

# Imaging Assistant General Curriculum

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## Introduction

The American Society of Radiologic Technologists defines an imaging medical assistant (IA-G) as a paraprofessional role to a medical imaging and radiation therapy professional.

The IA-G does not have any primary responsibility for a patient during the completion of medical imaging and radiation therapy procedures. The IA-G shall not function without appropriate supervision, shall not perform or participate in any imaging or therapeutic procedures, and is not intended to serve as the primary medical imaging personnel who provides direct patient care in the remote scanning environment. In the MR suite, the IA-G is a level 1 magnetic resonance personnel as defined by the American College of Radiology's 2024 Manual on MR Safety.

This curriculum is divided into specific content areas that represent the essential components of an IA-G program. The content and objectives should be organized to meet the mission, goals and needs of each IA-G program. Faculty members are encouraged to expand and broaden these fundamental objectives as they incorporate them into their curricula. Specific instructional methods were intentionally omitted to allow for programmatic prerogative as well as creativity in instructional delivery.

In summary, the IA-G curriculum is based on data relevant to today's health care environment, and the IA-G is prepared for direct entry into workforce and/or continued formal education. This curriculum offers an introduction to the medical imaging and radiation therapy profession. For additional information on other career opportunities in medical imaging and radiation therapy, visit [www.asrt.org](http://www.asrt.org).

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## Core Content

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# **Introduction to Patient Care and to the Medical Imaging and Radiation Therapy Environment**

## **Description**

Content is designed to provide the basic concepts of patient care, including consideration for the physical and psychological needs of the patient and family. Routine patient care procedures will be described, as well as infection control procedures using standard precautions. The role of the IA-G in patient education will be identified. Content also will include the study of factors that influence relationships with patients and professional peers. Understanding that patients have varied backgrounds and needs assists the student in providing better care.

## **Objectives:**

- Identify the responsibilities of the health care facility and members of the health care team.
- Describe the scope of practice for the IA-G.
- Demonstrate techniques for safe patient transfers and exhibit other ways to provide a safe patient environment.
- Describe methods for evaluating patient status and list the information to be collected during patient examination.
- Describe and perform vital signs used to assess patient condition.
- List institutional/departmental procedures for infection control and describe methods for the prevention of infection to the IA-G and patient.
- Identify symptoms related to specific emergency situations and know how to handle an emergency situation.
- Explain the age-specific considerations necessary when performing patient care.
- Identify specific types of tubes, lines, catheters and collection devices.
- Demonstrate competence in basic life support (BLS) and various first-aid techniques.

## **Content:**

### **I. IA-G and the Health Care Team**

- A. Responsibilities of the health care facility
  1. Caring for all patients regardless of condition
  2. Caring for the pediatric patient
  3. Caring for the adult patient
  4. Caring for the geriatric patient
  5. Promoting health
  6. Preventing illness
  7. Education
  8. Research
  9. Scope of practice
  10. Licensure and regulations related to the medical imaging and radiation therapy professions

- B. Responsibilities of the IA-G
  - 1. Review examination requisition
  - 2. Assist medical imaging and radiation therapy professionals
  - 3. Provide patient care

## **II. Professionalism and Communication in Patient Care**

- A. Health-illness continuum
- B. Developing professional attitudes
  - 1. Teamwork
  - 2. Work ethic
  - 3. Health role model
  - 4. Sympathy
  - 5. Empathy
  - 6. Assertiveness
- C. Age-specific communication
  - 1. Neonates
  - 2. Pediatric
  - 3. Adolescence
  - 4. Young adulthood
  - 5. Middle adulthood
  - 6. Geriatric
- D. Communication
  - 1. Verbal
    - a. Presentation of material
    - b. Voice tone and volume
    - c. Effective listening
  - 2. Nonverbal
    - a. Facial expression
    - b. Physical appearance
    - c. Touch
    - d. Eye contact
  - 3. Written
  - 4. Cultural sensitivity
  - 5. Challenges of communication
    - a. Language barriers
    - b. Medical literacy
    - c. Hearing, vision and speech impairments
    - d. Impaired mental function
    - e. Altered states of consciousness
    - f. Age-specific communication
    - g. Communicating under stress
    - h. Varied backgrounds and needs of patients

- i. Artificial speech
    - 1) Transesophageal puncture (TEP)
    - 2) Esophageal speech
    - 3) Electrolarynx devices
  - 6. Other factors that impede communication
    - a. Colloquialism/slang
    - b. Medical terminology
  - 7. Patient interactions
    - a. Establishing communication guidelines
    - b. Reducing distance
    - c. Listening
    - d. Feedback
      - 1) Using therapeutic silence
      - 2) Responding to the feeling and the meaning of the patient's statement
      - 3) Restating the main idea
      - 4) Reflecting the main idea
      - 5) Making observations
  - 8. Communicating with families
  - 9. Communicating with other health care professionals
- E. Psychological considerations
- 1. Dying and death
    - a. Understanding the process
    - b. Aspects of death
      - 1) Emotional
      - 2) Personal
      - 3) Physical
    - c. Grief and counseling
    - d. Patient support services
      - 1) Family and friends
      - 2) Pastoral care
      - 3) Patient-to-patient support groups
      - 4) Psychological support groups
      - 5) Hospice
      - 6) Home care
  - 2. Factors affecting patient's emotional responses
    - a. Age
    - b. Gender
    - c. Marital/family status
    - d. Socioeconomic factors
    - e. Cultural and religious variations
    - f. Physical condition
    - g. Self-image
    - h. Past health care experiences
    - i. Beliefs
    - j. Attitudes

- k. Prejudices
- l. Self-awareness

### **III. Patient-IA-G Interactions**

- A. Patient identification methods
  - 1. Interview/questioning
  - 2. Chart/requisition
  - 3. Wristband
- B. Patient preparation
  - 1. Removal of clothing
  - 2. Changing into gown or facility apparel
  - 3. Removal of jewelry and accessories

### **IV. Safety and Patient Transfer**

- A. Environmental safety
  - 1. Fire
  - 2. Electrical
  - 3. Hazardous materials
    - a. Chemicals
    - b. Safety data sheet (SDS)
  - 4. Radioactive materials
  - 5. Personal belongings
  - 6. Occupational Safety & Health Administration (OSHA)
  - 7. Environmental Protection Agency (EPA)
- B. Body mechanics
  - 1. Proper body alignment
  - 2. Proper movement
  - 3. Proper balance
  - 4. Center of balance in the body
- C. Patient transfer and movement
  - 1. Assessing the patient's mobility
  - 2. Rules for safe patient transfer
  - 3. Wheelchair transfers
  - 4. Stretcher transfers
    - a. Sheet transfer
    - b. Log roll
    - c. Positioning for safety and comfort
    - d. Transfer devices
  - 5. Patients with disabilities
  - 6. Age-specific considerations
  - 7. Patients with medical equipment
    - a. Tubes
    - b. Oxygen delivery
    - c. Catheters

- d. Lines
- e. Collection devices
- 8. Fall prevention

**D. Patient immobilization**

- 1. Types
- 2. Applications
- 3. Devices
  - a. Adult
  - b. Pediatric

**E. Accident and incident reporting**

- 1. Purpose
- 2. Legal considerations
- 3. Documentation
- 4. Procedures

**V. Evaluating Physical Needs**

**A. Assessing patient status**

- 1. Evaluation methodology
- 2. Clinical information

**B. Vital signs – ranges and values**

- 1. Temperature
- 2. Pulse
- 3. Pulse oximetry
- 4. Respiration
- 5. Blood pressure
- 6. Normal values
- 7. Interfering factors
- 8. Terminology
- 9. Adult vs. pediatric
- 10. Documentation
- 11. Pain assessment
- 12. Weight
- 13. Skin
  - a. Diaphoresis
  - b. Cyanosis
  - c. Condition

**C. Acquiring and recording vital signs**

**D. Patient records or patient health information (PHI)**

- 1. Components
- 2. Confidentiality
- 3. Retrieval

4. Documentation
5. Release of information
6. HIPAA

## **VI. Infection Control**

- A. Introduction
  1. Health care-associated infections
  2. Communicable
  3. Infectious pathogens
  4. Multidrug-resistant organisms (MDRO)
  5. Other
- B. Centers for Disease Control and Prevention (CDC)
  1. Purpose
  2. Publications and bulletins
- C. Cycle of infection
  1. Infectious pathogens
    - a. Bloodborne
    - b. Airborne
  2. Reservoir of infection
  3. Susceptible host
  4. Transmission of disease
    - a. Direct
    - b. Indirect
    - c. Droplet
    - d. Airborne/suspended
    - e. Fomites
    - f. Common vehicle
    - g. Vector-borne
- D. Preventing disease transmission
- E. Medical asepsis
  1. Definition
  2. Procedures
    - a. Hand washing
    - b. Chemical disinfectants
- F. Environmental asepsis
  1. Handling linens
  2. Equipment disinfection
  3. Techniques
    - a. Attire
    - b. Hair
    - c. Hand washing

- d. Gloves
- e. Eye protection
- f. Cleaning and proper disposal of contaminated waste
- g. Needles

G. Standard precautions

- 1. Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS)
- 2. Hepatitis
  - a. Type A
  - b. Type B
  - c. Type C (non-A or non-B)
- 3. Tuberculosis (TB)
- 4. Viral respiratory diseases
- 5. Methicillin-resistant *Staphylococcus aureus* (MRSA)
- 6. *Clostridium difficile* (*C. diff*)
- 7. Other

**VII. Medical Emergencies and First Aid**

A. Basic first-aid technique

B. Emergency equipment

C. Allergic reactions

- 1. Latex
- 2. Contrast media
- 3. Other

D. Shock

- 1. Types
  - a. Hypovolemic
  - b. Septic
  - c. Cardiogenic
  - d. Neurogenic
  - e. Anaphylactic
- 2. Signs
- 3. Symptoms
- 4. Interventions

E. Diabetic emergencies

- 1. Types
  - a. Hypoglycemia
  - b. Hyperglycemia (ketoacidosis)
  - c. Hyperosmolar coma
- 2. Signs
- 3. Symptoms

- 4. Interventions
  
- F. Respiratory and cardiac failure
  - 1. Age of patient
    - a. Adult
    - b. Pediatric
  - 2. Equipment
  - 3. Signs
  - 4. Symptoms
  - 5. Interventions
  
- G. Airway obstruction
  - 1. Signs
  - 2. Symptoms
  - 3. Interventions
  
- H. Cerebral vascular accident (stroke)
  - 1. Signs
  - 2. Symptoms
  - 3. Interventions
  
- I. Syncope
  - 1. Causes
  - 2. Signs
  - 3. Symptoms
  - 4. Interventions
  
- J. Seizures
  - 1. Types
  - 2. Causes
  - 3. Signs
  - 4. Symptoms
  - 5. Intervention
  
- K. Other medical conditions
  - 1. Epistaxis
  - 2. Nausea
  - 3. Postural hypotension
  - 4. Vertigo
  - 5. Asthma
  
- L. Trauma or physical injury

## **VIII. Tubes, Catheters, Lines and Collection Devices**

- A. Feeding tubes

B. Nasogastric/nasointestinal

C. Ostomies

1. Tracheostomy
  - a. Purpose
  - b. Location
  - c. Care
  - d. Access
2. Ileostomy
  - a. Purpose
  - b. Location
  - c. Care
  - d. Access
3. Ureteroileostomy
  - a. Purpose
  - b. Location
  - c. Care
  - d. Access

D. Chest tube

E. Venous catheters

F. Implanted devices

G. Tissue drains

H. Oxygen administration

1. Values
2. Oxygen therapy
3. Oxygen delivery systems
  - a. Low-flow systems
  - b. High-flow systems
4. Documentation
5. Special precautions

I. Urinary collection

1. Procedure
  - a. Male
  - b. Female
2. Alternative methods of urinary drainage
3. Documentation

## **IX. Values**

A. Personal

1. Development

2. Conflict
3. Effect on patient care

**B. Professional**

1. Development
2. Conflict
3. Effect on patient care

**X. Patient-Centered, Quality Care for All**

**A. Societal and individual factors**

1. Socioeconomic
  - a. Effects on health care
  - b. Access to care
  - c. Relationship to disease occurrence
2. Varying backgrounds and lived experiences
  - a. Social factors
  - b. Medical treatment barriers
  - c. Cultural differences
3. Family structure and dynamics
4. Geographical factors
  - a. Availability of health care services
  - b. Social acceptance of cultural differences
5. Religion, spirituality and belief system
6. Lifestyle choices and behaviors
7. Disability
8. Cognitive processing

**B. Optimal wellness and quality care for all patients**

1. Barriers
2. Health outcomes, including morbidity and mortality
3. Social factors
4. Patient- and family-centered care
5. Adapting to patient needs
  - a. Processes
  - b. Interpersonal engagement

# Fundamentals, Ethics and Laws of Health Care

## Description:

Content is designed to provide an overview of the foundations in medical imaging and radiation therapy and the IA-G's role in the health care delivery system. Principles, practices and policies of health care organization(s) will be examined and discussed in addition to the professional responsibilities of the IA-G. The elements of ethical behavior will be discussed, as well as a variety of ethical and legal issues found in clinical practice. An introduction to terminology, concepts and principles also will be presented. The importance of proper documentation and consent is emphasized.

## Objectives:

- Identify other health science professionals who participate in the patient's total health care.
- Identify various settings involved in the delivery of health care and discuss reimbursement and payment options for health care services.
- Define accreditation, credentialing, certification, licensure and regulations and identify the benefits of continuing education.
- Describe the moral, social and cultural basis of ethics.
- List legal/professional standards and their relationship to practice in health professions.
- Explain the legal implications of IA-G liability, malpractice, negligence/carelessness and other legal doctrines applicable to an IA-G.

## Content

### I. Medical Imaging and Radiation Therapy Professionals

- A. Medical imaging
  - 1. Radiography
    - a. Fluoroscopy
    - b. C-arm
    - c. Operating room
  - 2. Computed tomography
  - 3. Mammography
  - 4. Cardiovascular-interventional radiography
  - 5. Vascular-interventional radiography
  - 6. Bone densitometry
  - 7. Nuclear medicine
  - 8. Multiskilled (fusion technology)
  - 9. Diagnostic medical sonography
  - 10. Magnetic resonance imaging
  - 11. Quality management
  - 12. Advanced practice roles in medical imaging
    - a. Radiologist assistant
    - b. Nuclear medicine advanced associates
    - c. Advanced practice sonographers
- B. Radiation oncology

1. Radiation therapy
  2. Medical dosimetry
  3. Advanced practice radiation therapy
- C. Radiation safety officer
- D. Magnetic resonance safety officer (MRSO)
- E. Medical image management and processing system (MIMPS, formerly PACS)
- F. Informatics
- G. Education
- H. Management
- I. Allied health professions

## **II. The Health Care Environment**

- A. Health care settings
1. Hospitals
  2. Clinics
  3. Outpatient or ambulatory care
  4. Mental health facilities
  5. Long-term/residential facilities
  6. Hospice
  7. Preventive care
  8. Home health care
  9. Telemedicine
  10. Mobile imaging
- B. Payment and reimbursement systems
1. Self-pay
  2. Insurance
  3. Government programs
- C. Quality management
1. Quality management and improvement
  2. Quality assurance
  3. Quality control
- D. Benefits
1. Patient safety
  2. Efficacy of patient care
  3. Efficiency

4. Consistency
5. Cost effectiveness

### **III. Facility Organization**

- A. Philosophy and mission
  
- B. Administrative services
  1. Governing board
  2. Health care facility administration
  3. Human resources
  4. Procurement
  5. Accounting and billing
  6. Patient registration
  7. Information systems
  8. Support services
  
- C. Medical services
  1. Physician
  2. Clinical services
  3. Clinical support services

### **IV. Medical Imaging Organization**

- A. Administrative personnel
  1. Administrator
  2. Director and manager
  3. Supervisor
  
- B. Clinical personnel
  1. Imaging assistant - general
  2. Medical imaging and radiation therapy professionals
    - a. Limited x-ray machine operators
    - b. Registered technologists
    - c. Advanced practice roles
  3. Medical image management and processing system (MIMPS, formerly PACS) administrator
  4. Clinical informatics
  5. Medical imaging nurse
  
- C. Physician
  1. Interpreting radiologist
  2. Interventional radiologist
  3. Specialists
  
- D. Medical physicist
  
- E. Radiation safety officer

F. Magnetic resonance safety officer

G. Support staff

1. Clerical staff
2. Technical assistant
3. Transport staff

H. Educational personnel

1. Program director
2. Clinical coordinator
3. Didactic instructor
4. Clinical preceptors
5. Clinical staff

**V. Accreditation**

A. Health care institutions

1. Facility level
2. Departmental level
3. Service line (e.g., MR program with ACR or IAC)

B. Educational programs

1. Programmatic
2. Regional/facility
3. Other

**VI. Regulatory Agencies**

A. Federal

B. State

**VII. Professional Credentialing**

A. Definition

1. Certification
2. Registration
3. Licensure

B. Agencies

1. National
2. State

**VIII. Professional Organizations**

A. Purpose, function and activities

B. Types

1. Local
2. State

3. National
4. International

## **IX. Professional Development**

- A. Clinical experience requirements
- B. Continuing education opportunities
  1. Continuing education programs
  2. General medical imaging programs
  3. Postprimary certification
  4. Collegiate/educational programs
- C. Continued qualifications requirements (CQR)
- D. Employment considerations
  1. Geographic mobility
  2. Economic factors
  3. Workforce needs
- E. Advancement opportunities
  1. Limited x-ray machine operator (LXMO)
  2. Registered professionals
    - a. Primary disciplines
      - 1) Magnetic resonance imaging
      - 2) Medical dosimetry
      - 3) Nuclear medicine technology
      - 4) Radiation therapy
      - 5) Radiography
      - 6) Sonography
      - 7) Vascular sonography
    - b. Postprimary disciplines
      - 1) Bone densitometry
      - 2) Breast sonography
      - 3) Cardiac interventional radiography
      - 4) Computed tomography
      - 5) Magnetic resonance imaging
      - 6) Mammography
      - 7) Vascular interventional radiography
      - 8) Vascular sonography
  3. Advanced practice roles in medical imaging and radiation therapy
  4. Administration and management
  5. Certified imaging informatics professional (CIIP)
  6. Education
    - a. Administration
    - b. Faculty
      - 1) Didactic

- 2) Clinical
- 7. Medical physics
- 8. Research

**X. Ethics in Health Care**

- A. Origins and history of medical ethics
- B. Moral reasoning
- C. Personal behavior standards
- D. Competence
- E. Professional attributes
  - 1. Competency-based professionalism
  - 2. Social media
  - 3. Emotional intelligence
- F. Scope of practice defined
  - 1. Lines of authority
  - 2. Areas of responsibility
  - 3. Limitations
- G. Self-assessment and self-governance
- H. Ethical concepts
- I. Systematic analysis of ethical problems

**XI. Ethical Issues in Health Care**

- A. Individual and societal rights
- B. Cultural considerations
- C. Economic considerations
- D. Access to quality health care
- E. Technology
- F. Resource allocation
- G. Medical/health care research
- H. End-of-life decisions
  - 1. Living wills
  - 2. Advanced directives

3. Health care power of attorney
4. Nonintervention

## **XII. Legal Responsibilities**

- A. Parameters of legal responsibility
  1. Professional liability
  2. Intentional misconduct
    - a. Libel and slander
    - b. Assault and battery
    - c. False imprisonment
    - d. Invasion of privacy
    - e. Breach of confidentiality
  3. Negligence/malpractice
    - a. Definitions
      - 1) Gross negligence
      - 2) Contributory negligence
    - b. Elements of malpractice
      - 1) Duty
      - 2) Dereliction (breach)
      - 3) Causation
      - 4) Damage
  4. Legal and professional standards
    - a. Standard of care
    - b. Patient Bill of Rights and Responsibilities
    - c. HIPAA
      - 1) Individual
      - 2) Institutional
  5. Legal doctrines (e.g., *respondeat superior*, *res ipsa loquitur*)
  6. Medical records
  7. Legal risk reduction and risk management
- B. Scope of practice and responsibilities of the IA-G
  1. Definition
  2. Supervision
  3. State statute
  4. Limitations

## **XIII. Patient Consent**

- A. Rationale
- B. Definition
  1. Implied
  2. Written
  3. Oral
- C. Condition for legal or valid consent

1. Legal age
2. Competence
3. Capacity
4. Voluntary
5. Provision of adequate information regarding case, procedure, alternatives and risk
6. American Hospital Association (AHA) and Joint Commission standards for disclosure

D. Documentation of consent

E. Right of refusal

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# Medical Terminology

## Description:

Content is designed to provide an introduction to the origins of medical terminology. A word-building system will be introduced, and abbreviations and symbols will be discussed. Also introduced will be an orientation to the understanding of medical imaging orders and interpretation of diagnostic reports. Related terminology is addressed.

## Objectives:

- Apply the word-building process.
- Interpret medical abbreviations and symbols.
- Critique orders, requests and diagnostic reports.
- Define medical imaging terms.

## Content

### I. The Word-building Process

- A. Basic elements
  1. Root words
  2. Prefixes
  3. Suffixes
  4. Combination forms
- B. Parts of speech
  1. Nouns
  2. Verbs
  3. Adjectives
  4. Adverbs
- C. Translation of terms into common language
- D. Correct pronunciation of medical terms

### II. Medical Abbreviations and Symbols

- A. Role in communications
- B. Abbreviations
  1. Examples
  2. Interpretations
  3. Restrictions (e.g., The Joint Commission's "Do Not Use" list)
- C. Symbols
  1. Pharmaceutical symbols and terms
  2. Math and science symbols and constants
    - a. Examples
    - b. Interpretations

### **III. Medical Imaging Procedures and Terminology**

- A. Radiography
- B. Other imaging modalities
- C. Radiation oncology
- D. Patient positions
  - 1. Supine
  - 2. Prone
  - 3. Decubitus
  - 4. Oblique
  - 5. Fowler's
  - 6. Semi-Fowler's
  - 7. Sims
  - 8. Trendelenburg
  - 9. Lithotomy

### **IV. Understanding Orders, Requests and Diagnostic Reports**

- A. Procedure orders and requests
  - 1. Patient identification
  - 2. Procedures ordered
  - 3. Patient history
  - 4. Clinical indications
  - 5. Ordering physician/provider
- B. Diagnostic reports
  - 1. Content
  - 2. Interpretation

# Human Anatomy and Physiology

## Description:

Content is designed to establish a knowledge base in anatomy and physiology. Components of the cells, tissues, organs and systems will be described and discussed.

## Objectives:

- Identify the location of anatomical structures using directional and orientation terms and indicate where various planes lie in relation to the body.
- Identify the structural limits, functions and contents of each of the body cavities.
- Identify and locate the bones, bony depressions, and articulations of the human skeleton.
- Describe the composition and characteristics of blood and describe the flow of blood through the body.
- Label the main blood vessels and the parts of the human heart.
- Label the components of the respiratory system and describe the physiology of respiration.
- Describe the functions of each of the main systems in the human body.

## Content

### I. Anatomical Nomenclature

#### A. Directional terms

1. Anterior/posterior
2. Ventral/dorsal
3. Medial/lateral
4. Superior/inferior
5. Proximal/distal
6. Cephalad/caudad

#### B. Body planes

1. Median/midsagittal
2. Sagittal
3. Coronal
4. Transverse
5. Longitudinal

#### C. Body cavities – structural limits, function and contents

1. Cranial
2. Thoracic
3. Abdominal/pelvic

### II. Skeletal System

#### A. Osseous tissue

1. Structural organization
  - a. Medullary cavity/marrow
  - b. Compact bone
  - c. Cancellous bone

- d. Periosteum
- e. Cartilage
- 2. Development and growth
  - a. Physis
  - b. Diaphysis
  - c. Diaphysis/epiphyseal line
  - d. Metaphysis
- 3. Classification and markings
  - a. Long
  - b. Short
  - c. Flat
  - d. Irregular
  - e. Processes and bony projections
  - f. Depressions/openings

#### B. Divisions

- 1. Axial
  - a. Skull
  - b. Hyoid bone
  - c. Vertebral column
  - d. Thorax
- 2. Appendicular
  - a. Pectoral girdle
  - b. Upper extremities
  - c. Pelvic girdle
  - d. Lower extremities
- 3. Sesamoids
- 4. Functions

#### C. Articulations

- 1. Function/joint classifications
  - a. Synarthroses, fibrosis
  - b. Amphiarthroses, cartilaginous
  - c. Diarthroses, synovial
- 2. Physiology

### III. Cardiovascular System

#### A. Blood

- 1. Composition
- 2. Clotting system
- 3. Hemopoiesis
- 4. Function

#### B. Heart and vessels

- 1. Anatomy
- 2. Function

#### **IV. Respiratory System**

- A. Components and structure
  - 1. Nose and sinus cavities
  - 2. Pharynx
  - 3. Larynx
  - 4. Trachea
  - 5. Bronchi
  - 6. Lungs
  - 7. Thorax
  
- B. Physiology
  - 1. Pulmonary ventilation
  - 2. Alveolar gas exchange
  - 3. Transport of blood gases
  - 4. Tissue gas exchange
  - 5. Control and regulation of respiration

#### **V. Abdomen**

- A. Digestive system
  - 1. Primary organs – structure, function and location
    - a. Oral cavity
    - b. Esophagus
    - c. Stomach
    - d. Small intestine
    - e. Large intestine
    - f. Rectum
  - 2. Accessory organs – structure, function and location
    - a. Salivary glands
    - b. Pancreas
    - c. Liver
    - d. Gallbladder
  
- B. Urinary system – structure, function and location
  - 1. Kidneys
  - 2. Ureters
  - 3. Bladder
  - 4. Urethra
  
- C. Reproductive systems – structure, function and location
  - 1. Male
  - 2. Female

#### **VI. Muscular System – Types, Characteristics and Functions**

- A. Smooth

B. Cardiac

C. Skeletal

## **VII. Nervous System**

A. Introduction

1. Neural tissue
2. Function
3. Central nervous system
4. Peripheral nervous system

B. Neural tissue

1. Types, location and physiology
  - a. Neurons
  - b. Neuroglia

C. Anatomy and functions

1. Central nervous system
2. Peripheral nervous system

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# Safety in Medical Imaging and Radiation Therapy Environments

## Description:

Content is designed to present an overview of the responsibilities for protecting patients, personnel and the public from excessive exposure to energies used in medical imaging and radiation therapy. Health and safety requirements of federal and state regulatory agencies, accreditation agencies and health care organizations are incorporated. This section includes safety principles for ionizing radiation, radioisotopes, magnetic fields, radiofrequency and ultrasound imaging. An overview of the principles of the interaction of energies from the electromagnetic spectrum in living matter and radiation effects of molecules, cells, tissues and the body as a whole are presented. Factors affecting biological response also are presented to include acute and chronic effects of exposure.

## Objectives:

- Explain the types of energies on the electromagnetic spectrum and identify the type of energy is used in each modality.
- Apply safety measures to reduce the risk of safety incidents for all environments.
- Explain the objectives of a radiation protection program and identify the basis for occupational exposure limits.
- Describe the function of federal, state and local regulations governing radiation protection practices.
- Describe personnel monitoring devices, including applications, advantages and limitations for each device.
- Describe how time, distance and shielding can be manipulated to minimize radiation exposures.
- Understand and apply nuclear medicine radiation safety that impacts patient care, such as pregnancy status, actions after exposure and limits for the individual public.
- Define the different magnetic fields associated with MR imaging and list the safety concerns associated with each one.
- Describe the process of reporting MR safety incidents and discuss ways to respond to emergencies in the MR environment.

## Content

### I. Energies Used and Safety Principles

#### A. Electromagnetic spectrum

1. Nonionizing
  - a. Radiofrequency
2. Ionizing
  - a. X-rays
  - b. Gamma rays

#### B. Particles

1. Alpha particles
2. Beta particles

- C. Sound waves
- D. Magnetic fields
- E. ALARA principle for all environments
- F. Cardinal principles of radiation protection
  1. Time
  2. Distance
  3. Shielding

## **II. Units of Measurement**

- A. Exposure - Coulomb/kilogram (C/kg)
- B. Absorbed dose - Gray (Gy)
- C. Air kerma
  1. Kinetic energy release in matter
  2. Measurement unit in gray
- D. Dose equivalent - Sievert (Sv)
- E. Radioactivity - Becquerel (Bq)
- F. Magnetic flux density – Gauss (G)
- G. Magnetic field strength – Tesla (T)

## **III. Ionizing Radiation**

- A. Justification for radiation protection
- B. Objectives of a radiation protection program
  1. Documentation
  2. Occupational and nonoccupational dose limits
  3. ALARA concept (optimization)
  4. Comparable risk
  5. Negligible individual dose (NID)
- C. Sources of radiation
  1. Natural
  2. Man-made (artificial)
- D. Legal, ethical and social responsibilities

## **IV. Elements of Radiation Biology**

- A. Atomic/Molecular structure

- B. Basic cellular biology
  - 1. Cellular structure
    - a. Cell membrane
    - b. Cytoplasm
    - c. Protoplasm
    - d. Organelles
    - e. Nucleus
  - 2. Cellular function
    - a. Basic cell chemistry
    - b. Metabolism
    - c. Organic and inorganic compounds
  - 3. Cell proliferation
    - a. Cell cycle
    - b. Mitosis
    - c. Meiosis
    - d. Differentiation

## **V. Ionizing Radiation Effects**

- A. Subcellular radiation effects
  - 1. Radiation effects on DNA
    - a. Types of damage
    - b. Implications in humans
  - 2. Radiation effects of chromosomes
    - a. Types of damage
    - b. Implications in humans
- B. Cellular radiation effects
  - 1. Types of cell death
    - a. Interphase death
    - b. Mitotic (genetic) death
  - 2. Other effects
    - a. Mitotic delay
    - b. Reproductive failure
    - c. Interference of function
- C. Individual radiation effects
  - 1. Somatic effects
    - a. Short term
    - b. Long term
    - c. Stochastic (probabilistic) effects
    - d. Tissue reactions (deterministic) effects
  - 2. Genetic effects
    - a. Mutagenesis
    - b. Genetically significant dose (GSD)
  - 3. Embryo and fetal effects

- D. Factors influencing radiation response

## **VI. Occupational Dose**

- A. Radiation weighting factor ( $W_r$ )
- B. Equivalent dose (EqD)

## **VII. Surveys, Regulatory/Advisory Agencies and Regulations**

- A. General survey procedures
  - 1. Qualified expert
  - 2. Records
- B. Equipment survey
  - 1. Conditions
  - 2. Radiographic and fluoroscopic equipment
- C. Area survey
  - 1. Controlled and uncontrolled areas
  - 2. Access
  - 3. Conditions
  - 4. Recommendations
  - 5. "Radiation Area" signage
  - 6. Monitors
  - 7. Regulations concerning possession of instruments
- D. Regulatory/agencies
  - 1. Nuclear Regulatory Commission (NRC)
  - 2. Food and Drug Administration (FDA)
  - 3. Environmental Protection Agency (EPA)
  - 4. Recommendations from the United States Pharmacopeia
  - 5. Occupational Safety and Health Administration (OSHA)
  - 6. Department of Transportation
  - 7. State agencies
  - 8. The Joint Commission
- E. Advisory agencies and resources
  - 1. International Council on Radiation Protection and Measurements (ICRP)
  - 2. National Council on Radiation Protection and Measurements (NCRP)
  - 3. Biological Effects of Ionizing Radiation (BEIR)
  - 4. National Academy of Sciences Advisory Committee on the Biologic Effects of Ionizing Radiation
  - 5. United Nations Scientific Committee on the Effects of Atomic Radiation
  - 6. Conference of Radiation Control Program Directors Inc
  - 7. Biologic Effects of Ionizing Radiation Reports

## **VIII. Personnel Monitoring**

- A. Requirements for personnel monitoring
  - 1. Deep dose equivalent (DDE)
  - 2. Shallow dose equivalent (SDE)
  - 3. Eye dose equivalent (EDE)
  - 4. Total effective dose equivalent (TEDE)
  
- B. Methods and types of personnel monitors
  - 1. Film badge
  - 2. Thermoluminescent dosimeter (TLD)
  - 3. Optically stimulable luminescent dosimeter (OSLD)
  - 4. Ring dosimeter
  
- C. Records of accumulated dose
  - 1. Purpose
  - 2. Content
  - 3. Interpretation/evaluation
  - 4. Length of recordkeeping
  - 5. Retrieval from previous employers
  
- D. Effective dose limits
  - 1. Occupational
  - 2. Nonoccupational limits
  - 3. Critical organ sites
  - 4. Embryo and fetus
  - 5. Emergency exposures
  
- E. Responsibilities for radiation protection
  - 1. Facility
    - a. Declaration of pregnancy
    - b. Worker protection
    - c. Posting notices
    - d. Radiation safety education
    - e. Workers' rights
  - 2. IA-G
    - a. Adherence to institutional policy
    - b. Best practice

## **IX. Application**

- A. Materials
  
- B. Primary barrier
  
- C. Secondary (scatter and leakage) barrier
  
- D. ALARA philosophy

- E. Emergency procedures
- F. Current regulations and recommendations
  - 1. NCRP
  - 2. Applicable state regulations
  - 3. NRC, Title 10CFR20 (Standards for Protection Against Radiation)
  - 4. NRC, Title 10CFR35 (Medical Use of Byproduct Material)
  - 5. NRC, Title 10CFR19 (Notices, Instructions and Reports to Workers)
  - 6. NRC, Title 10CFR71 (Transport of Radioactive Material)
  - 7. Department of Transportation, Title 49CFR170 (Hazardous Material Training)
  - 8. NUREG-1556, Volume 9
  - 9. Agreement and non-agreement states
  - 10. State regulations

## **X. Radiographic Patient Protection**

- A. Awareness of radiation safety practices
  - 1. Beam restriction
    - a. Types
    - b. Purpose
  - 2. Shielding
  - 3. Exposure factors
  - 4. Positioning
  - 5. Patient education
  - 6. Immobilization
- B. Entrance skin exposure
- C. Patient dose
- D. Equipment and accessories
  - 1. Filtration
  - 2. Image receptor system
- E. Special considerations
  - 1. Pediatric patients
  - 2. Pregnant patients
  - 3. Bariatric patients

## **XI. Nuclear Medicine Patient Radiation Safety**

- A. Occupational considerations
  - 1. Protection techniques specific to nuclear medicine for time, distance and shielding
  - 2. Exposure limits for individual members of the public
  - 3. Exposure rate limits for unrestricted areas
  - 4. Pregnant radiation worker dose limit and shielding

- B. Patient considerations
  - 1. Pregnancy and/or breastfeeding precautions
  - 2. Pediatric patients
  - 3. Release of patients containing byproduct material
    - a. Diagnostic examinations
    - b. Therapeutic procedures

## **XII. Magnetic Resonance Environment**

- A. Magnetic fields in MR
  - 1. Main static field
  - 2. Radiofrequency field
  - 3. Gradient field
  
- B. MR safety organizations
  - 1. International Electrotechnical Commission (IEC)
  - 2. U.S. Food and Drug Administration (FDA)
  - 3. National Electrical Manufacturers Association (NEMA)
  - 4. American Society for Testing and Materials (ASTM)
  - 5. American College of Radiology (ACR)
  - 6. International Society for Magnetic Resonance in Medicine (ISMRM) Safety Group
  - 7. Institute for Magnetic Resonance Safety Education and Research (IMRSER)
  - 8. Intersocietal Accreditation Commission (IAC)
  - 9. American Board of Magnetic Resonance Safety (ABMRS)

## **XIII. Static Magnetic Field**

- A. Guidelines for static field safety
  - 1. Safety policies and procedures
  - 2. Safety zones
  - 3. Warning signage
  - 4. Personnel training
    - a. Non-MR
    - b. Level 1
    - c. Level 2
  - 5. Patient screening

## **XIV. Time-Varying Radio Frequency (RF) Magnetic Field**

- A. Potential dangers
  - 1. Thermal heating
    - a. Core (whole body) and localized heating
    - b. Implanted devices
  - 2. Burns
    - a. Proximity
    - b. Looping
    - c. Resonant
    - d. Reflective
  - 3. Acoustic noise

- B. Guidelines for RF safety

## **XV. Patient and Personnel Safety Screening in MR Imaging**

- A. Safety screening questionnaire
  - 1. Trained personnel
  - 2. Documentation review
    - a. Written
    - b. Verbal
  - 3. Contraindications for entering the MR suite
    - a. Implanted electronic devices
    - b. Implanted metallic objects at risk of deflection
    - c. Foreign bodies
- B. Reporting of MR safety incidents

## **XVI. Equipment Safety Screening in the MR Environment**

- A. MR safety labeling
  - 1. Safe
  - 2. Conditional
  - 3. Unsafe
- B. MR Conditional and MR Unsafe equipment
- C. Conductive equipment (e.g., ECG leads, coils, cables)
- D. Identify gauss lines
- E. Pulse receptor, ECG cables and disposable electrodes check
- F. Spills (e.g., phantom fluid)
  - 1. SDS forms
  - 2. First aid
  - 3. Mandatory reporting
  - 4. Disposal

## **XVII. Emergencies in the MR Environment**

- A. Emergency code (e.g., Code Blue)
  - 1. Evacuate patient
  - 2. Emergency plan
  - 3. Follow-up documentation
- B. Fire emergency
  - 1. Patient and staff evacuation
  - 2. Institutional fire emergency procedure
    - a. Suspending electricity to the MR scanner

- b. Quench protocol
  - 3. MR Safe fire equipment
  - 4. Training for local fire departments
- C. Pinned metallic items
  - 1. Patient danger
  - 2. Pinned equipment
- D. Emergency protocols
  - 1. Table stop button
  - 2. Emergency shutdown
  - 3. Quench
    - a. Causes
    - b. Evacuation procedure
    - c. Entry procedure for positive pressure seal
    - d. Notifying support personnel
    - e. Cryogen boil-off

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## Imaging and Radiologic Sciences Resources

This list of resources is to assist educators in sampling the references and study materials available in the medical imaging and radiologic sciences. The resources list should be viewed as a snapshot of available materials and is not exhaustive. Omission of any one title is not intentional. Because the pool of literature and media related to the profession is dynamic, educators are encouraged to find additional sources for recent updates, revisions, and additions to this collection of titles.

American Society of Radiologic Technologists. Imaging assistant general: introduction to imaging assistant general and the healthcare team. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: professionalism and communication in patient care. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: patient-IMA interactions. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: safety, body mechanics, and patient transfer. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: evaluating physical needs and vital signs. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: infection control in healthcare Settings. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: responding to medical emergencies. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: understanding medical devices: tubes and catheters. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: cultural humility in patient care. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: structure of medical imaging and radiation therapy professions. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: understanding healthcare environments. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: ethics, legal responsibilities and patient consent. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: medical terminology and communication. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: human anatomy, body systems and physiology. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: the biological effects of radiation. ASRT Live Recorded. 2025. URL

American Society of Radiologic Technologists. Imaging assistant general: magnetic resonance imaging (MRI) safety. ASRT Live Recorded. 2025. URL

Adler AM, Carlton R. *Introduction to Radiologic and Imaging Sciences and Patient Care*. 7th ed. Elsevier; 2018.

Callaway WJ. *Introduction to Radiologic Technology*. 8<sup>th</sup> ed. CV Mosby; 2019.

Newman Giger J. Haddad, L. *Transcultural Nursing: Assessment & Intervention*. 8th ed. Mosby; 2020.

Doherty R, Purtilo RB. *Ethical Dimensions in the Health Professions*. 6th ed. Elsevier/Saunders; 2015.

Pozgar GD. *Legal and Ethical Issues for Health Professionals*. 5<sup>th</sup> ed. Jones and Bartlett Learning; 2020.

*Journal of Interprofessional Care*. Taylor & Francis Online.

*Journal of Interprofessional Education & Practice*. Published by Elsevier, affiliated with University of Nebraska Medical Center, and the official journal of National Academies of Practice (NAP).

## Appendix

### Curriculum Revision Workgroup

We would like to extend special recognition to the outstanding professionals who volunteered their time as members of the curriculum project:

Brandon A. Smith, M.B.A., M.S.R.S., R.T.(R)(VI), CIIP  
Heather Moore, Ph.D., R.T.(R)  
Daniel DeMaio, M.Ed., R.T.(R)(CT)  
Marissa Mangrum, M.S.R.S., R.T.(T)  
Jennifer Thompson, Ed.D., R.T.(R)(QM)  
Beth Vealé, Ph.D., R.T.(R)(QM)  
Shellie Pike, M.S.R.S., R.R.A., R.T.(R)(CT)  
Ashley Smith, M.H.A., R.T.(R)(MR)

We also wish to express our sincere appreciation for the many contributions and suggestions from the professional community over the course of this project.