HealthStream Regulatory Script

[Radiation and MRI Safety]

Version: [011.18.04]

Lesson 1: Introduction
Lesson 2: Radiation in the Healthcare Setting
Lesson 3: Radiation Safeguards
Lesson 4: Magnetic Resonance Imaging
Lesson 5: MRI Safeguards
Welcome to the introductory lesson on radiation and MRI safety.

Radiation is used commonly in the healthcare setting, for both diagnostic and therapeutic purposes. Both radiation and other modern-day imaging techniques, such as magnetic resonance imaging (MRI), have greatly improved the quality of healthcare and increased the options available to patients.

Because both radiation and MRI procedures involve powerful forms of energy, however, precautions must be taken to prevent associated injury.
### Course Rationale

This course has been designed to help protect you and your patients from the potential hazards of radiation and MRI, by providing information on:

- How radiation and MRI work, how they are used in the healthcare setting, and the associated risks
- Specific best practices to safeguard against potential dangers

![Image: 1002.JPG](image: 1002.JPG)
Course Goals

After completing this course, you should be able to:

- Describe how radiation and MRI are used in the healthcare setting.
- List and explain the potential hazards of both radiation and MRI.
- List and describe specific safeguards for healthcare personnel who work with radiation, radioactivity, or radioactive patients.
- List and describe specific safeguards for healthcare personnel and patients involved in MRI.
The remainder of this introductory lesson provides additional background information on radiation, MRI, and the risks of each.

Lesson 2 takes a closer look at the use of radiation in the healthcare setting. Learning how various types of radiation are used will give you a better understanding of the sources of radiation exposure and associated risks for healthcare workers.

Lesson 3 provides information on radiation safeguards. You will learn how to limit your exposure to the radiation sources described in lesson 2, while still providing quality patient care.

Lesson 4 provides insight into the mechanisms of MRI. You will learn about the main components of an MRI system, and the specific hazards associated with each component.

Finally, lesson 5 outlines MRI safeguards. You will learn how to protect yourself and your patients from the potential hazards of MRI.

<table>
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Point 4 of 9
## Radiation

Radiation is a powerful form of energy.

In the healthcare setting, this energy may be used to:
- Visualize internal structures of the body and diagnose disease.
- Help treat certain diseases.

Many times, radiation procedures can mean the difference between life and death for a patient.

As beneficial as radiation can be, however, this powerful form of energy also poses risks.
The primary health risk associated with exposure to radiation is an increased incidence of cancer.

If radiation increases the risk of cancer, it may seem odd that we use radiation to diagnose and treat disease.

Note, however, that radiation exposure does not occur only in the healthcare setting. We all are exposed to naturally occurring radiation (or background radiation) every day.

Most radiation procedures expose patients to relatively small doses of radiation, equivalent to the amount of background radiation a person would naturally receive over the course of a few weeks, months, or years.

Thus, single radiation procedures do not generally pose a significant risk for patients.
Radiation: Risks to Healthcare Workers

As we have just seen, a single radiation procedure poses little risk to a patient.

A single procedure poses little risk to involved healthcare personnel, as well.

Remember, however, that certain healthcare personnel are involved in performing radiation procedures day after day, year after year.

If these personnel do not take appropriate precautions, their long-term exposure to radiation may reach dangerous levels and pose significant health risks.

In lessons 2 and 3, we will take a closer look at situations in which healthcare workers may be exposed to radiation, and how they can protect themselves.

Image: Healthcare workers who risk exposure to radiation on a regular basis include:
- Physicians, nurses, and technicians who work in departments such as:
  - Radiology
  - Nuclear medicine
  - Nuclear cardiology
  - Radiation oncology
  - Cardiac catheterization
- Nurses who care for patients who have been treated with radioactive implants or radioactive medications
Magnetic resonance imaging (MRI) is a form of imaging that does not involve ionizing radiation.

Instead, MRI uses powerful magnetic and radiofrequency fields to visualize internal structures of the body.

MRI is a very useful technique, providing:

- Excellent soft tissue contrast (for example, MRI can distinguish between the gray and white matter of the brain)
- Three-dimensional reconstructions of anatomical structures
An MRI system poses little or no inherent biological hazard to the human body.

For both patients and healthcare workers, however, hazards can arise if ferromagnetic [link to glossary] objects or electronic devices enter the magnetic field of the MRI system:

- Ferromagnetic objects can become dangerous projectiles [link to glossary], as they are attracted to the core of the MRI magnet (the "projectile effect").
- Electronic devices can malfunction.

In lessons 4 and 5, we will take a closer look at the hazards associated with MRI, and how to safeguard against these hazards.
Welcome to the lesson on radiation in the healthcare setting. This lesson discusses various sources of radiation in the healthcare setting and their specific hazards.

FLASH ANIMATION: 2001.SWF/FLA
### Objectives

After completing this lesson, you should be able to:

- List sources of radiation in the healthcare setting.
- Describe and discuss characteristics and hazards of:
  - Unsealed source therapeutic radiation
  - Brachytherapy
  - Nuclear medicine
  - External beam radiation
Radiation Sources

Radiation used diagnostically and/or therapeutically may be broadly divided into four categories:

- Unsealed source therapeutic radiation
- Brachytherapy (sealed source implants)
- Nuclear medicine (unsealed source diagnostic radiation)
- External radiation beams

Let’s take a closer look at each.
In an unsealed source therapeutic procedure, the patient swallows or is injected with a dosed amount of radioactive material, to treat a specific disease.

Doses of radiation are relatively high, as compared to those used in diagnostic procedures.

The radiation used in an unsealed procedure is not contained in a seed or other distinct form. Radiation travels throughout the patient’s system, and can contaminate all bodily fluids.

Radiation may be eliminated with the patient’s:

- Feces
- Urine
- Perspiration
Examples of unsealed source therapeutic radiation include:

- Iodine-131 (I-131) for thyroid disease
- Radioimmunotherapy for the treatment of cancer
### Gamma particles
Iodine-131 (used in the treatment of thyroid disease) emits radioactivity in the form of powerful gamma particles. These radioactive particles blast nearby cells (i.e., diseased thyroid cells), destroying them.

Gamma particles are so powerful and energetic that they can pass right through the patient’s body, exiting the patient and hitting YOU, if you are caring for the patient and have not taken proper precautions to shield yourself.

### Beta particles
Radioactive materials used in radioimmunotherapy (for the treatment of cancer) emit beta particles. Beta particles, like gamma particles, are capable of blasting nearby cells (i.e., cancerous cells).

Unlike gamma particles, however, beta particles cannot travel far through soft tissue. Beta particles cannot exit the patient’s body and hit you.
Brachytherapy

Brachytherapy is a form of cancer treatment in which small sources of radiation are implanted into the cancerous area of a patient's body.

The radiation is sealed in a seed and cannot leak into the patient's system. The patient's bodily fluids remain uncontaminated.

Seeds may be implanted on a short-term or long-term basis:

- Short-term implants are referred to as fletcher or syed implants, and are implanted for one to two days.
- Long-term implants (such as those used for the treatment of prostate cancer) are considered permanent.

FLASH ANIMATION: 2007.SWF/FLA
Brachytherapy: Uses

Brachytherapy is common in the treatment of prostate cancer. Sealed implants also may be used in the treatment of other forms of cancer, such as gynecological cancers.
In nuclear medicine, the patient swallows or is injected with a radioactive substance (called a radiopharmaceutical or tracer).

Specific tracers are designed to accumulate in specific organs. Once in the organ, the tracers emit high-energy gamma particles. Remember, gamma particles are powerful enough to pass all the way through a patient’s body. As gamma particles exit the patient’s body, they are detected by a gamma camera.

The detected energy is analyzed by a computer to give images of body anatomy and function.

FLASH ANIMATION: 2009.SWF/FLA
Nuclear medicine uses relatively low doses of radiation.

As we have seen, however, this radiation is powerful (gamma-emitting).

Moreover, as with unsealed source therapeutic procedures, the radiation is not contained, and may be carried out of the patient’s body with:

- Feces
- Urine
- Perspiration
- Breath (moisture)
- Blood
- Spilled IV fluids
<table>
<thead>
<tr>
<th>2011</th>
<th>Nuclear Medicine: Half-Life</th>
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</thead>
<tbody>
<tr>
<td>Tracers used in nuclear medicine have short half-lives.</td>
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</tr>
<tr>
<td>This means that a nuclear imaging patient will soon be non-radioactive, and will pose no risk to healthcare staff or other close contacts.</td>
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<tr>
<td>Until you know otherwise, however, treat all of the patient’s bodily fluids as potentially radioactive.</td>
<td>IMAGE: 2011.JPG</td>
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</tbody>
</table>

Treat all patients' body fluids as potentially radioactive until you know otherwise.
An example of nuclear medicine is positron emission tomography (PET).
Like internal radiation, external beam radiation may be used for
diagnosis or treatment.

External radiation, however, differs in many ways from the
internal procedures previously discussed in this lesson.
Specifically, in external beam procedures:

- The patient is exposed to a beam of radiation from an
  **external** source.
- No radioactivity is administered to the patient (orally,
intravenously, or in the form of implants).
- The patient does not become radioactive.
- The patient does not eliminate radioactivity in his or her
  bodily fluids.
In external beam procedures, the highest dose of radiation comes from the primary beam aimed at the patient. Secondary beams may scatter off the patient's body while the primary beam is active.

Thus, as a caregiver, you risk exposure to a relatively high dose of radiation, if you expose any part of your body to the primary beam while it is active.

In addition, you risk exposure to a lower dose of radiation (from scattered secondary beams), if you remain in the room while an external beam procedure is being performed, without wearing a lead apron or other appropriate shielding.
Common procedures involving external beam radiation include:

- **X-rays (radiography or plain films)**
- **Mammography**
- **Bone densitometry**
- **Computed tomography**
- **Fluoroscopy**
- **External beam radiation therapy**

Click on each item in the list to learn more.

**CLICK TO REVEAL**

In a simple **X-ray**, a beam of radioactive particles is allowed to pass through the body, to a sheet of highly sensitive film. Structures such as bone absorb the energy of most of the radioactive particles, and appear white on the film. Other structures allow most of the radioactive particles to pass through, and appear black or gray.

**Mammography** uses low dose x-ray to examine the breasts, for early detection of breast cancer.

**Bone densitometry** uses an enhanced form of x-ray technology (dual-energy x-ray absorptiometry, or DEXA) to measure bone mineral density and diagnose osteoporosis.

**Computed tomography** (CT or CAT scan) uses special equipment to obtain x-ray image data from different angles around the body. A computer then processes these data to show a cross-section of body tissues and organs.

**Fluoroscopy** uses x-rays to capture real-time, moving images of organs as they function. This technique requires the use of a contrast material (a substance that will appear white on x-ray films). For example, in a barium enema, barium is used as the contrast material to capture real-time x-ray images of the large intestine. In an intravenous pyelogram (IVP), a contrast material is injected into the patient and x-rayed as it passes through the kidneys, ureters, and urinary bladder.

**External beam radiation therapy** is used to kill cancer cells.
Regarding radiation, all of the following statements are true EXCEPT:

a. **Radiation poses no biological risks.**
b. Radiation is used to help treat disease.
c. Radiation is a powerful form of energy.
d. Radiation is used to help diagnose disease.

**MULTIPLE CHOICE INTERACTION**

Correct answer: A

Feedback for A: Correct. Exposure to radiation can increase the risk of cancer.

Feedback for B: Incorrect. B, C, and D all are true. The correct answer is A. Exposure to radiation can increase the risk of cancer.

Feedback for C: Incorrect. B, C, and D all are true. The correct answer is A. Exposure to radiation can increase the risk of cancer.

Feedback for A: Incorrect. B, C, and D all are true. The correct answer is A. Exposure to radiation can increase the risk of cancer.
In brachytherapy:

a. The radiation source is sealed in a seed.
b. Radioactive implants are always permanent.
c. The patient's bodily fluids may become contaminated with radiation.
d. All of these are true of brachytherapy.

**MULTIPLE CHOICE INTERACTION**

Correct answer: A

Feedback for A: Correct.

Feedback for B: Incorrect. The correct answer is A. In brachytherapy, the radiation source is sealed in a seed. For this reason, radiation cannot leak out of the patient, and the patient’s bodily fluids cannot become contaminated. Seeds may be implanted on a short-term or long-term basis.

Feedback for C: Incorrect. The correct answer is A. In brachytherapy, the radiation source is sealed in a seed. For this reason, radiation cannot leak out of the patient, and the patient’s bodily fluids cannot become contaminated. Seeds may be implanted on a short-term or long-term basis.

Feedback for D: Incorrect. The correct answer is A. In brachytherapy, the radiation source is sealed in a seed. For this reason, radiation cannot leak out of the patient, and the patient’s bodily fluids cannot become contaminated. Seeds may be implanted on a short-term or long-term basis.
Summary

You have completed the lesson on radiation in the healthcare setting.

Remember:

- Sources of radiation in the healthcare setting include unsealed source therapeutic radiation, brachytherapy, nuclear medicine, and external beam radiation.
- In an unsealed source therapeutic procedure, the patient swallows or is injected with a dosed amount of radioactive material, to treat a specific disease.
- Brachytherapy is a form of cancer treatment in which small sources of radiation are implanted into the cancerous area of a patient’s body.
- In nuclear medicine, the patient swallows or is injected with a radioactive tracer, to give images of body anatomy and function.
- In external beam radiation, the patient is exposed to a beam of radiation from an external source.
- Each type of procedure poses distinct risks to healthcare personnel.
Lesson 3: Radiation Safeguards

<table>
<thead>
<tr>
<th>3001</th>
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<tbody>
<tr>
<td><strong>Introduction</strong></td>
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</table>

Welcome to the lesson on radiation safeguards.

This lesson covers the three key concepts of radiation safety: time, distance, and shielding. We also examine safety precautions specific to particular types of patients and/or radioactive procedures.

FLASH ANIMATION: 3001.SWF/FLA
After completing this lesson, you should be able to:

- Explain what is meant by the phrase “time, distance, shielding,” and why this method is used.
- List general precautions for working with radiation, radioactivity, and/or radioactive patients.
- Recognize specific precautions for working with patients who have received (or are receiving):
  - Unsealed source therapeutic radiation
  - Brachytherapy
  - Nuclear medicine
  - External beam radiation
Lesson 2 equipped you with background information regarding sources of radiation in the healthcare setting.

You are now ready to learn how to limit your exposure to these sources, **while still providing quality patient care.**
The three key factors for limiting your exposure to radiation are time, distance, and shielding:

- Minimize the amount of **time** that you are exposed to the source.
- Maximize the **distance** between yourself and the source.
- Use appropriate **shielding** to absorb the energy of radioactive particles, and prevent them from hitting YOU.

If you use time, distance, and shielding effectively, you will achieve the goal of **ALARA**: you will keep your radiation exposure **As Low As Reasonably Achievable**.
General Precautions

Keep in mind the overarching concepts of time, distance, and shielding as you review the following list of general precautions for working with radioactivity and/or radioactive patients:

- Always work toward reducing the amount of time you or any portion of your body is exposed to a source of radiation.
- Wear gloves and a lab coat at all times when handling radioactive materials or potentially contaminated materials (e.g., patient excretions). Wash hands after removing gloves.
- Always work at the greatest distance possible from a source of radiation, without compromising patient care.
- Use shielding whenever possible. This may include lead or other shields set up in a radioactive patient’s room, or a lead apron when working around x-ray equipment.
Additional General Precautions

Additional general precautions for working with radioactivity include:

- As appropriate, use a chemical fume hood certified for radioactive materials when preparing tracers or other radiopharmaceuticals.
- Where radioactive materials are present, do not:
  - Eat.
  - Drink.
  - Smoke.
  - Apply cosmetics.
- Never store food or drinks in a refrigerator designated for radioactive materials.
- Never mouth-pipette radioactive materials.
- Dispose of contaminated sharps appropriately.

FLASH ANIMATION: 3006.SWF/FLA
Continue to keep time, distance, and shielding in mind as you review specific precautions for working with patients who have received (or are receiving):

- Unsealed source therapeutic radiation
- Brachytherapy
- Nuclear medicine
- External radiation beams
### Unsealed Source Therapeutic Radiation: Typical Precautions

In general, when working with a patient who has received unsealed source therapeutic radiation:

- Put on shoe covers immediately upon entering the patient's room. Remove shoe covers prior to leaving the room.
- Treat all objects in the patient's room (including leftover food) as potentially contaminated and touch only with gloves.
- Place all waste into radioactive waste bins.

Check with your supervisor or radiation safety department regarding other precautions you may need to take.

Important note: If you are not trained and qualified to care for radioactive patients, do NOT enter patient rooms marked with the yellow-and-maroon radiation sign.

| Use shoe covers. | Use gloves. | Dispose of waste properly. | IMAGE: 3008.GIF |
Brachytherapy

Prostate seeds are very low-level radiation implants, and do not typically require extensive precautions.

Short-term brachytherapy implants (fletcher or syed seeds), on the other hand, are high-energy implants. When working with high-energy implant patients, observe all facility precautions.

Typical precautions for short-term, high-energy implants are listed on the next two screens. These may or may not be fully applicable in your facility. Check with your supervisor or radiation safety department.
Typical precautions for working with patients who have received high-energy brachytherapy include:

- Organize your patient-care tasks such that you minimize trips into the patient’s room (for example, bring morning meds with the patient’s breakfast tray).
- Use the phone to check on additional patient needs, rather than going into the patient’s room.
- Whenever possible, avoid going completely into the patient’s room.
- Per facility policy, adhere to stay-time restrictions [glossary]. Look for stay times posted on the patient’s door and/or listed in the patient’s chart. If stay-time restrictions interfere with your ability to provide quality patient care, consult your supervisor or the radiation safety officer.
- Provide patient care from behind a lead shield.
- Keep the patient’s door closed.
Additional precautions when working with patients who have received high-energy brachytherapy include:

- If a source seed should become dislodged from the patient's body, pick the source up with forceps and place it in a lead container. Never pick up a radioactive source with your bare hands.
- To prevent the accidental loss of a radiation source if one should become dislodged from the patient's body, do not remove any items from the patient's room, including linens, trash, and dietary trays. Consult your supervisor or radiation safety department for appropriate disposal of these items.
Typical precautions associated with nuclear medicine include:

- Wear gloves at all times when handling radioactive tracers.
- Wear gloves as much as possible during patient contact.
- Until you know otherwise, treat all IV and patient fluids as radioactive. Consult your supervisor or radiation safety officer regarding where and how to dispose of potentially radioactive fluids.
- Store unused tracers in a room separate from work or waiting areas.
External Radiation Beams: Typical Precautions

External beam radiation does not make a patient radioactive. Therefore, there are no precautions necessary for interacting with the patient after the procedure.

During an external beam procedure, however:

- Use the shortest exposure time compatible with high-quality patient diagnosis or treatment. (Important note: Never alter therapeutic radiation treatment plans without first consulting the attending physician or medical physicist).
- During procedures such as fluoroscopy, minimize the amount of time your hand spends in the active radiation beam.
- Whenever possible, leave the room while an x-ray machine or fluoroscopy unit is operating.
- Wear a lead apron when working around active x-ray, CT, or fluoroscopy equipment.
<table>
<thead>
<tr>
<th>Special Precautions: Pregnancy</th>
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<tbody>
<tr>
<td>Young children and developing fetuses are especially sensitive to the effects of radiation.</td>
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<tr>
<td>Before performing any radiation-based procedure on a female patient, be sure to ask whether she is or might be pregnant.</td>
</tr>
<tr>
<td>If you are pregnant and routinely work with radioactive materials or radiation, consult your supervisor or radiation safety department regarding:</td>
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</tbody>
</table>
  - Any concerns you might have |
  - Any special precautions you might need to take |
### Radiation Spills

If a radioactive material spills, or if you suspect a radioactive spill or leakage, do **NOT** attempt to clean it up.

Immediately contact your supervisor or the radiation safety department.

Keep all staff and patients away from the area until the clean-up crew arrives.
Your radiation dosimetry badge is collected for analysis. When analyzed, the badge reveals that you have been exposed to unacceptably high levels of occupational radiation. You might have:

| a. Gotten too close to a source of radiation |
| b. Spent too much time around radioactive materials |
| c. Not used appropriate shielding when working with or around radiation |
| d. Any of these |

**MULTIPLE CHOICE INTERACTION**

Correct answer: D

Feedback for A: Not quite. The correct answer is D. The three key factors for limiting your exposure to radiation are time, distance, and shielding. If your radiation exposure is unacceptably high, you may be failing to use time, distance, and/or shielding to protect yourself.

Feedback for B: Not quite. The correct answer is D. The three key factors for limiting your exposure to radiation are time, distance, and shielding. If your radiation exposure is unacceptably high, you may be failing to use time, distance, and/or shielding to protect yourself.

Feedback for C: Not quite. The correct answer is D. The three key factors for limiting your exposure to radiation are time, distance, and shielding. If your radiation exposure is unacceptably high, you may be failing to use time, distance, and/or shielding to protect yourself.

Feedback for D: Correct. The three key factors for limiting your exposure to radiation are time, distance, and shielding. If your radiation exposure is unacceptably high, you may be failing to use time, distance, and/or shielding to protect yourself.
Young children and fetuses are especially sensitive to the effects of radiation.

- a. True
- b. False

**TRUE / FALSE INTERACTION**

Correct answer: A

Feedback for A: Correct. This statement is true.

Feedback for B: Incorrect. This statement is true.
You have completed the lesson on radiation safeguards.

Remember:

- The three key factors for limiting your exposure to radiation are time, distance, and shielding.
- Take appropriate precautions when working with patients who have received:
  - Unsealed source therapeutic radiation
  - Brachytherapy
  - Nuclear medicine
- Take appropriate precautions when working around active x-ray, CT, or fluoroscopy equipment.
- If you are pregnant and routinely work with radiation, consult your supervisor or radiation safety department regarding any special precautions you might need to take.
- Report radioactive spills/leakage immediately.
- Wear a radiation dosimetry badge between your waist and shoulders at all times when at work.
Lesson 4: Magnetic Resonance Imaging

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<tr>
<th>Introduction</th>
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<tbody>
<tr>
<td>Welcome to the lesson on magnetic resonance imaging (MRI). This lesson covers the hazards associated with the MRI system and its components.</td>
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</table>

FLASH ANIMATION: 4001.SWF/FLA
Objectives

After completing this lesson, you should be able to:

- List the three main components of an MRI system.
- Describe how these components interact to produce images of internal body structures.
- Discuss the characteristics of and hazards associated with each of these components.
MRI is a powerful tool for generating three-dimensional images of internal body structures.

Although the magnetic fields used in MRI do not have inherent adverse effects on the human body, MRI does have certain hazards related to its effects on ferromagnetic objects and electronic devices.

To understand these effects and their associated hazards, let's first take a look at the main components of an MRI system.
An MRI system has three main components:

- A strong static magnetic field
- Pulsed radiofrequency (RF) fields
- Pulsed gradient magnetic fields

The following screens provide a closer look at the characteristics and hazards of each type of field.
MRI Components: Static Magnetic Field

**Characteristics**
A powerful electromagnet is at the core of every MRI system. This powerful source of energy creates the static magnetic field.

Depending on the system, the core of this magnetic field may be 100,000 times stronger than the magnetic field of the earth.

The MRI field, however, is not equally strong throughout. The field is strongest at its core, and weaker as the distance from the core increases.

In other words, the closer a ferromagnetic object gets to the core of the magnet, the stronger the pull of the magnet. As the pull of the magnet increases, the object moves toward the core more and more rapidly.

**Hazards**
With this situation, any ferromagnetic object can become a dangerous projectile.

Moreover, any ferromagnetic object implanted in a patient can tear through soft tissues as the object attempts to align with and move toward the core of the static magnetic field.
Static Magnetic Field Hazards: Examples

Actual examples of injury resulting from the movement of ferromagnetic objects in an MRI field include:

- Tearing of soft tissues in the brain due to movement of an aneurysm clip
- Blindness due to movement of metallic fragments in or near the eye
- Injury to a patient when an IV pole accelerated toward the MRI magnet and struck the patient
- Injury to a patient when scissors were pulled out of a nurse’s hand, accelerated toward the magnet, and struck the patient
- Injury to a technician when steel tines (of a forklift) accelerated toward the magnet and struck the technician
- Death of a pediatric patient when a metal oxygen tank accelerated toward the magnet and fractured the patient’s skull
Another hazard of the static magnetic field is the possibility of electromagnetic interference with active electronic devices.

Patients with pacemakers have died during or shortly after MRI exams, due to disruption of pacemaker function by the MRI system.

Hospital staff with pacemakers or other implanted electronic devices also could be affected if they come within the strong magnetic field of the MRI.
## MRI Components: Pulsed RF Fields

### Characteristics
Radiofrequency (RF) fields are pulsed during imaging to cause tissues of the body to give off magnetic resonance signals.

### Hazards
Pulsed RF fields can induce electrical currents in metal implants (such as hip prostheses) or cables (such as ECG leads). These currents can produce heat, resulting in severe patient burns.

---

**CAUTION**

Electrical currents in metal implants can cause severe burns.
Actual examples of patient injury resulting from pulsed RF fields during an MRI examination include:

- Burns from an ECG cable, requiring a skin graft
- Extensive burns from an ECG gating cable
- Blistered burns from a pulse oximeter, requiring a skin graft
### MRI Components: Pulsed Gradient Magnetic Fields

<table>
<thead>
<tr>
<th><strong>Characteristics</strong></th>
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<tbody>
<tr>
<td>Gradient magnetic fields are pulsed during imaging to create rapid changes in magnetic field intensity. This helps the MRI system characterize and localize the magnetic resonance signals emitted by body tissues.</td>
<td><strong>Hazards</strong></td>
</tr>
<tr>
<td>The primary hazard associated with pulsed magnetic fields is electronic device failure or malfunction, due to electromagnetic interference.</td>
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</tbody>
</table>

**NO IMAGE**
Ferromagnetic objects can become dangerous projectiles when they:

- a. Interact with gamma rays
- b. Are bombarded with beta particles.
- c. Encounter electromagnetic interference
- d. **Accelerate toward the center of an MRI system.**

**MULTIPLE CHOICE INTERACTION**

Correct answer: D

Response for A: Incorrect. A ferromagnetic object is any substance subject to the pull of a magnet. This sort of object can become a dangerous projectile when it encounters the strong pull of an MRI electromagnet, and accelerates toward the center of the MRI system.

Response for B: Incorrect. A ferromagnetic object is any substance subject to the pull of a magnet. This sort of object can become a dangerous projectile when it encounters the strong pull of an MRI electromagnet, and accelerates toward the center of the MRI system.

Response for C: Incorrect. A ferromagnetic object is any substance subject to the pull of a magnet. This sort of object can become a dangerous projectile when it encounters the strong pull of an MRI electromagnet, and accelerates toward the center of the MRI system.

Response for D: Correct. A ferromagnetic object is any substance subject to the pull of a magnet. This sort of object can become a dangerous projectile when it encounters the strong pull of an MRI electromagnet, and accelerates toward the center of the MRI system.
MRI Field | Role in Creating Image of Internal Body Structures | Associated Hazards
---|---|---
Strong static magnetic field | Align protons in tissues of patient's body | Projectile effect
Tearing of soft tissues
Electronic device malfunctions
Pulsed radiofrequency fields | Cause body tissues to emit magnetic resonance signals | Burns
Pulsed gradient magnetic fields | Characterize and localize signals from body tissues | Electronic device malfunctions
Summary

You have completed the lesson on magnetic resonance imaging.

Remember:

- An MRI system has three main components: a strong static magnetic field, pulsed RF fields, and pulsed gradient magnetic fields.
- The static magnetic field is created by a powerful electromagnet, and is responsible for aligning protons within the tissues of the patient's body.
- Hazards associated with the strong static magnetic field include:
  - The projectile effect, as ferromagnetic objects accelerate toward the center of the magnetic field
  - Tearing of soft tissues, as implanted ferromagnetic devices attempt to align with and move toward the center of the magnetic field
  - Failure or malfunction of electronic devices (such as pacemakers), due to electromagnetic interference
- Radiofrequency (RF fields) are pulsed during imaging to cause tissues of the body to give off magnetic resonance signals.
- Hazards associated with pulsed RF fields include:
  - Burns due to induced electrical currents in monitoring cables or metal implants
- Gradient magnetic fields are pulsed during imaging to create rapid changes in magnetic field intensity. This helps the MRI system characterize and localize magnetic resonance signals elicited from body tissues.
- Hazards associated with pulsed magnetic fields include:
  - Electronic device failure or malfunction, due to electromagnetic interference
**Lesson 5: MRI Safety**

**5001 Introduction**

Welcome to the lesson on MRI safety.

This lesson gives an overview of MRI safeguards, including posted warnings, proper screening of patients, proper patient positioning, and controlling access to the MRI field.

FLASH ANIMATION: 5001.SWF/FLA

Point 1 of 15
## Objectives

After completing this lesson, you should be able to:

- List MRI safeguards.
- Describe a “patient screening” for MRI.
As we have seen, MRI does not have any inherent biological hazards. Hazards only arise in the presence of ferromagnetic objects or certain electronic devices.

Therefore, MRI safety is largely a matter of taking steps to ensure that such objects and devices remain outside the strong-magnetic-field area of the MRI system.

**Key Thought**

MRI is very safe as long as precautions are taken!
Specific MRI Safeguards

Specific safeguards to ensure that ferromagnetic objects and electronic devices remain outside the MRI field include:

- Controlling access to the strong-magnetic-field area of the MRI system
- Posting warning signs outside the strong-magnetic field area
- Removal of metallic objects from clothing and pockets prior to entering the strong-magnetic-field area
- Thorough screening of patients prior to MRI
- Proper positioning of patients for MRI

On the following screens, let’s take a closer look at each of these safeguards.
### Controlling Access

Access to the high-magnetic-field area of the MRI system should be limited to:

- Trained personnel
- Screened patients/visitors accompanied by trained personnel

The entrances to the high-magnetic-field area should be:

- Lockable
- Visible to the MRI system operator
**5006**

**Posting Warning Signs**

<table>
<thead>
<tr>
<th>Signs should be posted outside the strong-magnetic-field area.</th>
</tr>
</thead>
<tbody>
<tr>
<td>These signs should warn of the:</td>
</tr>
<tr>
<td>• Projectile effect</td>
</tr>
<tr>
<td>• Danger to cardiac pacemakers and other electronic implants</td>
</tr>
</tbody>
</table>

**FLASH ANIMATION: 5006.SWF/FLA**
<table>
<thead>
<tr>
<th>5007</th>
<th>Removal of Metallic Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anyone entering the high-magnetic-field area should first remove items such as:</td>
</tr>
<tr>
<td></td>
<td>- Purse, wallet, or money clip</td>
</tr>
<tr>
<td></td>
<td>- Credit cards</td>
</tr>
<tr>
<td></td>
<td>- Other cards with magnetic stripes</td>
</tr>
<tr>
<td></td>
<td>- Hearing aids</td>
</tr>
<tr>
<td></td>
<td>- Metal jewelry or watches</td>
</tr>
<tr>
<td></td>
<td>- Pens</td>
</tr>
<tr>
<td></td>
<td>- Paper clips and safety pins</td>
</tr>
<tr>
<td></td>
<td>- Keys and coins</td>
</tr>
<tr>
<td></td>
<td>- Hair barrettes/hairpins</td>
</tr>
</tbody>
</table>

FLASH ANIMATION: 5007.SWF/FLA
Removal of Metallic Objects (Cont.)

Also be sure to remove:

- Any article of clothing with metal:
  - Zippers
  - Buttons
  - Snaps
  - Hooks
  - Underwires
  - Threads
- Shoes
- Belt buckles

Visitors and untrained staff members should be screened before entering the high-magnetic-field area. Any metallic objects identified should be tested with a small magnet. Ferromagnetic objects should not be permitted in the high-magnetic-field area.
Patients should be screened thoroughly prior to an MRI exam. A thorough patient screening/questionnaire should establish:

- The nature of any previous surgeries
- The presence of any implants
- The presence of any foreign metallic bodies or prostheses
- Any special medical conditions that may be relevant to the appropriateness of MRI
- Any potential occupational exposure to metal fragments (if occupational exposure to metal fragments is established, x-rays or CT scans should be obtained to rule out the presence of metal fragments in the eyes)
## Patient Screening: Contraindications to MRI

If patient screening reveals any of the following, MRI should not be performed:

<table>
<thead>
<tr>
<th>Contraindication</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Presence of an active electronic device in the body:</td>
</tr>
<tr>
<td>o Cardiac pacemaker</td>
</tr>
<tr>
<td>o Cochlear implant</td>
</tr>
<tr>
<td>o Nerve or bone stimulator</td>
</tr>
<tr>
<td>• Cerebral aneurysm clip</td>
</tr>
<tr>
<td>• Intraocular metal fragments</td>
</tr>
<tr>
<td>• Ferromagnetic foreign bodies</td>
</tr>
<tr>
<td>• Any unfamiliar device</td>
</tr>
</tbody>
</table>

The items in this list should be considered absolute contraindications to MRI, unless and until absolute evidence to the contrary is obtained.
Patient Screening: Safe Metallic Implants

Patient screening may reveal metallic implants that are not absolute contraindications to MRI.

These include:

- Orthopedic hardware
- Extracranial surgical clips
- Staples and wires
- Intravascular stents, coils, and filters (if firmly embedded in the vessel wall)
- All dental devices

Before MRI is performed, obtain medical documentation from the appropriate device vendor to verify the safety of ANY metallic implant.
Proper Patient Positioning

<table>
<thead>
<tr>
<th>To guard against potential RF burns, the patient should be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Positioned so that neither the hands nor the calves</td>
</tr>
<tr>
<td>touch one another (to avoid the creation of an electrically conductive loop)</td>
</tr>
<tr>
<td>• Insulated from skin-to-skin contact using sheets or</td>
</tr>
<tr>
<td>other appropriate materials</td>
</tr>
</tbody>
</table>

In addition, any monitoring leads or cables should be:

|   • Positioned so that they do not form electrically        |
|     conductive loops                                        |
|   • Insulated from contact with bare skin through the use   |
|     of sheets or other thermal and electrical insulating    |
|     materials                                              |

FLASH ANIMATION: 5011.SWF/FLA
Which of the following items should you remove from your pockets prior to entering the strong-magnetic-field area of an MRI system?

a. A penny  
b. A safety pin  
c. Your house key  
d. All of these

MULTIPLE CHOICE INTERACTION

Correct answer: D

Feedback for A: Not quite. The correct answer is D. Any one of these items may be ferromagnetic, and should be removed prior to entering the strong-magnetic-field area of an MRI system.

Feedback for B: Not quite. The correct answer is D. Any one of these items may be ferromagnetic, and should be removed prior to entering the strong-magnetic-field area of an MRI system.

Feedback for C: Not quite. The correct answer is D. Any one of these items may be ferromagnetic, and should be removed prior to entering the strong-magnetic-field area of an MRI system.

Feedback for D: Correct. Any one of these items may be ferromagnetic, and should be removed prior to entering the strong-magnetic-field area of an MRI system.
<table>
<thead>
<tr>
<th>You are screening a patient prior to an MRI exam. Which of the following metallic implants would be an absolute contraindication for the exam?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Intravascular stent</td>
</tr>
<tr>
<td>b. Orthodontic braces</td>
</tr>
<tr>
<td>c. Orthopedic hardware</td>
</tr>
<tr>
<td><strong>d. Cerebral aneurysm clip</strong></td>
</tr>
</tbody>
</table>

**MULTIPLE CHOICE INTERACTION**

Correct answer: D

Feedback for A: Incorrect. A, B, and C all may be acceptable, if their MRI-safety is verified by the device vendor. The correct answer is D. A cerebral aneurysm clip would be an absolute contraindication to MRI. The clip would be likely to move under the influence of an MRI magnetic field, thereby tearing soft tissue and causing serious injury or death.

Feedback for B: Incorrect. A, B, and C all may be acceptable, if their MRI-safety is verified by the device vendor. The correct answer is D. A cerebral aneurysm clip would be an absolute contraindication to MRI. The clip would be likely to move under the influence of an MRI magnetic field, thereby tearing soft tissue and causing serious injury or death.

Feedback for C: Incorrect. A, B, and C all may be acceptable, if their MRI-safety is verified by the device vendor. The correct answer is D. A cerebral aneurysm clip would be an absolute contraindication to MRI. The clip would be likely to move under the influence of an MRI magnetic field, thereby tearing soft tissue and causing serious injury or death.

Feedback for D: Correct. A cerebral aneurysm clip would be an absolute contraindication to MRI. The clip would be likely to move under the influence of an MRI magnetic field, thereby tearing soft tissue and causing serious injury or death.
Summary

You have completed the lesson on MRI safety.

Remember:

- Access to the strong magnetic-field-area of the MRI system should be limited to trained personnel and screened patients/visitors accompanied by trained personnel.
- Signs posted outside the strong-magnetic-field area should warn of the projectile effect and potential danger to electronic devices.
- Anyone entering the strong-magnetic-field area should first remove any metallic object that may be ferromagnetic.
- Patients should be screened thoroughly prior to an MRI exam.
- Certain electronic and/or metallic implants in patients should be considered absolute contraindications to MRI.
- Other metallic implants may be safe, but their safety should be verified with the device vendor prior to performing MRI.
- To guard against RF burns, patients and any monitoring leads or cables should be positioned to prevent the formation of electrically conductive loops.
## Course Glossary

<table>
<thead>
<tr>
<th>#</th>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>radiofrequency</td>
<td>energy of a certain wavelength in the electromagnetic spectrum</td>
</tr>
<tr>
<td></td>
<td>ferromagnetic</td>
<td>able to be attracted by a magnet</td>
</tr>
<tr>
<td></td>
<td>electromagnetic</td>
<td>referring to the combined electric and magnetic fields caused by electron motion through conductors</td>
</tr>
<tr>
<td></td>
<td>static</td>
<td>remaining the same</td>
</tr>
<tr>
<td></td>
<td>gradient</td>
<td>growing larger or smaller over space or time</td>
</tr>
<tr>
<td></td>
<td>projectile</td>
<td>an object (as a weapon) that is thrown, sent, or cast forward</td>
</tr>
<tr>
<td></td>
<td>electromagnetic</td>
<td>any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment</td>
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<tr>
<td></td>
<td>interference</td>
<td></td>
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<tr>
<td></td>
<td>intraocular</td>
<td>within the eye</td>
</tr>
<tr>
<td></td>
<td>stay-time restriction</td>
<td>limit on the amount of time healthcare staff and visitors can safely remain with a radioactive patient; usually established by the radiation safety department, based on the type and dosage of radiation the patient received</td>
</tr>
</tbody>
</table>
[Radiation and MRI Safety]

Pre-Assessment

1. Regarding ionizing radiation, all of the following statements are true EXCEPT:
   a. Radiation is used to diagnose and treat disease.
   b. Exposure to radiation can increase the risk of cancer.
   c. All forms of radiation are equally powerful.
   d. We are all exposed to background radiation every day.

Correct answer: C
Rationale: Ionizing radiation varies in energy. Gamma radiation, for example, has very high energy. Beta particles are less energetic, and cannot travel as far through solid materials.

2. A metal oxygen tank can be a hazard in an MRI system.
   a. True
   b. False

Correct answer: A
Rationale: In at least one case, a metal oxygen tank has caused a fatality in an MRI system. The tank accelerated toward the center of the MRI magnetic field and struck a pediatric patient, fracturing his skull.

3. You are preparing to administer therapeutic iodine-131 to a patient. While administering the medication, you wear gloves and a lab coat, and work behind a lead shield. After the patient has taken the I-131 and returned to her room:
   a. You will no longer need to work behind a shield when caring for her.
   b. Radioactivity will accumulate in her liver.
   c. You should treat all objects in her room as potentially contaminated, and handle them only with gloves.
   d. Her eighteen-month-old son will be able to visit her, without restriction.

Correct answer: C
Rationale: I-131 is an unsealed source, and may be present in any of the patient’s secretions or excretions. Therefore, you should treat all objects in the room as potentially contaminated, and handle them only with gloves.

4. Because the radiation in a brachytherapy implant is sealed in a seed, it is safe to handle these implants without putting on gloves.
   a. True
   b. False

Correct answer: B
Rationale: Never handle any source of radiation without wearing gloves.

5. Regarding positron emission tomography (PET), all of the following are true EXCEPT:
   a. PET is a form of nuclear medicine.
   b. The radioactive materials used in PET have short half-lives.
   c. PET requires the use of external beam radiation.
   d. Certain PET procedures make use of radiolabeled glucose.

Correct answer: C
Rationale: PET does not use external beam radiation. PET is a form of nuclear medicine, in which a radioactive tracer (such as radiolabeled glucose) is administered to the patient, allowed to accumulate in the appropriate tissues, then visualized using a special camera to detect the emitted gamma radiation.

6. During an external beam procedure, unshielded healthcare personnel in the exam room only risk radiation exposure if they place a part of their body directly in the path of the primary beam.
   a. True
   b. False

Correct answer: B
Rationale: In external beam procedures, the highest dose of radiation comes from the primary beam aimed at the patient. Secondary beams, however, may scatter off the patient’s body and strike nearby caregivers while the primary beam is active.

7. The three key factors for limiting your exposure to radiation are time, distance, and _______.
   a. Dose
   b. Shielding
   c. Beta emitters
   d. Imaging

Correct answer: B
Rationale: The three key factors are time, distance, and shielding.

8. Radiation dosimetry badges are used to:
   a. Protect healthcare workers from exposure to radiation.
   b. Identify patients as radioactive.
   c. Identify workers who are qualified to care for radioactive patients.
   d. Measure occupational exposure to radiation.

Correct answer: D
Rationale: Healthcare personnel who work with radiation should wear a radiation dosimetry badge between the waist and shoulder at all times, to measure occupational radiation exposure.
9. You are caring for a patient with a short-term sealed source implant. The posted stay-time restriction for the patient is 30 minutes per day. You find that you have difficulty caring for your patient adequately in this amount of time. You should:
   a. Organize your patient-care tasks, such that you minimize trips into the patient’s room.
   b. Use the phone to check on additional patient needs, rather than going into the patient’s room.
   c. Consult your supervisor or the radiation safety department regarding an adjustment to the stay-time limit.
   d. Any of these could be an appropriate solution.
   e. None of these is an appropriate solution.

Correct answer: D
Rationale: Organizing your tasks and using the phone to check on patient needs could help you decrease your stay time, while still providing quality patient care. If you are unable to care for your patient adequately regardless of how you organize your work, consult your supervisor or the radiation safety department.

10. You are caring for a patient who has received unsealed source therapeutic radiation. As you are preparing to leave the room, you notice the remains of the patient’s lunch tray. In disposing of the leftover food, you should treat it as if potentially radioactive.
   a. True
   b. False

Correct answer: A
Rationale: When caring for a patient who has received unsealed source radiation, treat all objecting in the patient’s room (including leftover food) as potentially contaminated, and touch only with gloves.

11. Radiation can be especially damaging to:
   a. The elderly
   b. Young children and fetuses
   c. Females
   d. Diabetics and patients with heart disease

Correct answer: B
Rationale: Young children and fetuses are especially sensitive to the effects of radiation.

12. Which of the following have been documented as adverse consequences of entering an MRI magnetic field?
   a. Blindness
   b. Cerebral hemorrhage
   c. Pacemaker malfunction
   d. All of these
   e. None of these

Correct answer: D
Rationale: All of these have been documented. Metallic fragments in or near the eye have shifted in the MRI field, resulting in blindness. Cerebral aneurysm clip have moved under the influence of the magnetic field, resulting in soft tissue damage and cerebral hemorrhage. Pacemakers have malfunctioned, due to electromagnetic interference.

13. Severe burns during MRI exams can occur as a result of:
   a. Currents in electrically conductive loops, induced by pulsed radiofrequency fields
   b. Electromagnetic interference, caused by pulsed gradient magnetic fields
   c. The projectile effect
   d. All of these
   e. None of these

Correct answer: A
Rationale: Patients may be burned if they are positioned such that electrically conductive loops are formed. Pulsed RF fields can induce current in these loops. Current moving through resistance creates heat, resulting in burns.

14. You are screening a visitor to the MRI area. Prior to entering the MRI system, you should ask this visitor to remove her:
   a. Plastic barrettes
   b. Cloth shoelaces
   c. Blazer with brass buttons
   d. Beaded necklace

Correct answer: Blazer with brass buttons
Rationale: Prior to entering the MRI area, all clothing with metallic buttons should be removed.

15. Patients with metallic orthodontic braces should never undergo MRI.
   a. True
   b. False

Correct answer: B
Rationale: Orthodontic braces are generally MRI-safe. Safety should be verified with the device manufacturer, however, before MRI is performed.
Final Exam

Question Title: Question 1

Question: Caregivers and patients are exposed to ionizing radiation only in the healthcare setting.

Answer 1: True
Answer 2: False
Answer 3:
Answer 4:
Answer 5:

Correct Answer: False

Answer Rationale: We are all exposed to naturally occurring radiation (or background radiation) every day.

Question Title: 2

Question: MRI uses powerful magnetic and radiofrequency fields to visualize internal structures of the body.

Answer 1: True
Answer 2: False
Answer 3:
Answer 4:
Answer 5:

Correct Answer: True

Answer Rationale: This statement is true.

Question Title: 3

Question: When a patient is treated with iodine-131:

Answer 1: It is safe to care for the patient without using shielding, as long as you use gloves to handle any patient excretions.
Answer 2: The patient may excrete radiation in his or her urine or perspiration.
Answer 3: Radiation accumulates in the liver.
Answer 4: It is safe for children and pregnant women to have direct contact with the patient.

Correct Answer: The patient may excrete radiation in his or her urine or perspiration.

Answer Rationale: I-131 is given as an unsealed source to treat thyroid disease. The uncontained radiation may be excreted in the patient’s urine, perspiration, or feces. Because I-131 is a gamma-emitter, it is important to use shielding when caring for patients treated with radioactive iodine, and it is not safe for children or pregnant women to have direct contact with the patient.

Question Title: 4

Question: Tracers used in nuclear medicine have short half-lives. This means that:

Answer 1: The radiation in tracers decays rapidly.
Answer 2: Patients who undergo nuclear medicine procedures never become radioactive.
Answer 3: It is safe to handle the bodily fluids and excretions of nuclear-medicine patients as if these fluids and excretions are not radioactive.
Answer 4: All of these are true.
Answer 5: None of these is true.

Correct Answer: The radiation in tracers decays rapidly.

Answer Rationale: Tracers used in nuclear medicine have short-half lives. This means that their radioactivity decays rapidly, and the patient will soon be non-radioactive. Until you know otherwise, however, treat all of the patient’s bodily fluids as if they are radioactive.

Question Title: 5

Question: Which of the following procedures involves external beam radiation?

Answer 1: CT scan
Answer 2: MRI
Answer 3: Radioimmunotherapy
Answer 4: PET scan
Answer 5: 

Correct Answer: CT scan

Answer Rationale: MRI does not use any ionizing radiation. Both radioimmunotherapy and PET scan involve administration of radioactive substances. A CT scan uses external radiation beams and special equipment to obtain x-ray image data from different angles around the body.
Question: Which of the following involves internal use of radiation?

Answer 1: Brachytherapy
Answer 2: Mammography
Answer 3: Barium enema
Answer 4: Bone densitometry
Answer 5: 

Correct Answer: Brachytherapy

Answer Rationale: Mammography, barium enema, and bone densitometry all involve x-rays. Brachytherapy involves implantation of radioactive seeds.

Question Title: 7

Question: If you eat while working with radioactive materials, and accidentally ingest radiation, you will be unable to utilize which of the following protections against exposure?

Answer 1: Time
Answer 2: Distance
Answer 3: Shielding
Answer 4: All of these
Answer 5: None of these

Correct Answer: All of these

Answer Rationale: If you accidentally ingest radioactivity, you eliminate your three primary defenses against exposure: time, distance, and shielding.

Question Title: 8

Question: If a source seed should become dislodged from a brachytherapy patient's body, you should pick up the seed with a gloved hand and place it in a waste bin.

Answer 1: True
Answer 2: False
Answer 3: 
Answer 4: 
Answer 5: 

Correct Answer: False
Answer Rationale: You should pick up the seed with forceps and place it in a lead container.

Question Title: 9

Question: Regarding an MRI static magnetic field, all of the following are true EXCEPT:

Answer 1: The static magnetic field is created by a powerful electromagnet.
Answer 2: The static magnetic field is responsible for aligning protons in the tissues of the patient’s body.
Answer 3: The static magnetic field is responsible for the projectile effect.
Answer 4: The static magnetic field is responsible for patient burns caused by induced electric currents.
Answer 5:

Correct Answer: The static magnetic field is responsible for patient burns caused by induced electric currents.

Answer Rationale: Pulsed radiofrequency fields are responsible for patient burns caused by induced electric currents.

Question Title: 10

Question: Although patients with cerebral aneurysm clips should not undergo MRI, it is safe for healthcare personnel with cerebral aneurysm clips to enter the strong-magnetic-field area of an MRI system.

Answer 1: True
Answer 2: False
Answer 3:
Answer 4:
Answer 5:

Correct Answer: False

Answer Rationale: Patients are not the only ones at risk from the MRI static magnetic field. Medical personnel with metallic implants face the same risks as patients, when they enter the strong-magnetic-field area of an MRI system: device failure and/or soft tissue tearing.