Tomography (CT)–Chest	6.1 mSv	2 years
Computed Tomography (CT)–Lung Cancer Screening	1.5 mSv	6 months
Chest X-ray	0.1 mSv	10 days

DENTAL

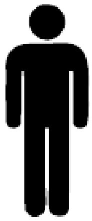


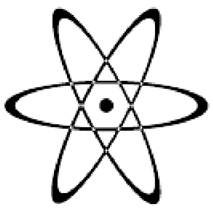
Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Dental X-ray	0.005 mSv	1 day
Panoramic X-ray	0.025 mSv	3 days
Cone Beam CT	0.18 mSv	22 days

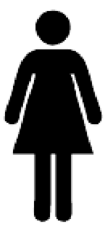
HEART



Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
Coronary Computed Tomography Angiography (CTA)	8.7 mSv	3 years
Cardiac CT for Calcium Scoring	1.7 mSv	6 months
Non-Cardiac Computed Tomography Angiography (CTA)	5.1 mSv	Less than 2 years

MEN'S IMAGING	Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
	Bone Densitometry (DEXA)	0.001 mSv	3 hours

NUCLEAR MEDICINE	Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
	Positron Emission Tomography–Computed Tomography (PET/CT) Whole body protocol	22.7 mSv	3.3 years

WOMEN'S IMAGING	Procedure	Approximate effective radiation dose	Comparable to natural background radiation for:
	Bone Densitometry (DEXA)	0.001 mSv	3 hours
	Screening Digital Mammography	0.21 mSv	26 days
	Screening Digital Breast Tomosynthesis (3D Mammogram)	0.27 mSv	33 days

Note for pediatric patients: Pediatric patients vary in size. Doses given to pediatric patients will vary significantly from those given to adults. *For more information on radiation safety in pediatric imaging, visit http://www.imagegently.org/Roles-What-can-I-do/Parent (https://www.imagegently.org/Roles-What-can-I-do/Parent)* .

Please note that this chart attempts to simplify a very complex topic. If you have questions about radiation risks, ask your medical physicist and/or radiologist about these risks and the benefits of your medical imaging procedure.

*****The effective doses are typical values for an average-sized adult. Actual doses can vary substantially.

The International Commission on Radiological Protection (ICRP) Report 103 states: "The use of effective dose for assessing the exposure of patients has severe limitations that must be considered when quantifying medical exposure." The report warns, not all tissues being exposed receive equal distribution of the same radiation characteristics. In other words, effective dose is not always the same for everyone. It can vary based on a person's height and weight, the equipment and how the procedure is performed, and the area of the body being exposed to radiation.

For more information, see this freely accessible summary (https://pubs.rsna.org/doi/10.1148/radiol.2020192256) of the National Council on Radiation Protection and Measurements (NCRP) report 184.

Benefit versus risk

The risk associated with medical imaging procedures refers to possible long-term or short-term side effects. Most imaging procedures have a relatively low risk. Hospitals and imaging centers apply the principles of ALARA (As Low As Reasonably Achievable). This means they make every effort to decrease radiation risk. It is important to remember that a person is at risk if the doctor cannot accurately diagnose an illness or injury. Therefore, it could be said that the benefit from medical imaging, which is an accurate diagnosis, is greater than the small risk that comes with using it. Talk to your doctor or radiologist about any concerns you may have about the risks of a procedure.

For more discussions about benefit versus risk, see the Benefits and Risks section (https://www.radiologyinfo.org/en/patient-safety)