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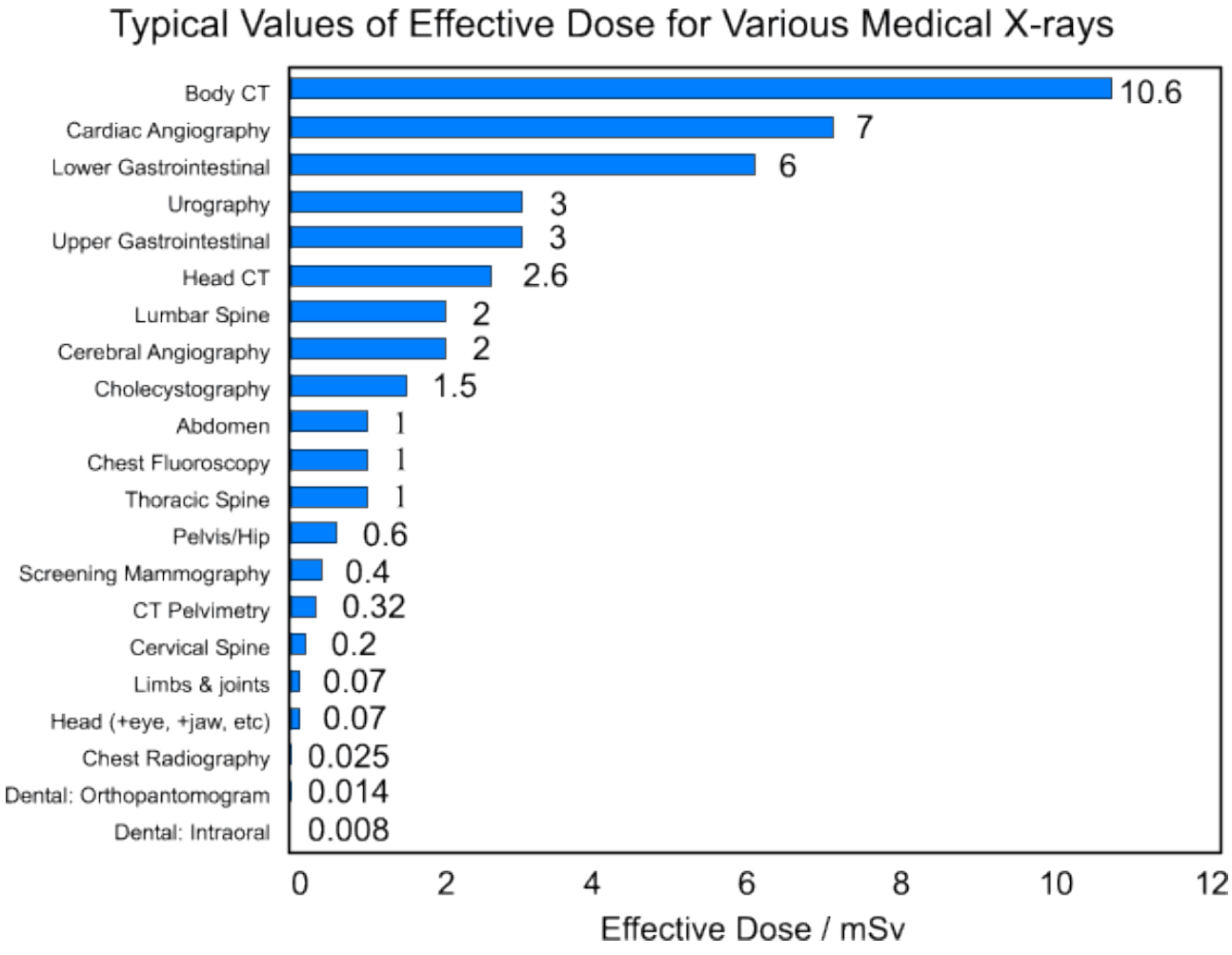
Medical Radiation Exposure

Adapted from:
Australian Radiation Protection and Nuclear Safety Agency,
Health Physics Society

How can I be exposed to X-rays?

Diagnostic medical x-rays are the most likely way you will encounter x-rays. Diagnostic x-rays only expose part of the body to radiation. The quantity **effective dose** is used as a way of comparing the risk of a partial body exposure to that due to a whole body exposure (such as that due to background radiation in the environment). **For comparison, in the United States each person receives about 3.0 *mSv* (300 mrem) of radiation exposure from background sources every year.**



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 (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)

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)

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.

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. http://www.doseinfo-radar.com/RADARDoseRiskCalc.html

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 (mSv) is equal to 100 millirem (mrem).

References

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Australian Radiation Protection and Nuclear Safety Agency
http://www.arpansa.gov.au/radiationprotection/basics/xrays.cfm

Health Physics Society
http://www.hps.org/

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