

# Compliance Training

## Ionizing Radiation Safety

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Practices that perform radiology procedures must have in place operational and safety procedures as required by state and federal requirements. The purpose of a facility's operational and safety procedures are to ensure that employees are aware of the proper guidelines to follow in their facility. Additionally, each state has varying requirements with which workers should be familiar for operator and patient safety. Check with your facility's Radiation Safety Officer (RSO) regarding the requirements in your state.

Staff members that are involved in procedures in which there is an opportunity for radiation exposure should be familiar with the operation of the equipment, safety precautions recommended by the manufacturer, state requirements for operator and patient safety, use of personal protective equipment, and following established work practices or procedures.

### Signage and Labeling

The immediate area used for radiology should be identified to warn of the potential for exposure to radiation. The area should be identified with the international radiation symbol, as shown below. Control panels and equipment should also be labeled to remind staff members of the radiation hazard and to prompt them to take appropriate precautions.



### Operator's Manual

Basic equipment operation and safety precautions will be found in the operator's manual provided by the manufacturer. These guidelines developed by the manufacturer serve as the minimal requirements for working safely with ionizing radiation and limiting radiation exposure. These instructions and precautions should be carefully followed to ensure safety. Ensure that a copy of the operator's manual is available.

### THIS TRAINING SESSION IS RECOMMENDED FOR:

All personnel who are involved in radiology procedures, and/or who may experience radiation exposure during the performance of their duties.

### Training Objectives

This training material is designed to ensure that healthcare workers with occupational risk for radiation exposure are:

- Familiar with the health risks associated with exposure to radiation; and
- Aware of the different types of radiation exposure.

### Interactive Training Reminder

Compliance Training is an interactive training program in which you can address questions with other staff members or supervisors to obtain clarification for situations in your work setting.

Write down any questions that you have about the training topic and address them with your Safety Training Coordinator or supervisor.

## What are the health risks involved with radiology?

When x-rays, gamma rays, and ionizing particles interact with living materials, such as our bodies, they may deposit enough energy to cause biological damage. Radiation can cause several different types of events, such as the very small physical displacement of molecules, changing a molecule to a different form, or ionization. Ionization is the removal of electrons from atoms and molecules. When a quantity of radiation energy deposited in living tissue is high enough, biological damage can occur as a result of chemical bonds being broken and cells being damaged or killed. These effects can result in observable clinical symptoms.

The possible health effects from exposure to radiation can range from no effect at all to diseases such as leukemia or bone, breast, and lung cancer, and even death. Very high short-term doses of radiation (100s of rads) have been known to cause early effects such as vomiting, diarrhea, skin burns, and cataracts. It is also suspected that radiation exposure may be linked to the potential for genetic effects in children of exposed parents. It is important to note that these kinds of health effects result from high doses delivered over a relatively short period of time. Occupational exposures experienced by healthcare workers are much lower and rarely result in such health effects.

Most occupational exposures for healthcare workers are low-level radiation doses. It is not known exactly what the chances are of getting cancer from low-level radiation doses, primarily because the few effects that may occur cannot be distinguished from normally occurring cancers. The actual radiation risk for a healthcare worker depends upon the amount of the dose. Very few healthcare workers receive doses near 5 rems per year (the annual permissible exposure limit for the whole body (see table below)).

## *Will an exposure that is within the permissible exposure limits cause cancer?*

It is unlikely that an exposure within the permissible exposure limits will cause cancer. The actual risk for cancer has only been established with radiation doses that were above the permissible exposure limits. This is because the effect of lower doses does not show a significant difference in the normal incidence of cancer from other possible causes.

Healthcare employers are required to monitor the exposure levels of healthcare workers. Monitoring devices are used to identify the levels of exposure for healthcare workers and if permissible exposure limits are exceeded. Most monitoring devices are set to measure exposure in rems.

It is important to note that permissible exposure limits do not necessarily define safe or unsafe levels of radiation exposure. Exceeding a limit does not mean that you will get cancer. It is assumed that risk is related to the size of the radiation dose. Therefore, when the worker's dose is higher, their risk is also considered to be higher. Radiation exposure limits are similar to highway driving speeds. If you drive at 70 mph, your risk of injury is higher than driving at 55 mph, even though you may not have an accident. While driving or riding in a vehicle places you at risk for possible injury, the risk is relative to your speed and driving behavior.

## *What is meant by early effects and delayed or late effects?*

Early effects are those that occur shortly after a large exposure that is delivered within hours to a few days. They are observable after receiving a very large dose in a short period of time (i.e., 300 rads received within a few minutes to a few days). Early effects are not caused at the levels of radiation

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### Exposure

Whole body; head & trunk; active blood forming organs, lens of eyes or gonads

Hands & forearms, feet & ankles

Skin of whole body

### Maximum rems per calendar quarter

1.25

18.75

7.50

exposure allowed under the acceptable occupational limits. For example, a dose of 300-500 rads is more than 60 times the annual permissible exposure limit.

Delayed effects may occur years after exposure. These effects are caused when the radiation changes parts of the cells in the body and causes the normal function of the cell to change (i.e., normal healthy cells turn into cancer cells). The potential for delayed effects is one of the main concerns addressed when setting limits for occupational doses to minimize the risk for healthcare workers.

### *What is the difference between acute and chronic radiation dose?*

Acute radiation dose usually refers to a large dose of radiation received in a short period of time. Chronic dose refers to the sum of multiple small doses received repeatedly over long periods of time. The concern for occupational radiation risk is primarily focused on controlling chronic exposure.

The difference between acute and chronic radiation exposure can be demonstrated by using exposure to the sun's rays as an example. An intense exposure to the sun can result in painful burning, peeling, and growing of new skin. However, repeated short exposures provide time for the skin to be repaired between exposures. Whether exposure to the sun's rays is long term or spread over short periods, some of the injury may not be repaired, and may eventually cause skin cancer.

### *What is meant by external and internal exposure?*

A worker's occupational dose may be caused by exposure to radiation that originates outside the body. This type of dose is called "external exposure." Exposure to radiation from radioactive material that has been injected into the body (i.e., as in nuclear medicine scans) is called "internal exposure." Most healthcare facility (i.e., medical and dental practices) activities involve little, if any, internal exposure for the healthcare workers.

### *How does radiation cause cancer?*

The mechanics of radiation-induced cancer are not completely understood. When radiation interacts with the cells in the human body, several possible events can occur. One possibility is that damaged cells can repair themselves and no permanent damage results. Another possibility is that the cells can die, much like the large number of cells that die every day in the human body, and be replaced through the normal biological processes. Another possibility may cause a change to occur in the reproductive structure of cells. Another possibility is that the affected cells can mutate and subsequently be repaired without effect, or they can form pre-cancerous cells that may become cancerous.

Radiation is only one of many agents with the potential for causing cancer, and cancer caused by radiation often cannot be distinguished from cancer attributable to any other cause.

### **Personal Protective Equipment and Work Practices**

As with any occupational health risk, the use of personal protective equipment (PPE) and following established safe work practices or procedures are critical to limiting the risk for radiation exposure. While employers must provide appropriate PPE and procedures, it is also the responsibility of workers to use PPE and follow established procedures. PPE such as lead aprons, gloves, and shields will help reduce exposure to radiation and keep radiation exposure as low as reasonably achievable (ALRA). PPE should be used as specified in the facility's operational and safety procedures.

### **Summary**

The risks associated with the exposure to radiation that workers actually receive are comparable to risks in other industries, and are considered acceptable by scientific groups that have studied them. Studies that have compared occupational risks in the nuclear industry to those in other job areas indicate that nuclear work is relatively safe. As with any occupational risk, it is important to understand the risk and follow established safety procedures to limit your potential for injury or illness. ●

# Compliance Training Test

## Ionizing Radiation Safety

NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

STAFF POSITION: \_\_\_\_\_

*There are 10 questions to the test for Ionizing Radiation Safety. There is no pass or fail grade to the test. Review the training information to find the correct answers to any questions that may have been missed.*

**1** The immediate area used for radiology should be identified with the international radiation symbol to warn of the potential for exposure to radiation.

**Select One**      T                  F

**2** Basic equipment operation and safety precautions will be found in the operator's manual provided by the manufacturer.

**Select One**      T                  F

**3** The possible health effects from exposure to radiation can range from no effect at all to diseases such as leukemia or bone, breast, and lung cancer, and even death.

**Select One**      T                  F

**4** Delayed effects may occur years after exposure. The potential for delayed effects is one of the main concerns addressed when setting limits for occupational doses to minimize the risk for healthcare workers.

**Select One**      T                  F

**5** Very few healthcare workers receive doses near 5 rems per year.

**Select One**      T                  F

**6** Monitoring devices are used to identify the levels of exposure for healthcare workers and determine whether permissible exposure limits are exceeded.

**Select One**      T                  F

**7** Permissible exposure limits define safe or unsafe levels of radiation exposure.

**Select One**      T                  F

**8** Most occupational exposures for healthcare workers are low-level radiation doses.

**Select One**      T                  F

**9** Radiation is only one of many agents with the potential for causing cancer, and cancer caused by radiation cannot be distinguished from cancer attributable to any other cause.

**Select One**      T                  F

**10** While employers must provide appropriate PPE and procedures, it is also the responsibility of workers to use PPE and follow established procedures.

**Select One**      T                  F