

Imaging Aide General

The American Society of Radiologic Technologists defines an imaging aide (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.

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

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 IM-G in patient education will be identified. Content also will include the study of factors that influence relationships with patients and professional peers. Understanding the varied backgrounds and needs of patients assists the student in providing better care.

Objectives and Key Takeaways

1. Identify the responsibilities of the health care facility and members of the health care team.
2. Describe the scope of practice for the IM-G.
3. Describe ethical, emotional, personal and physical aspects of illness, trauma and death.
4. Utilize methods for identifying the correct patient.
5. Explain the use of various communication methods.
6. Demonstrate correct principles of body mechanics applicable to patient care.
7. Demonstrate techniques for specific types of patient transfer.
8. Demonstrate select procedures for turning patients with various health conditions.
9. Describe select immobilization devices and techniques for various patient conditions.
10. Explain the purpose, legal considerations and procedures for reporting an accident or incident.

11. Describe methods for evaluating patient status.
12. List the information to be collected prior to patient examination.
13. Describe and perform vital signs used to assess patient condition.
14. Define terms related to infection control.
15. Describe the importance of standard precautions.
16. Explain sources and modes of infection and disease transmission.
17. List institutional/departmental procedures for infection control.
18. Describe methods for the prevention of infection to the health worker and patient.
19. Identify symptoms related to specific emergency situations.
20. Describe the emergency medical code system for the institution and the role of the IM-G during a medical emergency.
21. Explain the age-specific considerations necessary when performing patient care.
22. Identify specific types of tubes, lines, catheters and collection devices.
23. Demonstrate competence in basic life support (BLS).
24. Demonstrate basic first-aid techniques.
25. Explain the influence a person's value system has on his or her behavior.
26. Describe how professional values influence patient care.
27. Differentiate between culture and ethnicity.
28. Explain how a person's beliefs toward illness and health affect his or her health status.
29. Use patient and family education strategies appropriate to the comprehension level of the patient/family.
30. Provide desired psychosocial support to the patient and family.
31. Examine cultural and socioeconomic factors that influence patient compliance with medical care.

Content

I. IM-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 IM-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 assists the student in providing better care.
 - 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- IM-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. Healthcare 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 – blood-borne and 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. Signs and symptoms
2. Types
 - a. Hypovolemic
 - b. Septic
 - c. Cardiogenic
 - d. Neurogenic
 - e. Anaphylactic
3. Medical intervention

E. Diabetic emergencies – signs, symptoms and interventions

1. Hypoglycemia
2. Hyperglycemia (ketoacidosis)
3. Hyperosmolar coma

F. Respiratory and cardiac failure

1. Signs, symptoms and interventions
2. Adult vs. pediatric
3. Equipment

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. Intervention

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 bias
 - b. Medical treatment bias
 - 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. Patient and family centered care
 - a. Processes
 - b. Interpersonal engagement

Part 2

Fundamentals, Ethics and Laws of Health Care

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.

Part 2 Objectives and Key Takeaways

1. Identify other health science professionals who participate in the patient's total health care.
2. Describe the relationship of health science professionals to the integrated care of patients.
3. Identify various settings involved in the delivery of health care.
4. Discuss the reimbursement/payment options for health care services.
5. Describe relationships and interdependencies within health care.
6. List patient services that might be available in medical imaging and radiation therapy.
7. Define accreditation, credentialing, certification, licensure and regulations.
8. Identify the benefits of continuing education as related to improved patient care and professional enhancement.
9. Describe the moral, social and cultural basis of ethics.
10. Explain the role of ethical behavior in health care delivery.
11. Differentiate between empathetic rapport and sympathetic involvement in relationships with patients and relate these to ethical conduct.
12. Explain concepts of personal honesty, integrity, accountability, competence and compassion as ethical imperatives in health care.
13. List legal/professional standards and their relationship to practice in health professions.
14. Identify specific situations and conditions that give rise to ethical dilemmas in health care.
15. Employ a basic system of examination, clarification, determination of alternatives and decision making in addressing ethical questions.
16. Explain select concepts embodied in HIPAA, principles of patients' rights, the doctrine of patient consent and other issues related to patients' rights.
17. Explain the legal implications of IM-G liability, malpractice, negligence/carelessness and other legal doctrines applicable to an imaging aide.
18. Describe the importance of accurate, complete, and correct methods of documentation as a legal/ethical imperative.
19. Describe the scope of practice for the IM-G, the elements that comprise it and responsibilities of the IM-G.
20. Describe institutional and professional liability protection typically available to the IM-G.

Part 2 Classroom and Lab 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 assistants
 - 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. Healthcare 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 aide
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

D. Employment considerations

1. Geographic mobility
2. Economic factors
3. Workforce needs

E. Advancement opportunities

1. 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. Patients' bill of rights
 - c. HIPAA
 - 1) Individual
 - 2) Institutional
- 5. Legal doctrines (i.e., *respondeat superior*, *res ipsa loquitur*)
- 6. Medical records
- 7. Legal risk reduction and risk management
- B. Scope of practice and responsibilities of the IM-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

Part 3

Medical Terminology

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.

Part 3 Objectives and Key Takeaways

1. Apply the word-building process.
2. Interpret medical abbreviations and symbols.
3. Critique orders, requests and diagnostic reports.
4. Define medical imaging terms.
5. Translate medical terms, abbreviations and symbols into common language from a medical report.

Part 3 Classroom and Lab 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

Part 4

Human Anatomy and Physiology

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.

Part 4 Objectives and Key Takeaways

1. Identify the location of anatomical structures using directional and orientation terms.
2. Indicate where various planes lie in relation to the body.
3. Identify the structural limits, functions and contents of each of the body cavities.
4. Identify and locate the bones of the human skeleton.
5. Identify bony processes and depressions found on the human skeleton.
6. Describe articulations of the axial and appendicular skeleton.
7. Summarize the functions of the skeletal system.
8. Compare the types, locations and movements permitted by the different types of articulations.
9. Describe the function of the primary and accessory organs of the digestive system.
10. Describe the composition and characteristics of blood.
11. Label the parts of the human heart.
12. Describe the flow of blood through the body and identify the main vessels.
13. Describe the structure and function of arteries, veins and capillaries.
14. Label the components of the respiratory system.
15. Describe the physiology of respiration.
16. Describe the function of each organ of the urinary system.
17. Label the anatomy of the male and female reproductive organs.
18. Describe the functions of the different types of muscles.
19. Describe the functions of the nervous system.

Part 4 Classroom and Lab 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

Part 5

Safety in Medical Imaging and Radiation Therapy Environments

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.

Part 5 Objectives

1. Explain the types of energies on the electromagnetic spectrum and which type of energy is used in each medical imaging and radiation therapy specialty.
2. Identify and justify the need to minimize unnecessary radiation exposure to humans.
3. Explain the objectives of a radiation protection program.
4. Identify effective dose limits (EDL) for occupational and nonoccupational radiation exposure.
5. Describe the ALARA concept.
6. Identify the basis for occupational exposure limits.
7. Distinguish between perceived risk and comparable risk.
8. Describe the concept of negligible individual dose (NID).
9. Identify ionizing radiation sources from natural and man-made sources.
10. Comply with legal and ethical radiation protection responsibilities of radiation workers.
11. Distinguish between controlled and noncontrolled areas and list acceptable exposure levels for ionizing radiation.
12. Describe "Radiation Area" signs and identify appropriate placement sites.
13. Describe the function of federal, state and local regulations governing radiation protection practices.
14. Express the need and importance of personnel monitoring for radiation workers.
15. Describe personnel monitoring devices, including applications, advantages and limitations for each device.
16. Interpret personnel monitoring reports.
17. Compare values for individual effective dose limits for occupational radiation exposures.
18. Identify anatomical structures that are considered critical for potential late effects of whole-body irradiation exposure with emphasis on occupational safety.
19. Distinguish between primary and secondary radiation barriers.
20. Describe how time, distance and shielding can be manipulated to minimize radiation exposures.
21. Explain the purpose of types of and rationale for patient shielding.
22. Discuss embryonic and fetal effects of radiation exposure.
23. Comply with current federal, state, and institutional regulations regarding ionizing radiation.
24. Maintain effective radiation safety practices to minimize patient, occupational and public exposure including special populations (i.e. pediatric, pregnant and/or breast feeding).
25. Recognize a radioactive spill and know who to contact.

26. Understand and apply nuclear medicine radiation safety that impacts patient care, such as pregnancy status, actions after exposure, and limits for the individual public.
27. List MR safety organizations and identify the role of each organization in MR safety.
28. Define the different magnetic fields associated with MR imaging and list the safety concerns associated with each one.
29. Apply safety measures to reduce the risk of safety incidents for all environments.
30. Identify and discuss the various components of MR safety screening for patients and personnel.
31. Describe the process of reporting MR safety incidents.
32. Discuss the various components of MR safety screening for equipment.
33. Recognize emergencies that can occur in MR imaging and explain appropriate reactions.

Part 5 Classroom and Lab Content

I. Energies used and safety principles in the medical imaging and radiation therapy environments

- 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. OSHA
 6. Department of Transportation
 7. State agencies
 8. 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 record-keeping
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
 - f. IM-G
 - g. Adherence to institutional policy
 - h. 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 NM 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 exams
 - 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

- 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 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
 - 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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