VERMONT
DEPARTMENT OF HEALTH

X-RAY FACILITY TIPS

Topic 4: Personal Dosimeters (Badges)

Measurements of radiation dose received by occupationally exposed individuals serve two different purposes. They provide information that may identify unsuspected sources of high exposure and/or undesirable practices, thus permitting the application of physical or administrative controls to limit over-exposure. They also provide information regarding the dose to the individual employee, indicating compliance with occupational dose limits (5,000 millirem per year) and documentation of annual and lifetime dose.

Personal dosimeters shall be provided to all employees who are likely to exceed 500 millirem per year. Personal dosimeters are not necessary for most Vermont dental, podiatric and chiropractic facilities due to their low annual radiographic workload, and thus dose, to which employees are exposed. Personal dosimeters are not required where the nature of the work performed or the radiation exposures to personnel are below these limits and where there is very small potential for accidental exposure.

The dose limit applicable to pregnant workers is 50 millirem per month to the fetus once pregnancy is declared by the employee (500 millirem for the entire pregnancy). Personal dosimeters should be provided for known pregnant occupationally exposed personnel who are expected to exceed this limit. This is based on the philosophy that a monthly limit will control exposure to the fetus during potentially sensitive periods of gestation. It is recommended that at least one dosimeter be worn outside any personal protective equipment (lead apron) at the waist level. Alternatively, two dosimeters may be worn: one outside the lead apron to determine employee dose and one at the waist line under the lead apron to determine fetal dose.

The personal dosimeter should be worn between the chest and waist, since the x-ray tube head is most often positioned at this height.

Personal dosimeters must be obtained from NVLAP accredited laboratories for accuracy and reproducibility. These laboratories distribute personal dosimeters on a monthly or quarterly basis and the facility returns them to the laboratory after the appropriate time period for readout and report. For facilities that have low radiographic workloads, greater accuracy and reduced cost can be achieved by replacing personal dosimeters at quarterly intervals. However, longer intervals do not allow timely detection of unsuspected sources of high exposure and/or undesirable practices.

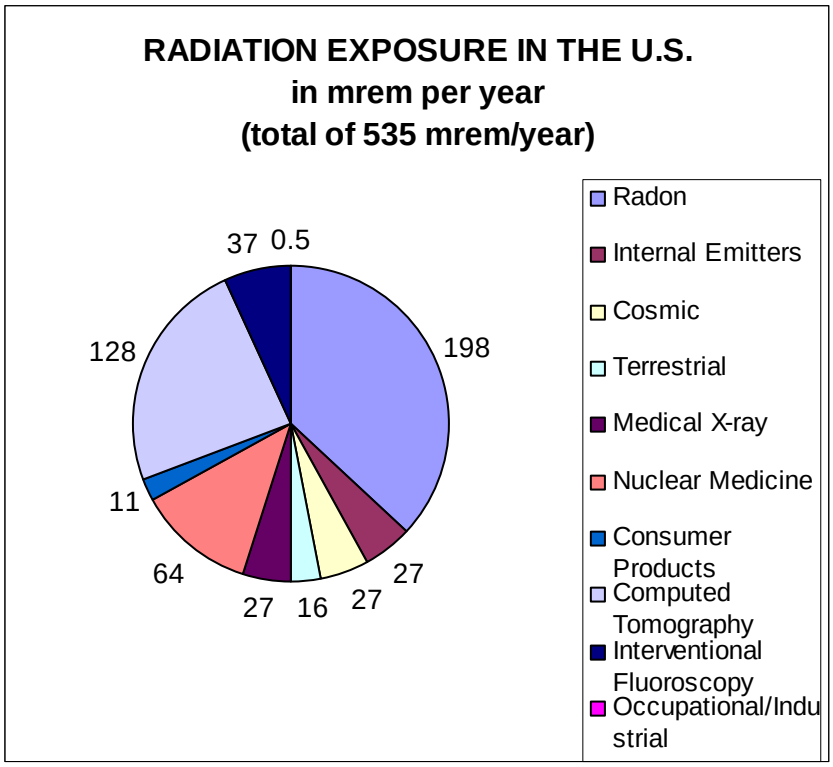
The most recent available data indicate that the average annual occupational dose in dentistry in the United States in 1980 was 2 millirem. Few dental workers receive more than 100 millirem, and 68 percent received exposures below the threshold of detection. The dose to an operator standing 1 meter from the patient may vary between 0.74 and 10 millirem per radiograph for D-speed film and between 0.4 and 6 millirem per radiograph for E-speed film (at 60 kVp in both cases).

The Vermont Department of Health began making calculations of effective dose to the operator in 2007. These calculations are based on worst case scenarios where the x-ray tube is aimed through a phantom head at the operator's position. These are the results for dental operators as of January 2008:

Examination	Film Type	Effective Dose (millirem)	Number of Measurements
Intraoral	D	4.4	80
Intraoral	E	1.2	10
Intraoral	F	2.2	127
Intraoral	Digital	2.9	151
Panoramic		2.1	71
Cephalometric		0.2	14

COMPARISION OF SOURCES AND DOSES OF RADIATION[1]	
SOURCE	**ESTIMATED DOSE (mrem)**
DENTAL RADIOGRAPHS	
Bitewing (4 films)	3.8
Periapical (each)	0.9
Full mouth series	15
Panoramic	2 - 10
MEDICAL RADIOGRAPHS	
Chest	2
Hand or Foot	0.5
Mammogram (4 views)	70
Pelvis or hips	80
CT pelvis	1000
AVERAGE RADIATION IN U.S. FROM NATURAL SOURCES PER YEAR	300
AVERAGE RADIATION FROM 6 HOUR AIRPLANE FLIGHT	3

[1] Adapted from JADA, Vol. 133, December 2002; Health Physic Society; "Radiation Exposure from Medical Diagnostic Imaging Procedures – Health Physics Society Fact Sheet"; Handbook of Health Physics and Radiological Health, 3rd edition, 1998.



Health Risk[3]	Estimated life expectancy lost
Smoking 20 cigarettes a day	6 years
Overweight by 15%	2 years
Alcohol (US average)	1 year
All Accidents	207 days
All Natural Hazards	7 days
Occupational dose of 300 mrem/year	15 days
Occupational dose of 1000 mrem/year	51 days

[3] www.umich.edu/~radinfo/introduction/risk.htm

SOURCES:

National Council on Radiation Protection and Measurements, NCRP Report No. 105, Radiation Protection for Medical and Allied Health Personnel

National Council on Radiation Protection and Measurements, NCRP Report No. 116, Limitation of Exposure to Ionizing Radiation

National Council on Radiation Protection and Measurements, NCRP Report No. 127, Operational Radiation Safety Program

National Council on Radiation Protection and Measurements, NCRP Report No. 133, Radiation Protection for Procedures Performed Outside the Radiology Department

National Council on Radiation Protection and Measurements, NCRP Report No. 145, Radiation Protection in Dentistry

National Council on Radiation Protection and Measurements, NCRP Report No. 148, Radiation Protection in Veterinary Medicine