

Radiation Safety for Nursing Personnel

Worker Instruction Program

Facility: _____

Date Completed: _____

RADIATION

Radiation is as much a part of our lives as are the sun and the earth. In fact, these are the two main sources of natural background radiation. It is estimated that each individual receives on the average 100 - 125 mrem/year from natural radiation.(1) This exposure value increases as you move closer to the sun or into areas which have greater amounts of natural radioactive material in the ground, such as Uranium or Radon.

As a nurse, you may on occasion be exposed to ionizing radiation. The possible sources of exposure in _____ are Nuclear Medicine patients, portable x-ray exams, and fluoroscopic exams. No area in _____ has been identified where a nurse would be expected to receive a radiation exposure in excess of the limit recommended for pregnant women which is 500 mrem for the nine (9) month gestation period. Millirem (mrem) is a unit of measure of radiation just as inch is a measure of distance. Millirem and milliroentgen (mR) are equivalent units when considering Diagnostic X-ray and Nuclear Medicine.

The American Cancer Society reports that ~25% of all adults 20 - 65 years of age develop cancer. A lifetime cumulative radiation dose of 1000 mrem is estimated to increase the cancer incidence from 25% to 25.03%.(2)

Sterility: Sterility is not induced at occupational exposure levels. An acute dose of 25,000 mrem to the testes causes only a temporary reduction in sperm count.(3)

Pregnancy: Rapidly growing tissue is known to be more sensitive to radiation damage than slower growing tissue. Therefore, the fetus is more sensitive to radiation than an adult; and the fetus is most sensitive during the first trimester. For this reason, the NRC and your employer have adopted the conservative policy of limiting a pregnant women's occupational exposure to 500 mrem over the entire gestation period.

The normal incidence rate of congenital abnormalities is 4 - 6/100 births and the rate of fatal childhood cancers is 4.3 per 100,000 population per year. Exposure of the pregnant woman to 1000 mrem over the nine (9) month period has been estimated to increase the incidence rate of malformations by 0.0005 and the rate of 0.00023 - 0.00058 fatal childhood cancers.(4)

Radiation Safety for Nursing Personnel

SOURCES OF RADIATION EXPOSURE TO NURSING PERSONNEL

Nuclear Medicine

Following a Nuclear Medicine test, patients are generally a source of radiation exposure. Urine, feces, and blood may be slightly radioactive and should be handled with gloves. Hands should be washed in accordance with normal biohazard precautions.

Most Diagnostic Nuclear Medicine procedures use a radionuclide (Tc-99m) with a very short half-life (6 hrs.). Therefore, after 24 hours the radioactivity has decayed and has been physically eliminated so that virtually all of it is gone.

Some patient studies require the use of radionuclides with somewhat longer half-lives. Examples of these are Gallium-67 with a 78 hour half-life, Indium-111 -- 67 hours, and Thallium-201 -- 73 hours. Even these radionuclides are virtually totally eliminated after four days.

Typical dose rates at the bedside of a Diagnostic Nuclear Medicine patient have been measured as 4 -6 mR/hr immediately following injection. These dose rates decrease as the distance between you and the patient increases. The dose rate also decreases as time elapses. Dose rate and dose should not be confused here. If a nurse spent 10 minutes at the patient's bedside, they would receive:

$$\frac{6 \text{ mrem}}{60 \text{ min}} * 10 \text{ min} = 1 \text{ mrem}$$

As the time following injection increased, the dose received by the nurse would be even less.

In Therapeutic Nuclear Medicine procedures (such as Iodine-131 thyroid cancer ablation), the radiopharmaceuticals which are used are potentially more damaging than the radiopharmaceuticals used routinely and the patients receive greater amounts of activity. Pregnant nurses should not be assigned the care of these patients.

X-ray

As a nurse assigned the care of patients, you are probably familiar with the portable x-ray machines that are operated by a radiology technologist. Due to the design of x-ray machines, a nurse need not be worried regarding the exposure from this procedure if they maintain a distance of at least six feet while x-rays are taken. If you are asked to hold a patient during the taking of an x-ray, your actual exposure would still be low if you remain outside of the primary beam. The primary beam is the area which is illuminated by the light from the x-ray machine.

Radiation Safety for Nursing Personnel

During an x-ray, the primary beam is directed at and passes through the patient. Radiation scattered by the patient's body is present near the patient only during the actual taking of the x-ray. Scattered radiation at one meter from the patient is only 0.1% of the intensity of the primary x-ray beam. A typical chest x-ray exposes the patient to approximately 10 mR surface dose. Therefore, the exposure to a person standing at one meter from the patient will only be about 0.01 mR. A person standing at the patient's side would receive approximately 3 mR. The actual exposure to that person would be much less if they wore a lead apron.

It has been determined that even x-ray technologists who are assigned to portable x-rays are not at risk of exceeding the recommended limit for pregnancy of 500 mrem/9 months.

Pregnant women should not be asked to hold patients during an x-ray procedure unless they are provided with a lead apron.

Nurses who assist with fluoroscopic procedures should wear aprons during the exam. Again, x-ray technologists who are assigned to fluoroscopy procedures on a full-time basis have been determined not to be at risk of exceeding the 500 mrem/9 month recommended limit.

Although it is very unlikely that a nurse caring for Diagnostic Nuclear Medicine patients and for patients receiving portable x-ray exams, or assisting with fluoroscopic exams would receive a radiation exposure near to the 500 mrem/9 month limit, you should be aware of things you can do to decrease your exposure even more.

Three important factors which affect your radiation exposure are:

1. Time. The less time you spend near a source of radiation, the lower your exposure. **Therefore**, you should work efficiently, but not hurriedly around Nuclear Medicine patients.
2. Distance. The farther away you are from a source of radiation, the less exposure you will receive. As you double the distance, the exposure rate decreases by a factor of four.

Practically, this means stand at least six (6) feet from the patient during x-ray exams (if the patient does not need your assistance), and when visiting with a Nuclear Medicine patient, stand at the foot of the bed rather than the side.

3. Shielding. Interposing most any sort of dense material between you and a radiation source will reduce your exposure. **Therefore**, you should wear lead aprons when assisting with fluoroscopic exams and when holding patients during x-ray procedures.

