Fact Sheet
Adopted: January 2010

Health Physics Society
Specialists in Radiation Safety

Radiation Exposure from Medical Exams and Procedures

Ionizing radiation is used daily in hospitals and clinics to perform diagnostic imaging exams and medical interventions. For the purposes of this fact sheet, the word radiation refers to ionizing radiation; the most common forms of radiation in medicine are x rays and gamma rays.

CT Scanner

photo courtesy of UConn Health Center

Exams and procedures that use radiation are necessary for accurate diagnosis of disease and injury. They provide important information about your health to your doctor and help ensure that you receive appropriate care.

Physicians can also use radiation to make some procedures, such as heart valve replacement, less time-consuming and invasive. Physicians and technologists performing these procedures are trained to use the minimum amount of radiation necessary for the procedure. Benefits from medical procedures greatly outweigh the potential small risk of harm from the amount of radiation used.

A more quantitative assessment of the benefits of medical radiation was prepared recently for the Health Physics Society Web site (http://hps.org/hpspublications/articles/Benefitsofmedradexposures.html).

A recent report from the National Council on Radiation Protection and Measurements (NCRP) states that exposure to the U.S. population from medical procedures has increased since the 1980s (NCRP 2009). These findings can be attributed to the growth in the use of medical imaging procedures, especially from increased use of computed tomography (CT) and nuclear medicine. The NCRP, the American College of Radiology, the World Health Organization, and others are working to improve the referral process for procedures involving CT and nuclear medicine so that they are based on objective, medically relevant criteria.

Which types of diagnostic imaging procedures use radiation?

- In x-ray procedures, x rays pass through the body to form pictures on a computer or television monitor, which are viewed by a radiologist. If you have an x ray, it will be performed with a standard x-ray machine or with a more sophisticated x-ray machine called a CT machine.
- During interventional procedures, fluoroscopy is used by cardiologists, gastroenterologists, pain specialists, and radiologists to perform procedures inside the body.

- In nuclear medicine procedures, a small amount of radioactive material is inhaled, injected, or swallowed by the patient. If you have a nuclear medicine procedure, a special camera will be used to detect energy given off by the radioactive material in your body and form a picture of your organs and their level of function on a computer monitor. A nuclear medicine physician views these pictures. The radioactive material typically disappears from your body within a few hours or days.

Do benefits from medical examinations using radiation outweigh the risks from the radiation?

Your doctor will order an x ray for you when it is needed for accurate diagnosis of your condition. There is no conclusive evidence of radiation causing harm at the levels patients receive from diagnostic x-ray exams. Although high doses of radiation are linked to an increased risk of cancer, the effects of low doses of radiation used in diagnostic imaging are either nonexistent or too small to observe. The benefits of diagnostic medical exams are vital to good patient care.

What are typical doses from medical procedures involving radiation?

Radiation *dose** can be estimated for some common diagnostic x ray, fluoroscopic, and nuclear medicine procedures. It is important to note that these are only typical values. Radiation doses differ for each person because of differences in x-ray machines and their settings, the amount of radioactive material given in a nuclear medicine procedure, and the patient's metabolism.

The following tables give dose estimates for typical diagnostic x ray, interventional, and nuclear medicine procedures. Many diagnostic exposures are less than or similar to the exposure we receive from natural background radiation. For comparison, in the United States each person receives about 3.0 *mSv* (300 mrem) of radiation exposure from background sources every year. The effective dose listed is a comparable whole-body dose from the exam. The effective dose is given in mSv (an international unit of radiation measurement) and mrem (the traditional unit used in the United States).

Typical Effective Radiation Dose from Diagnostic X Ray—Single Exposure (Mettler 2008)

Exam	**Effective Dose** mSv (mrem)
Chest	0.1 (10)
Cervical Spine	0.2 (20)
Thoracic Spine	1.0 (100)
Lumbar Spine	1.5 (150)
Pelvis	0.7 (70)
Abdomen or Hip	0.6 (60)
Mammogram (2 view)	0.36 (36)
Dental Bitewing	0.005 (0.5)
Dental (panoramic)	0.01 (1)
DEXA (whole body)	0.001 (0.1)
Skull	0.1 (10)
Hand or Foot	0.005 (0.5)

The following table shows the dose a patient could receive if undergoing an entire procedure that may be diagnostic or interventional. For example, a lumbar spine series usually consists of five x-ray exams. (Mettler 2008)

Examinations and Procedures	**Effective Dose** mSv (mrem)
Intravenous Pyelogram	3.0 (300)
Upper GI	6.0 (600)
Barium Enema	7.0 (700)
Abdomen Kidney, Ureter, Bladder (KUB)	0.7 (70)
CT Head	2.0 (200)
CT Chest	7.0 (700)
CT Abdomen/Pelvis	10.0 (1,000)
Whole-Body CT Screening	10.0 (1,000)
CT Biopsy	1.0 (100)
Calcium Scoring	2.0 (200)
Coronary Angiography	20.0 (2,000)
Cardiac Diagnostic & Intervention	30.0 (3,000)
Pacemaker Placement	1.0 (100)
Peripheral Vascular Angioplasties	5.0 (500)
Noncardiac Embolization	55.0 (5,500)
Vertebroplasty	16.0 (1,600)

*Words in italics are defined in the Glossary on page 3.

Typical Effective Radiation Dose from Nuclear Medicine Examinations (Mettler 2008)

Nuclear Medicine Scan Radiopharmaceutical (common trade name)	Effective Dose mSv (mrem)
Brain (PET) ^{18}F FDG	14.1 (1,410)
Brain (perfusion) ^{99m}Tc HMPAO	6.9 (690)
Hepatobiliary (liver flow) ^{99m}Tc Sulfur Colloid	2.1 (210)
Bone ^{99m}Tc MDP	6.3 (630)
Lung Perfusion/Ventilation ^{99m}Tc MAA & ^{133}Xe	2.5 (250)
Kidney (filtration rate) ^{99m}Tc DTPA	1.8 (180)
Kidney (tubular function) ^{99m}Tc MAG3	2.2 (220)
Tumor/Infection ^{67}Ga	2.5 (250)
Heart (stress-rest) ^{99m}Tc sestamibi (Cardiolite)	9.4 (940)
Heart (stress-rest) ^{201}Tl chloride	41.0 (4,100)
Heart (stress-rest) ^{99m}Tc tetrofosmin (Myoview)	11.0 (1,100)
Various PET Studies ^{18}F FDG	14.0 (1,400)

How can I obtain an estimate of my radiation dose from medical exams?

Ask your doctor to refer you to a medical health physicist or diagnostic medical physicist for information on medical radiation exposure and an estimate of exposure. You can also get an estimate of typical doses for procedures at RADAR Medical Procedure Radiation Dose Calculator.

Do magnetic resonance imaging (MRI) and ultrasound use radiation?

No. MRI and ultrasound procedures do not use ionizing radiation. If you have either of these types of studies, you are not exposed to radiation.

Glossary

Dose
A general term used to refer either to the amount of energy absorbed by a material exposed to radiation (absorbed dose) or to the potential biological effect in tissue exposed to radiation (equivalent dose).

Sv or Sievert
The International System of Units (SI) unit for dose equivalent equal to 1 joule/kilogram. The sievert has replaced the rem; one sievert is equal to 100 rem. One millisievert is equal to 100 millirem.

References

Mettler FA Jr, Huda W, Yoshizumi TT, Mahesh M. Effective doses in radiology and diagnostic nuclear medicine: A catalog. Radiology 248(1):254-263; 2008. Available at: http://radiology.rsna.org/content/248/1/254.long. Accessed 8 February 2010.

National Council on Radiation Protection and Measurements. Ionizing radiation exposure of the population of the United States. Washington, DC: National Council on Radiation Protection and Measurements; NCRP Report No. 160; 2009. Summary of the report available at: http://www.ncrponline.org/Press_Rel/Rept_160_Press_Release.pdf. Accessed 8 February 2010.

Resources for more information

Ask the Experts (http://hps.org/publicinformation/ate/cat4.html), sponsored by the Health Physics Society, provides information about pregnancy and radiation.

The Health Physics Society Radiation Exposure and Pregnancy Fact Sheet (http://hps.org/documents/pregnancy_fact_sheet.pdf) provides information about pregnancy and radiation.

The Health Physics Society document *People Exposed to More Radiation from Medical Exams* (http://hps.org/media/documents/NCRP_Report-People_Exposed_to_More_Radiation_from_Medical_Exams_9Mar.pdf) provides information about radiation from medical exams.

RadiologyInfo.org (http://www.radiologyinfo.org), sponsored by the American College of Radiology and the Radiological Society of North America, provides information on x-ray exams.

RT Answers—Answers to Your Radiation Therapy Questions (http://www.rtanswers.org), sponsored by the American Society for Radiation Oncology, provides information on radiation therapy.

The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Formed in 1956, the Society has approximately 5,500 scientists, physicians, engineers, lawyers, and other professionals. Activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.