level of radiology interest among male and female medical students in the first year was not significantly different.

It has been recognized that medical students develop opinions about residency choices during their preclinical years, and misperceptions about radiology that form in the first year persist. If active mentoring and role modeling can be formed in the earliest years, the authors propose that more women may not lose interest as they advance to the later years of medical school.

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Reference

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Research

Effective Doses in Radiology and Diagnostic Nuclear Medicine: A Catalog

Mettler FA Jr, Huda W, Yoshizumi TT, et al (New Mexico Veterans Administration Healthcare System; Med Univ of South Carolina, Charleston; Duke Univ Med Ctr, Durham, NC; et al)

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Medical uses of radiation have grown very rapidly over the past decade, and, as of 2007, medical uses represent the largest source of exposure to

TABLE 1.—Adult Effective Doses for Various Diagnostic Radiology Procedures

Examination	Average Effective Dose (mSv)	Values Reported in Literature (mSv)
Skull	0.1	0.03–0.22
Cervical spine	0.2	0.07–0.3
Thoracic spine	1.0	0.6–1.4
Lumbar spine	1.5	0.5–1.8
Posteroanterior and lateral study of chest	0.1	0.05–0.24
Posteroanterior study of chest	0.02	0.007–0.050
Mammography	0.4	0.10–0.60
Abdomen	0.7	0.04–1.1
Pelvis	0.6	0.2–1.2
Hip	0.7	0.18–2.71
Shoulder	0.01	…
Knee	0.005	…
Other extremities	0.001	0.0002–0.1
Dual x-ray absorptiometry (without CT)	0.001	0.001–0.035
Dual x-ray absorptiometry (with CT)	0.04	0.003–0.06
Intravenous urography	3	0.7–3.7
Upper gastrointestinal series	6*	1.5–12
Small-bowel series	5	3.0–7.8
Barium enema	8*	2.0–18.0
Endoscopic retrograde cholangiopancreatography	4.0	…

*Includes fluoroscopy.

TABLE 2.—Adult Effective Doses for Various CT Procedures

Examination	Average Effective Dose (mSv)	Values Reported in Literature (mSv)
Head	2	0.9–4.0
Neck	3	…
Chest	7	4.0–18.0
Chest for pulmonary embolism	15	13–40
Abdomen	8	3.5–25
Pelvis	6	3.3–10
Three-phase liver study	15	…
Spine	6	1.5–10
Coronary angiography	16	5.0–32
Calcium scoring	3	1.0–12
Virtual colonoscopy	10	4.0–13.2

TABLE 3.—Adult Effective Doses for Various Interventional Radiology Procedures

Examination	Average Effective Dose (mSv)*	Values Reported in Literature (mSv)
Head and/or neck angiography	5	0.8–19.6
Coronary angiography (diagnostic)	7	2.0–15.8
Coronary percutaneous transluminal angioplasty, stent placement, or radiofrequency ablation	15	6.9–57
Thoracic angiography of pulmonary artery or aorta	5	4.1–9.0
Abdominal angiography or aortography	12	4.0–48.0
Transjugular intrahepatic portosystemic shunt placement	70	20–180
Pelvic vein embolization	60	44–78

*Values can vary markedly on the basis of the skill of the operator and the difficulty of the procedure.

the U.S. population. Most physicians have difficulty assessing the magnitude of exposure or potential risk. Effective dose provides an approximate indicator of potential detriment from ionizing radiation and should be used as one parameter in evaluating the appropriateness of examinations involving ionizing radiation. The purpose of this review is to provide a compilation of effective doses for radiologic and nuclear medicine procedures. Standard radiographic examinations have average effective doses that vary by over a factor of 1000 (0.01–10 mSv). Computed tomographic examinations tend to be in a more narrow range but have relatively high average effective doses (approximately 2–20 mSv), and average effective doses for interventional procedures usually range from 5–70 mSv. Average effective dose for most nuclear medicine procedures varies between 0.3 and 20 mSv. These doses can be compared with the average annual effective dose from background radiation of about 3 mSv.

▶ This is an extraordinarily useful article that summarizes and compiles the average effective radiation doses of a wide range of diagnostic radiology and

TABLE 5.—Effective Doses for Adults from Various Nuclear Medicine Examinations

Examination*	Effective Dose (mSv)	Administered Activity (MBq)†	Effective Dose (mSv/MBq)‡
Brain (^{99m}Tc-HMPAO–exametazime)	6.9	740	0.0093
Brain (^{99m}Tc-ECD–Neurolite)	5.7	740	0.0077
Brain (^{18}F-FDG)	14.1	740	0.019
Thyroid scan (sodium iodine 123)	1.9	25	0.075 (15% uptake)
Thyroid scan (^{99m}Tc-pertechnetate)	4.8	370	0.013
Parathyroid scan (^{99m}Tc-sestamibi)	6.7	740	0.009
Cardiac stress-rest test (thallium 201 chloride)	40.7	185	0.22
Cardiac rest-stress test (^{99m}Tc-sestamibi 1-day protocol)	9.4	1100	0.0085 (0.0079 stress, 0.0090 rest)
Cardiac rest-stress test (^{99m}Tc-sestamibi 2-day protocol)	12.8	1500	0.0085 (0.0079 stress, 0.0090 rest)
Cardiac rest-stress test (Tc-tetrofosmin)	11.4	1500	0.0076
Cardiac ventriculography (^{99m}Tc-labeled red blood cells)	7.8	1110	0.007
Cardiac (^{18}F-FDG)	14.1	740	0.019
Lung perfusion (^{99m}Tc-MAA)	2.0	185	0.011
Lung ventilation (xenon 133)	0.5	740	0.00074
Lung ventilation (^{99m}Tc-DTPA)	0.2	1300 (40 actually inhaled)	0.0049
Liver-spleen (^{99m}Tc–sulfur colloid)	2.1	222	0.0094
Biliary tract (^{99m}Tc-disofenin)	3.1	185	0.017
Gastrointestinal bleeding (99mTc-labeled red blood cells)	7.8	1110	0.007
Gastrointestinal emptying (^{99m}Tc-labeled solids)	0.4	14.8	0.024
Renal (^{99m}Tc-DTPA)	1.8	370	0.0049
Renal (^{99m}Tc-MAG3)	2.6	370	0.007
Renal (^{99m}Tc-DMSA)	3.3	370	0.0088
Renal (^{99m}Tc-glucoheptonate)	2.0	370	0.0054
Bone (^{99m}Tc-MDP)	6.3	1110	0.0057
Gallium 67 citrate	15	150	0.100
Pentreotide (^{111}In)	12	222	0.054
White blood cells (^{99m}Tc)	8.1	740	0.011
White blood cells (^{111}In)	6.7	18.5	0.360
Tumor (^{18}F-FDG)	14.1	740	0.019

*DMSA = dimercaptosuccinic acid, DTPA = diethylenetriaminepentaacetic acid, ECD = ethyl cysteinate dimer, ^{18}F = fluorine 18, FDG = fluorodeoxyglucose, HMPAO = hexamethylpropyleneamine oxime, ^{111}In = indium 111, MAA = macroaggregated albumin, MAG3 = mercaptoacetyltriglycine, MDP = methylene diphosphonate, ^{99m}Tc = technetium 99m.

†Recommended ranges vary, although most laboratories tend to use the upper end of suggested ranges.

‡From reference 74.

nuclear medicine procedures. It is a summary of approximately 200 measurement studies that have appeared in the world literature since 1980.

Although there are multiple methods by which radiation exposure can be measured, perhaps the most current and most important is the "effective

dose," defined by the International Commission on Radiological Protection (ICRP). The ICRP first assigns radiation weighting factors depending on the type of radiation (photons are assigned a value of 1.0), allowing an equivalent dose to be obtained. To estimate the potential injury from cancer and hereditary effects, effective dose is used. The effective dose is calculated by multiplying the average organ equivalent dose by an ICRP-defined tissue weighting factor and summing the results over the whole body. Effective dose is expressed in units of millisieverts (mSv). It is a single dose parameter that reflects the risk of a nonuniform exposure in terms of whole-body exposure.

Effective dose is also age and sex averaged. The most important dose information is provided in Tables 1-3, and 5.

A. D. Elster, MD

Incidental findings in healthy control research subjects using whole-body MRI

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Aim.—Magnetic resonance imaging (MRI) is a powerful clinical tool used increasingly in the research setting. We aimed to assess the prevalence of incidental findings in a sequential cohort of healthy volunteers undergoing whole-body MRI as part of a normal control database for imaging research studies.

TABLE 1.—Abnormalities Ordered by Clinical Significance and Frequency (percentage of total scans in which an abnormality of the specified severity is found)

Abnormality	Frequency, % Total Scans	Number (% Abnormalities)
High clinical significance	3.4	5 (10.2)
Ovarian lesion; dermoid cyst		2 (4.1)
Mediastinal lymphadenopathy		1 (2.0)
Psoas mass		1 (2.0)
Splenomegaly		1 (2.0)
Moderate clinical significance	9.5	15 (30.6)
Gallstones		6 (12.2)
Diverticulosis		3 (6.1)
Enlarged uterus/fibroids		3 (6.1)
Kidney agenesis (unilateral)		2 (4.1)
Subdiaphragmatic cystic lesion		1 (2.0)
Low clinical significance	18.9	29 (59.2)
Renal cyst, one or more		21 (42.9)
Liver cyst or haemangioma		5 (10.2)
Splenic cyst/haemangioma		2 (4.1)
Simple bone cyst		1 (2.0)

Clinical significance is graded high, moderate and low. Absolute numbers of abnormalities are tabulated with the percentage of all abnormalities in parentheses.